PERFORMANCE EVALUATION OF WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS' OF ANDAMAN AND NICOBAR ISLANDS

A DISSERTATION

submitted in partial fulfilment of the
requirements for the award of the degree
of
MASTER OF ENGINEERING
in
IRRIGATION WATER MANAGEMENT

By

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CANDIDATE'S DECLARATION

I hereby declare that the dissertation titled **"PERFORMANCE EVALUATION OF WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS' OF ANDAMAN AND NICOBAR ISLANDS"** which is being submitted in partial fulfilment of the requirements for the award of Master's degree of Engineering in **Irrigation Water Management** at Water Resources Development Training Centre (WRDTC), University of Roorkee, Roorkee, is an authentic record of my own work carried out from 16th July 2000 till the date of submission, under the supervision and guidance of **Dr. S. K. Tripathi**, Professor, WRDTC, University of Roorkee.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree.

Vinod Kumar

Place : Roorkee **(C. VINOD KUMAR)**

Dated : 9.1.2001

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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SYNOPSIS

Water management for agricultural development is an integrated and interdisciplinary approach. This approach has been implemented and adopted in Andaman & Nicobar Islands executed by Directorate of Agriculture under the National Watershed Development Project for Rainfed Areas funded by Ministry of Agriculture & Cooperation, New Delhi. This study has attempted taking into consideration the various watershed activities the effect of planning and implementation on the islands watershed dwellers. For the design of the study project area where these activities have already been implemented was selected.

In order to assess the impact of watershed on the user beneficiaries of project area personal interview in respect to socio-economic condition, cropping pattern, productivity, land utilization and their participation and interaction in project activity was conducted. The additional information were collected from the village(s), Government organization involved in the implementation process and from literature.

The quantification of direct and indirect benefits from any soil and water conservation scheme implemented in rainfed areas on Watershed Area Development Approach is a complex one. The study has showed that field worthiness of the scheme in rainfed area is beneficial for sustainable development of the limited agricultural land and fragile eco-system of these islands.

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ABBREVIATIONS

AD	Agricultural Demonstrator
CARI	Central Agricultural Research Institute
CMFRI	Central Marine Fisheries Research Institute
CPR	Common Property Resources
CRIDA	Central Research Institute for Dryland Agriculture
CSWCR & TI	Central Soil and Water Conservation Research and Training Institute
DDP	Desert Development Programme
DOA	Directorate of Agriculture
DPAP	Drought Prone Areas Programme
FA	Field Assistant
FAO	Food Agricultural Organization
FPR	Flood Prone River
FTE	Farmers Training Centres
GOI	Government of India
HGC	Higher Grade Clerk
HYV	High Yielding Variety
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
IIMI	Irrigation Management Institute
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IVRI	Indian Veterinary Research Institute

IWDP	Integrated Wastelands Development Programme
KVK	Krishi Vigyan Kendra
LGC	Lower Grade Clerk
MI	Minor Irrigation
MKM	Mitra Krishak Mandal
NABARD	National Bank for Agriculture and Rural Development
NGO	Non Government Organisation
NWDPRA	National Watershed Development Project for Rainfed Areas
PHC	Primary Health Centre
PP	Plant Protection
RVP	River Valley Project
SAT	Semi Arid Tropics
SAU	State Agricultural University
SCOR	Shared Control of Natural Resources
SHG	Self Help Group
TRYSEM	Training of Rural Youth for Self Employment
USAID	United States Agency for International Development
UT	Union Territory
WDC	Watershed Development Committee
WDT	Watershed Development Team
WOTR	Watershed Organisation Trust
WRDTC	Water Resources Development Training Centre
WS I	Watershed Mannarghat
WS II	Watershed Uttara
WS III	Watershed Rampur
WS IV	Watershed Ramnagar

Chapter 1

INTRODUCTION

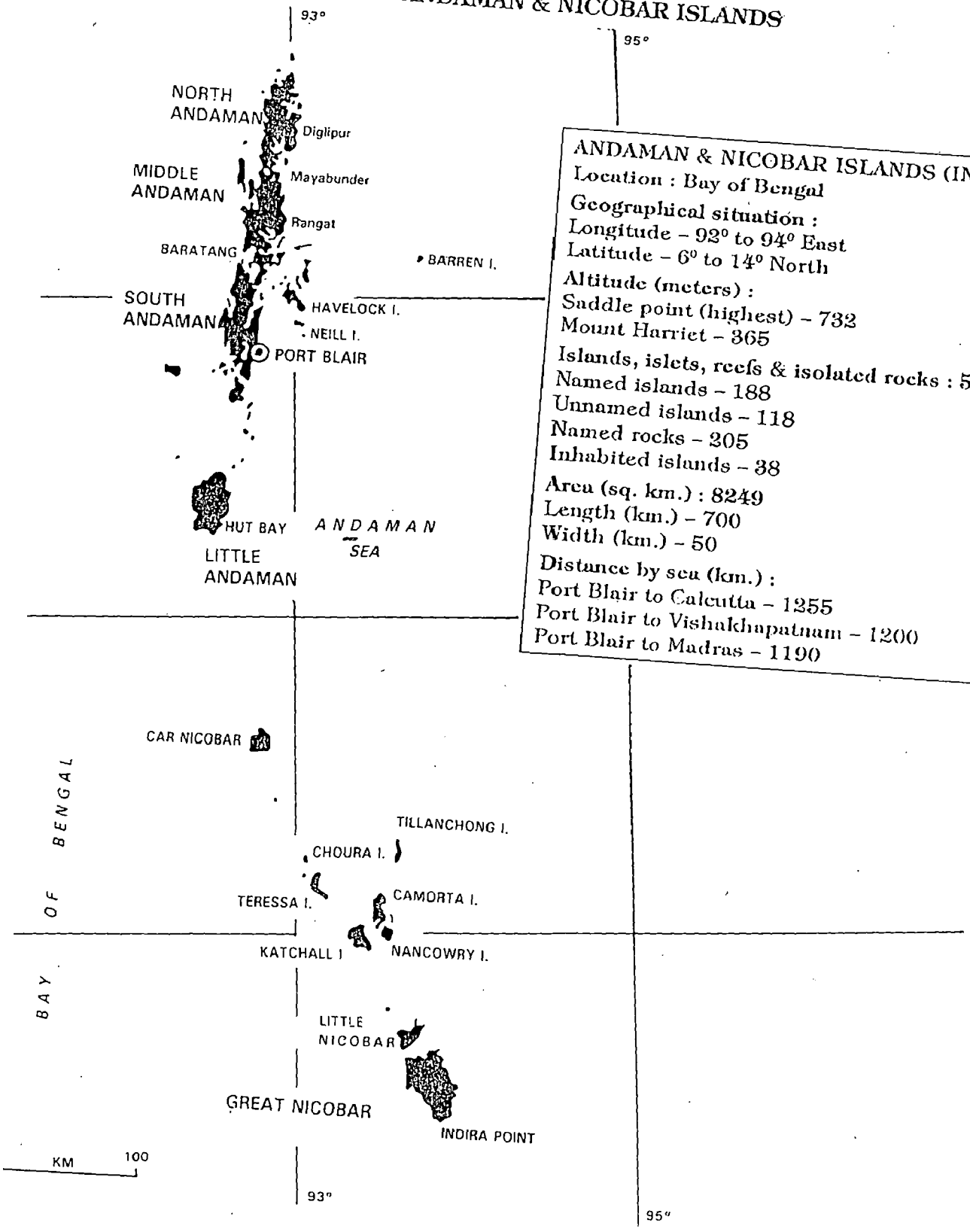
1.1 GENERAL

The chain of Andaman and Nicobar Islands comprise of 572 islands islets and rock out-crops spreading in the Bay of Bengal. This Union Territory is stretched over an area of more than 700 kms from North to South between lower Burma and the Upper Sumatra region of Indonesia located at 6°45' to 13°41' North latitude and 92°12' to 93°57' East longitude (Figure 1). The Andaman group with 278 islands forms the northern part of the chain, while the Nicobar group in the south separated from the main group by 160 km has 28 islands.

The total geographical area of the islands is 8249 sq. km. Only four islands, viz., North, Middle, South Andaman and Great Nicobar have an area greater than 1000 sq. km. Out of the 572 islands only 36 islands are inhabited and of which 8 islands have been covered under the various settlement programme. The characteristic features of the islands are low ranges of hill and narrow valleys covered with the tropical forest. The tropical ecosystem of Andaman and Nicobar Islands are very unique having different species with wide range of genetic diversity and density apart form the evergreen forest, mangroves and coral reefs.

The islands have a tropical and humid climate with an average rainfall of about 3000 mm (Table 1) in about eight months commencing from May to January. The average mean temperature varies from 23°C to 30°C with more than 90% humidity during rainy months and 70 to 80% in summer. The Islands enjoy both the monsoons namely south west from May to September and North East during October to January.

MAP OF ANDAMAN & NICOBAR ISLANDS



ANDAMAN & NICOBAR ISLANDS (INDIA)

Location : Bay of Bengal

Geographical situation :
Longitude – 92° to 94° East
Latitude – 6° to 14° North

Altitude (meters) :
Saddle point (highest) – 732
Mount Harriet – 365

Islands, islets, reefs & isolated rocks : 572
Named islands – 188
Unnamed islands – 118
Named rocks – 205
Inhabited islands – 38

Area (sq. km.) : 8249
Length (km.) – 700
Width (km.) – 50

Distance by sea (km.) :
Port Blair to Calcutta – 1255
Port Blair to Vishakhapatnam – 1200
Port Blair to Madras – 1190

Table 1 : Climatic Parameters of Andaman and Nicobar Islands

Month	Rainfall (mm)	Temp.		Rainy days	Relative humidity		Wind speed	Sun shine
		Min	Max		8.30 am	5.30 am	km/hr	hr/day
January	42.7	32.1	29.8	3	71	75	7.2	8.42
February	24.0	21.8	30.5	2	70	73	5.7	9.73
March	9.7	22.5	31.6	1	68	72	5.3	9.45
April	68.3	23.9	32.6	4	68	73	5.6	8.75
May	397.2	23.9	31.1	17	79	82	11.9	6.12
June	497.5	23.8	29.4	20	83	84	18.4	3.61
July	459.7	23.5	29.1	21	85	86	15.8	3.06
August	442.3	23.6	29.0	21	84	86	19.1	3.84
September	454.1	23.1	29.0	19	83	86	12.4	4.92
October	309.5	23.0	29.5	15	81	86	8.1	4.66
November	220.2	23.1	29.8	13	78	82	6.9	6.90
December	155.2	22.8	29.3	7	73	78	8.1	7.88
Total	3080.4			143				
Average		23.9	30.6		77	88	10.5	6.45

(Source : CARI, Port Blair)

Mythologically, the name Andaman was presumed to be derived from Hanuman, who was known to the Malays as Handuman. Since pre-historic times, these islands were the home of aboriginal tribes. The tribes in the Andaman Group of Islands are the Great Andamanese, Onges, Jarawas and Sentinelese, all of Negroid origin, while the tribes in the Nicobars are the Nicobarese and Shompens, both of Mongoloid stock. The first settlement by the British took place in 1789, which was later abandoned in 1796. The second settlement was basically a penal settlement, taken up in 1858, after the first war of Independence, followed by the settlement of convicts from various parts of mainland. Government of India used these islands for the settlement of refugees from erstwhile East Pakistan and Sri

Lankan, Burma repatriates and ex-servicemen families. The land distribution system generally followed in the settlement was to provide 2 ha of paddy land, 2 ha of hilly land and 0.4 ha of homestead land to each settler.

The island had a population of 3000 in 1857 which had become 300000 as per 1991 census (Table 2). Achieving sustainable food production to feed the increasing population and demand of the fragile ecosystem Islands of Andaman and Nicobar group is a growing challenge.

Table 2 : Population 1991 Census

S. No.	Name of Zone	Male	Female	Total
1	South Andaman	83,816	66,718	1,50,534
2	Rangat	18,177	15,251	33,368
3	Mayabunder	11,621	9,949	21,570
4	Diglipur	12,801	10,933	23,734
5	Little Andaman	6,703	5,544	12,247
6	Car Nicobar	10,164	9,172	19,336
7	Katchal	7,141	5,900	13,041
8	Campbell Bay	4,006	2,825	6,831
	Total	1,54,369	1,26,292	2,80,661

(Source : Directorate of Economics & Statistics, Port Blair)

The gap between supply and demand of food grains, vegetable and fruit has increased as population of the island increased. This calls for concerted efforts to develop new agricultural technologies suited to the specific agro-ecological conditions of these islands.

1.2 NATURAL VEGETATION

The total geographical area of Andaman and Nicobar Islands is 8,29,200 ha and out of which estimated area of 48,000 has so far been cleared of forest for agriculture, plantations and other allied purpose. This constitutes only 5.75% of

the total geographical area of the island. Most of the land area of the islands is surrounded from the sea coast to the hill tops with luxurious lush green tropical rain forests.

Vegetation, however becomes lush green as one proceeds from North to South. Some plant species occur only in Northern islands or in the southern islands. For example, 'Padouk' (Pterocarpus dal bergiodes) does not occur beyond the islands of the main Andaman group, and the distribution of 'Garjan' (Dipterocarpus sp.) is limited only up to Little Andaman. On the other hand, the distribution of tree ferns is limited only to Great Nicobar. The variation in elevation in the islands being small, the distribution of vegetation is almost uniform.

Vegetation of these islands has been classified by Champion and Seth (1909) into the following groups which seems to arise out of variations in edaphic factors. However, these forest types are not distinctively demarcated and imperceptibly merge into one another.

(1) Tidal swamp forests (mangrove forests)

(2) Littoral forests

(3) Andaman moist-deciduous forests

(4) Andaman semi-evergreen forests

(5) Bamboo brakes

(6) Cane brakes

(7) Southern hill top tropical evergreen forests

(8) Giant evergreen forests

The important species of each forest type and the soils on which they occur are given in Table 3.

The forest area in various groups of island is indicated in Table 4.

Table 3 : Distribution of Forest Species in Andaman and Nicobar Islands

Sl. No.	Forest type	Name of Species	Place of occurrence/soil type
1	Tidal swamp forests (Mangrove forests)	Rhizopora mucronata, R. Conjugata, Bruguira gymmnorrhiza, B. parviflora, Carapa obovata, Sonneratia acida and Nepa fruticans	Low lying banks of creeks and sheltered portions of the coastline subject to tidal action
2	Littoral forests (beach forests)	Mimusops litoralis (Bullet wood), Tetrameles mudiflora (Thitpok), Terminalia procera (Badam), Calophyllum inophyllum (poon), Harnandia peltata, Thespesia populnea, Pongamia grabra (Karanj) & Barringtonia sp.	Alluvial high level soil along the sea coast beyond the reach of the sea
3	Andaman moist deciduous forests	Padauk, silvergrey, Badam, Marble wood, chooi, kokko, white dhup, didu and papita	Shallow sandy or clay loam formed from hard coarse-grained sand stone with bands of shales and canglomerate
4	Andaman semi-evergreen forests	Dipterocarpus alatus (Gurjan), Dipterocarpus pilosus (Gurjan), Pterygota alata (Letkok), pterocymbium tinctorium (Papita). Terminalia bialata (white chuglam), Terminalia procera (Badam), Albizzia chinensis (Bombeza), Albizzia lebbek (kokko), Calophyllum soulatri (Poon), Salmalia insignis (Didu), Artocarpus lakoocha (Lakcuh), Artocarpus chaplasha (Taungpeinne), Pterocarpus dalbergiodes (Padauk) and Lagerstroemia hypoleuca (Pyinma)	Well drained, immature alluvial soil, sufficiently old and raised above flood level.
5	Bamboo brakes	Dipterocarpus sp. (Gurjan), Oxytenanthera nigrociliata, Bambusa schizostachyoides	Throughout the tropical evergreen tracts of the Andaman islands along streams or on badly drained hollows more or less displacing the tree forest.
6	Cane brakes	Calamus palustries, C. congisetus and Bamboo dinochba	Throughout the evergreen and semi evergreen forests and moist deciduous forests
7	Southern hill-top tropical evergreen forests	Dipterocarpus costatus, Mesua ferrea, Canarium manii, Eupullia cupanicides, Hopea andamanica, Cratodylon formosum, Euphorbia trigona, cryptocarya ferrarse, Phoenix sp.	On the tops of high hills, steep slopes lower down on poorer soils and usually exposed to high winds

8	Andaman tropical evergreen forests	Dipterocarpus grandiflorus (Gurjan), D. pilosus (Gurjan), Artocarpus chaplasha (Taungpeinne), A. gomeziana Lakooda), Calophyllum soulatri (Poon), Planchonia andamanica (Red Bombway), Hopea odorata (Thingam), Endospernum chinese (Bakota), Sideroxylon longepetiolatum (Lamba pati), Danthochymus andamanicum, Myristica andamanica (Jaiphal), Baccaurrea sapida (Khata phal), Dinehloa andamanica.	Throughout the island as caps to the lower hills with moist deciduous forests on the slopes.
9	Giant evergreen forests	Dipterocarpus alatus (Gurjan), D. grandiflorus (Gurjan), Artocarpus chaplasha (Tanugpeinne), A. gomeziana (Lakooda), Sideroxylon longe petiolatum (Lambapati), Amoora wallichi (Laichini), sterculia compa mulata, pometia pinnata (Thitkandu) and Mesua ferrea (Cangan)	Banks of large stream where soils are deep alluvial

(Source : CARI, Port Blair)

Table 4 : Division-wise Forest Area as on 31st March, 1996

Division	Forest Area			Total Forest Area
	Geographical Area	Reserved	Protected	
1	2	3	4	5
South Andaman	1658	1208.28	111.66	1319.94
Baratang	721	646.51	-	646.51
Middle Andaman	965	53.07	804.05	857.12
North Andaman	2325	314.41	1784.15	2098.56
Little Andaman	739	706.49	-	706.49
Nicobar Group of Islands	1841	-	1542.07	1542.07
Total	**8249**	**2828.76**	**4241.93**	**7170.69**

(Source : Directorate of Economics & Statistics, Port Blair)

1.3 SOILS AND LANDUSE OF ANDAMAN & NICOBAR ISLANDS

The soils of Andaman and Nicobar islands have developed under the dominant influence of vegetation and climate over diverse parent material. The uplands under forest cover are intensely leached, but runoff is very high wherever forest cover has been removed. Such soils have been severely eroded and support only scant grassy vegetation. Even though deforestation is relatively a recent phenomenon such soils have suffered changes in important physico-chemical

properties. The valley floors comprise of depositional land forms and have been termed low lands and have developed from the out wash of parent material from the surrounding hills. These soils are medium to heavy textured and moderately well drained and subjected to seasonal fluctuations in ground water.

An extensive survey conducted in the revenue area of inhabited islands, for analysis of physico-chemical properties (soil survey staff CARI, 1975), classified soils into three orders, seven sub orders and established eight series. Series wise distribution of soils in different islands is shown in Table 5. The physiographic positions of different soil series is shown in Figure 2.

Entisols :

These soils mostly in valley, are very young and devoid of diagnostic horizons as active erosion or flood-plain deposition is still in progress. They have been divided into 4 suborders, namely fluvents, orthents, aquents and psamments.

Inceptisols :

These soils are characterized by altered horizons that have lost materials by leaching and contains some weatherable minerals. They have umbric or orchric epipedon and cambic horizon and may contain a fragipan or a duripan. These soils have been identified in islands of South, Middle and North Andaman and Great Nicobar and placed under sub orders aquepts and ochrepts.

Alfisols :

These soils have an argillic horizon with ocheic epipedon having moderate to high base saturation. The other horizons which may be present include a fragipan, duripan and petrocalcic horizon. These soils are met in North Andaman and Little Andaman and the predominent suborder recognized in the area is ustalfs.

The details of soils classified by its orders, suborders and series in the major islands is shown in Fig. 3 to 7.

Table 5 : Series wise distribution of soil in different islands

Order	Suborder	Great Group	Name of Series	South Andaman	Middle Andaman	North Andaman	Little Andaman	Great Nicobar	Total
Entisol	Fluvents	Tropofluvents	Schooline	2619	3950	3560	998	2477	13604
	Orthents	Troporthents	Garacharma	10915	11497	-	-	-	22412
	Aquents	Fluventic Sulfaquepts	Dhanikhari	4933	564	183	-	-	5680
	Pasamments	Fluventic Quartzi Psamments	Rangachang	1724	-	-	2230	857	4811
Inceptisols	Aquecpts	Umbric Fluventic Haplaquepts	Tushnabad	2936	-	-	-	-	2936
	Ochrepts	Typic Dystrochrepts	Pahargaon	2338	8346	2771	-	1196	14651
	Ochrepts	Fluventic Dystrochrepts	Wandoor	11733	-	7790	-	-	19523
Alfisols	Udalfs	Hapludalfs	Little Andaman	-	-	450	4445	-	4895
			Total Area	37198	24357	14754	7673	4530	88512

Note : Total area includes revenue forests, area under non-agricultural use, barren and uncultivated land, land under trees, groves and hills, permanent pastures and grazing land, culturable wastes, fallow land and net area sown

(Source : CARI, Port Blair)

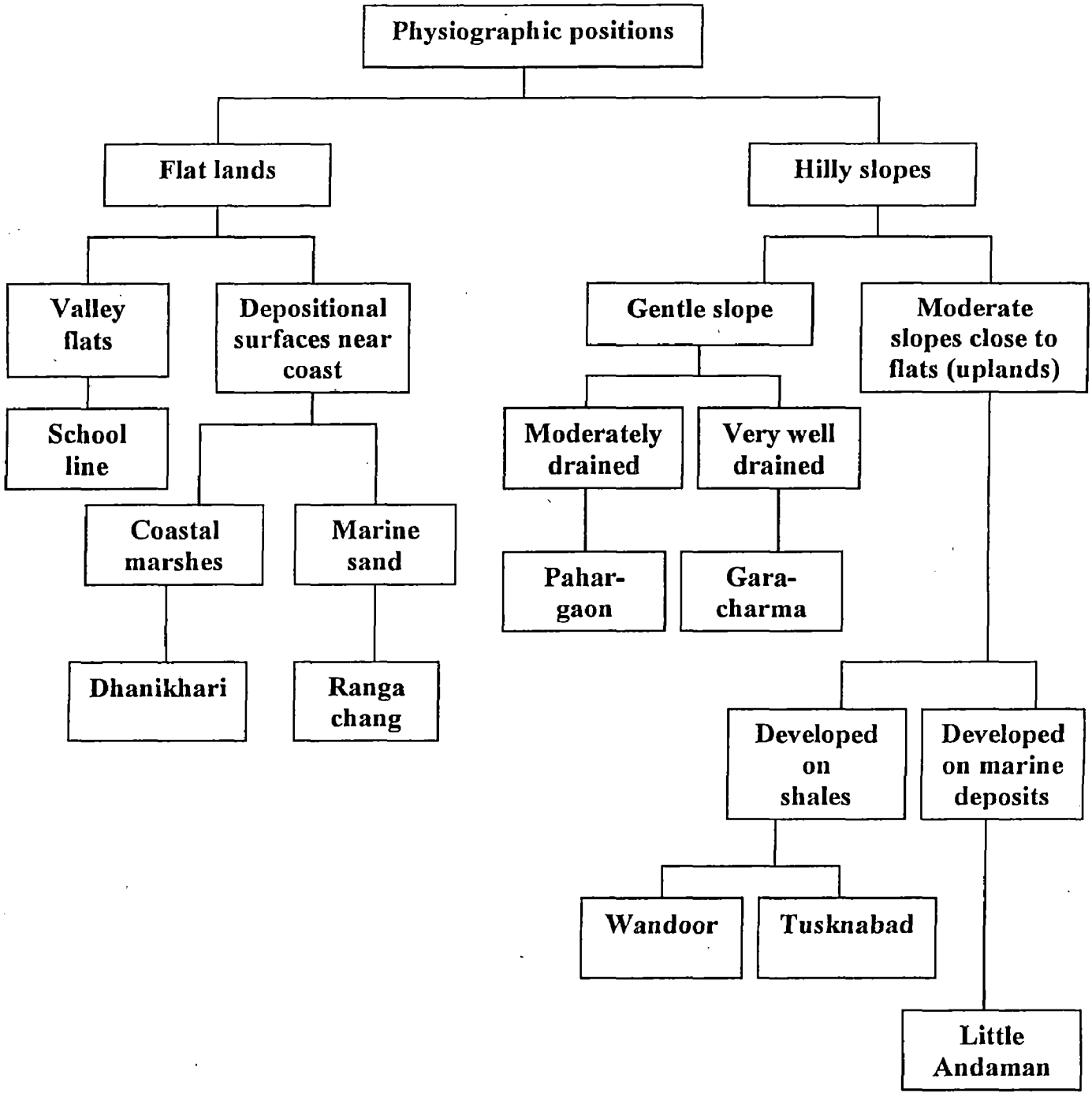

Physiographic positions
Flat lands
Hilly slopes
Valley flats
Depositional surfaces near coast
Gentle slope
Moderate slopes close to flats (uplands)
School line
Moderately drained
Very well drained
Coastal marshes
Marine sand
Pahar-gaon
Gara-charma
Dhanikhari
Ranga chang
Developed on shales
Developed on marine deposits
Wandoor
Tusknabad
Little Andaman

Figure 2

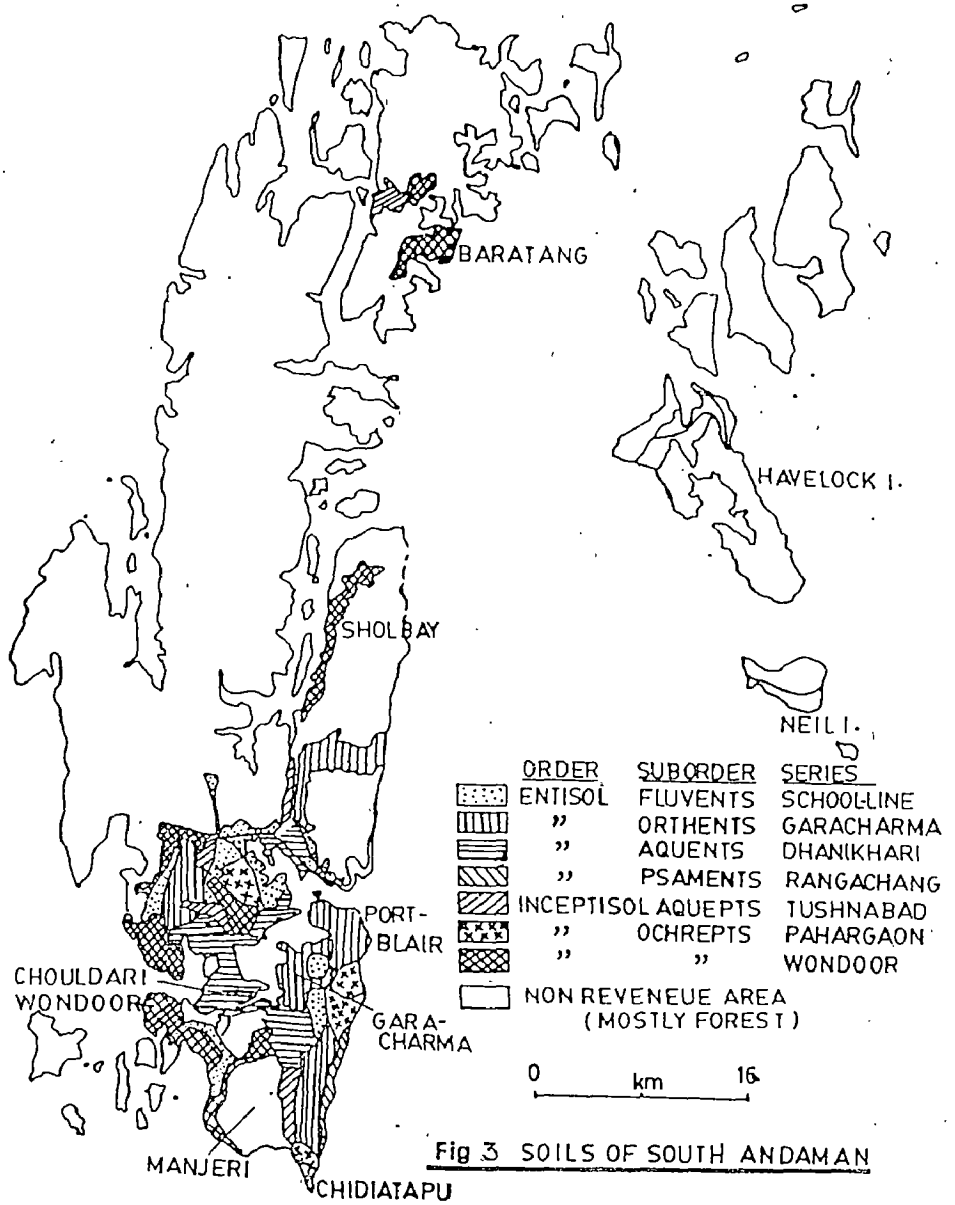


Fig 3 SOILS OF SOUTH ANDAMAN

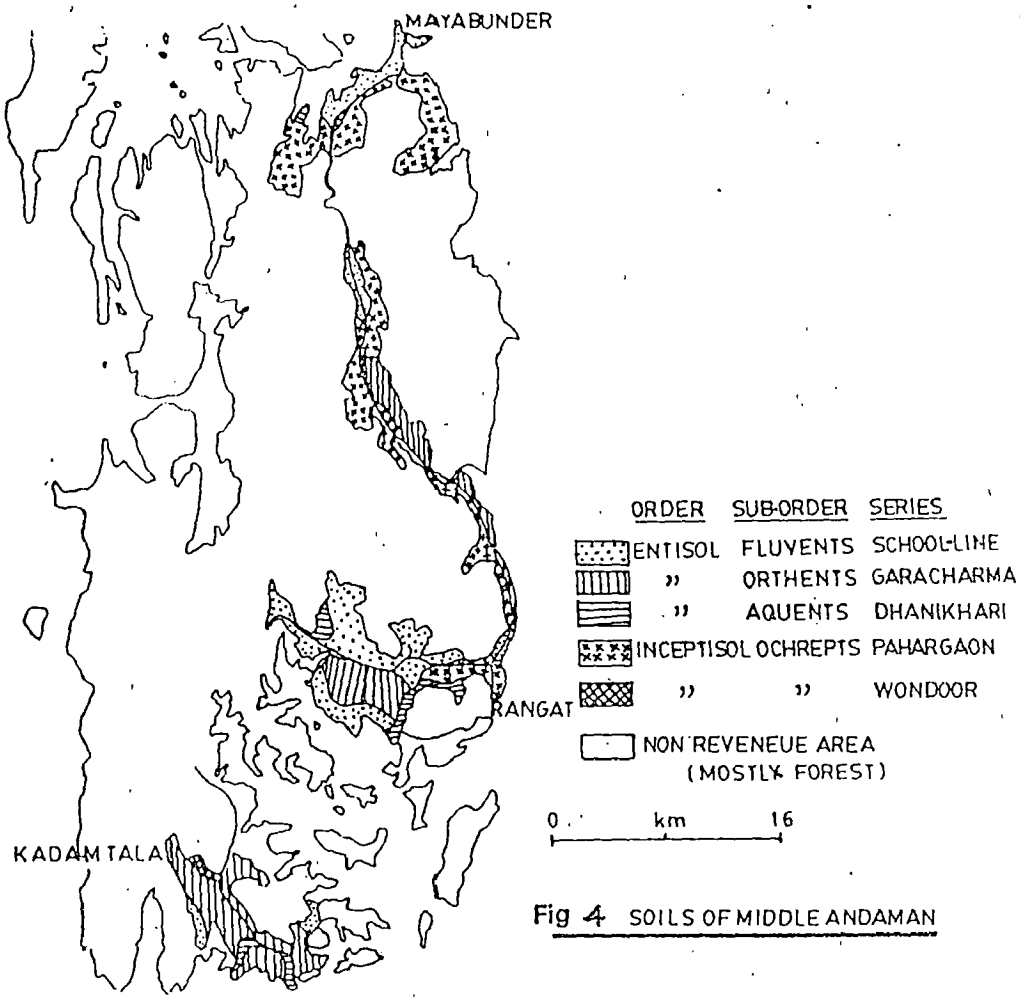


Fig 4 SOILS OF MIDDLE ANDAMAN

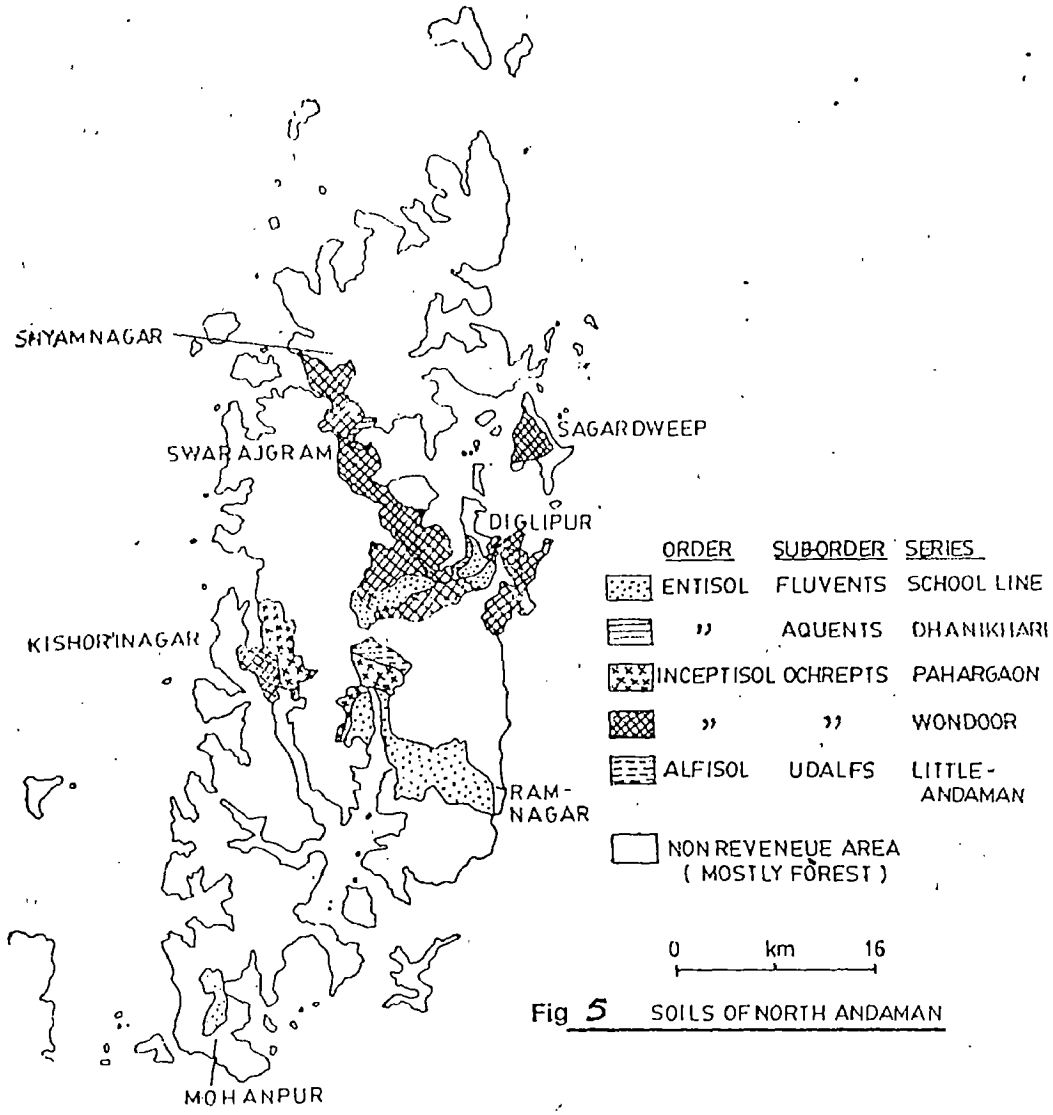
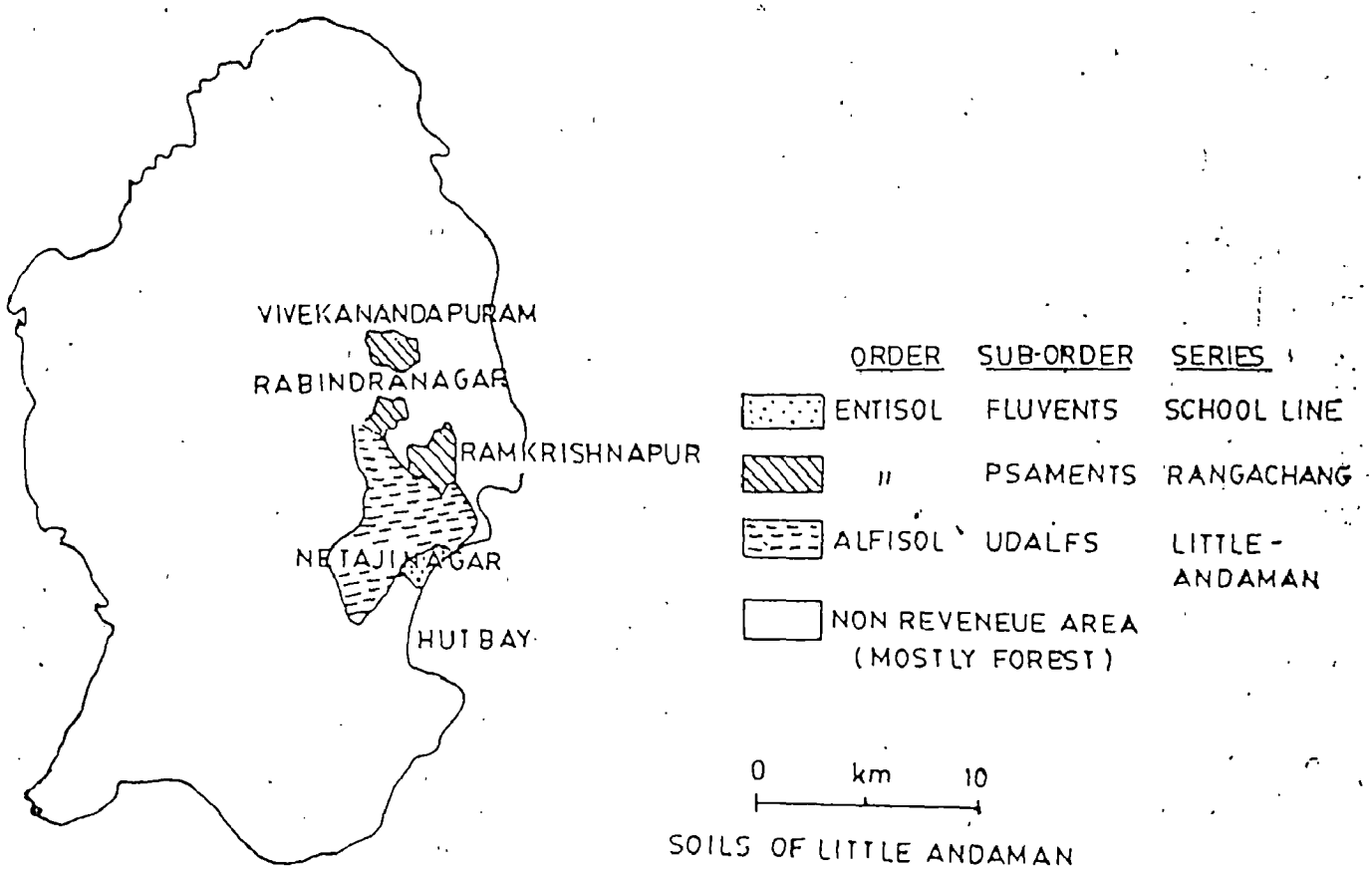
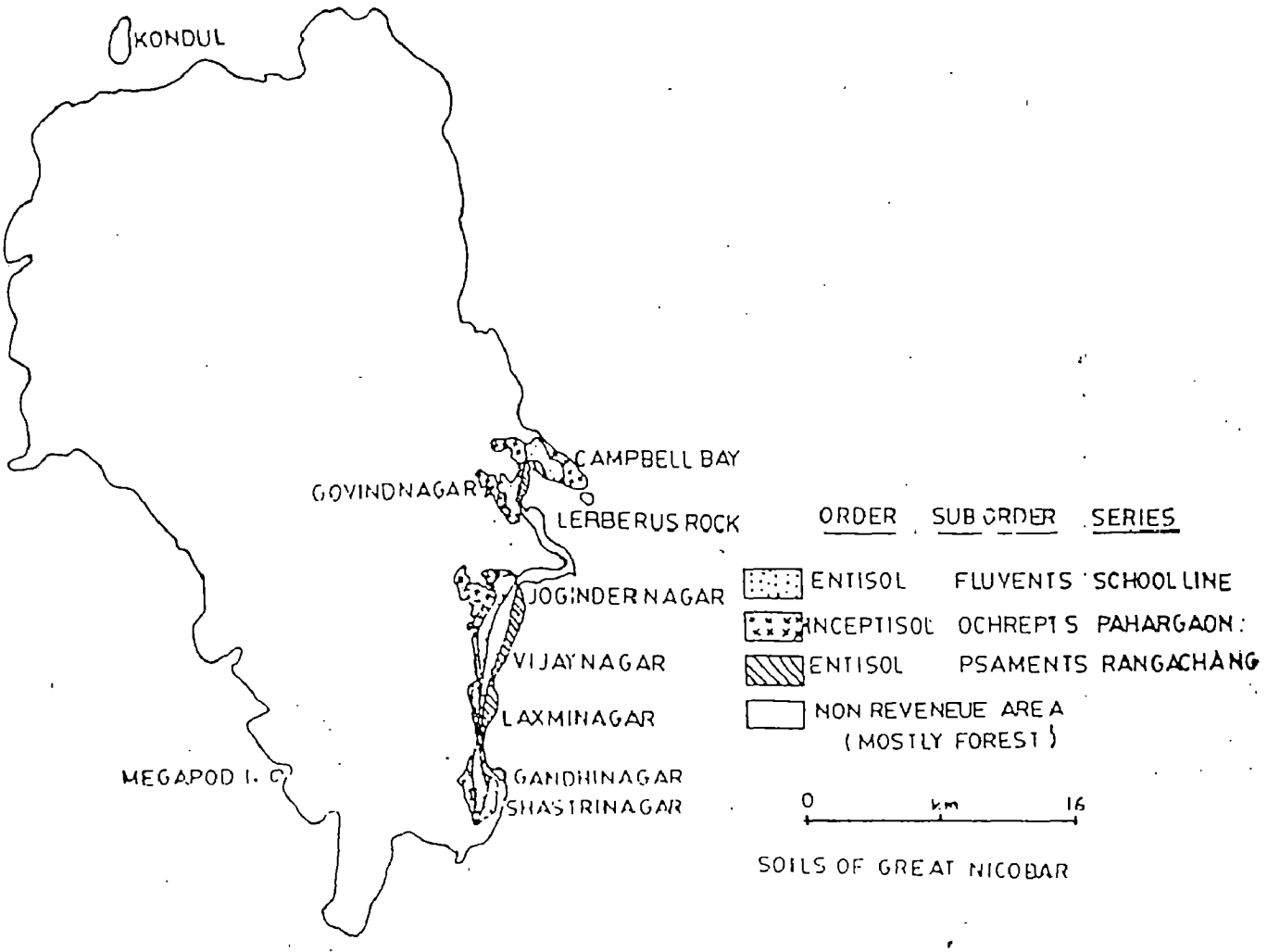


Fig 5 SOILS OF NORTH ANDAMAN



SOILS OF LITTLE ANDAMAN



SOILS OF GREAT NICOBAR

The soils of Kamorta and Teressa islands have developed from serpentine group consisting of rocks of porphyritic basalt to typical dolomite. In Kamorta the soils are shallow with iron rich shales immediately below the surface. In Teressa, soil erosion has been severe and water table is rather shallow. The deforested area mainly supports thick grass cover.

Soils on hill slopes have suffered severe erosion consequent upon deforestation and their allotment to the settlers who failed to use them properly. These soils need special management. Scientific landuse of the soil of Andaman & Nicobar Islands must be made in order to prevent their degradation. For the purpose of crop planning the soils of these islands can be grouped into :

(1) Heavy textured low land valley soils (school line and Tushnabad series)

(2) Medium to heavy textured upland soils (Tushnabad series)

(3) Coarse to medium textured well drained soils (Garacharma and Pahargaon series)

(4) Coastal saline and acid sulphate soils (Dhanikari series)

(5) Coastal and inland marshes (Dhanikari series)

(6) Coastal and Corralline deposits (Rangachang series)

(7) Severely eroded hill soils (Garacharma, Pahargaon and Wandoor series)

(8) Slightly to moderately eroded hill and foot hill soils (Little Andaman Series)

The land use pattern of Andaman & Nicobar Islands varies from island to island. The south, middle and north Andaman have maximum net sown area and these islands retain the bulk of fallow lands. The islands like Neil, Havelock and Little Andaman have no fallow land.

Based on the limitations of each category of soils, a land use plan on different soil is shown in Table 6.

Table 6 : Land use plan for soils of Andaman & Nicobar Islands

Suborder	Soil Series	Limitations	Proposed landuse
Fluvents	School line	Moderate erosional hazards Low base exchange	1. Rice (short duration)/pulses/ fodder/vegetables 2. Rice (medium to long duration)/ pulses/vegetables/ fodder 3. Cowpea (green manure)/fresh pods/ rice (medium to long duration)/ pulses/ vegetables/ fodders
Orthents	Garcharma	Serious erosional hazards Top soil is lost low nutrient status	1. Plantation crops especially cashew 2. Perennial grasses especially hybrid napier, thin niper combined with stylosanthes 3. Vegetables and pulses on terraced land at the base of the hill. 4. Arecanut and coconut on lower hill slopes with deep soils intercropped with perennial grasses and spices.
Aquents	Dhanikari	Salinity and low pH Acid sulphate soils, toxicity of Al and Fe Low P supplying capacity	1. Rice (salt resistant varieties) 2. Coconut-cum-brackish water fish culture in tideprone areas 3. Rice-cum-brackish water fish and prawn culture in tide prone areas
Pramments	Rangachang	Coarse textures soils Low nutrient supplying capacity Low water holding capacity	1. Suitable for pasture land and fodders 2. Groundnut and pulses 3. Vegetables and fruits 4. Plantation crops with judicious manuring
Aquents	Tishnabad	Poor drainage, heavy texture	1. Rice (short duration)/pulses/fodders/ vegetables 2. Rice (medium to long duration)/pulses/fodders/ vegetables

			3. Cowpea (green manure)/fresh pods/rice pulses/fodders/ vegetables
Ochrepts	Pahargaon Wandoor	Moderate to heavy erosional hazards due to due to moderate to steep slopes	1. Plantations, perennial grasses and spices on terraced lands at lower slopes 2. Plantations and natural forest on upper slopes intermixed with spices and perennial grasses for fodder 3. Upland base of the slopes after suitable terracing can be used for upland crops preferably spreading types.
Udalfs	Little Andaman	Erosional hazards due to undulating nature. Medium to low water and nutrient holding capacity	1. Vegetables and fruits 2. Plantation crops and spices with judicious manuring and water and soil management 3. Groundnut and pulses on coarse textured soils.

(Source : CARI, Port Blair)

1.4 AGRICULTURE IN THE ISLANDS

In these islands agriculture is barely 130 years old as 86% of the land area is protected and reserved for forest and due to fragile ecological conditions, further release of land is not possible. Sustainability can be maintained by increasing long term production without damaging or depleting the resource base. While making such attempts for the development of agriculture sector in the islands great strain is placed on the natural resource base that supports agriculture. The expansion of cropping on to land unfit for cultivation has led to erosion. It may also entail the sacrifice of primary forest with its rich flora and fauna. Overgrazing by livestock has lead to degradation of pastures. The overuse of chemicals has improved crop production but pose problem to environment, water and soil resources. The increasing dependence on water for irrigation may deplete aquifers and water

courses, causing shortages for users and raising levels of soil salinity. These are some of the threats which may adversely affect the environment and quality of life when attempts are made for increasing food production.

Agriculture in the islands is not very old. The original inhabitants belonging to different tribes lived in isolation and depended for food on forest products, fish, wild animals, etc. Cultivation of crops was unknown to them. Conventional plant cultivation was witnessed for the first time in these islands in 1799 when a colony was established at Chatham island. This project was abandoned after a few years because of number of deaths due to diseases and for economic reasons.

The next team successfully established a penal colony in 1858 and some lands of South Andaman were cleared for cultivation of vegetable crops. The number of settlers was around 7000 by 1865 and in another 20 years the population spread to 29 villages with convict labourers and 34 villages with self supporters who practiced agriculture. These cultivators introduced some crops and their varieties which they were growing in the areas to which they belonged in the mainland.

The Department of Agriculture was established in 1945 and modernisation of agriculture started in the islands with introduction of inputs like fertilizers, plant protection chemicals and improved seeds.

Agricultural research in the islands was initiated in early seventies through different research stations of the mainland institutes like IARI, IVRI, CMFRI and CPRI. All these research stations were later amalgamated to form the Central Agricultural Research Institute for Andaman and Nicobar Islands in 1978. This institute has been entrusted with all research relevant to the needs of Islands in the field of agriculture, animal husbandry and fisheries.

1.5 OBJECTIVES OF AGRICULTURAL DEVELOPMENT IN A & N ISLANDS

Agricultural development in these islands requires among other things

careful planning and its implementation, which is as follows :

(1) Raising agricultural production and productivity through wider adaption of appropriate ecology-specific and cost-effective technology.

(2) Bringing more area under high yielding, hybrid and improved varieties of crops through increased supply of quality seeds and planting materials.

(3) Increasing cropping intensity.

(4) Intensifying training of farmers and establishment of demonstration centres in farmers fields on the latest know-how.

(5) Farmers being encouraged for mechanization through the use of agricultural implements and machineries.

(6) Sustainable agriculture through Integrated Pest Management, PIM, INM, watershed management and organic cultivation are being emphasized and popularized.

(7) Infrastructural facilities of the existing farms to be strengthened for the production of quality seeds, planting materials, and developing them as model demonstration centres for the farmers.

(8) Crisis management in the event of natural calamities.

(9) Study tour and training of technical personnels to upgrade their skills.

1.6 PAST AND PRESENT FARMING SYSTEM IN THE ISLANDS

Although plantation of coconut and arecanut in Nicobar group of island goes as back as 7th century. The years between 1927 to 1931 saw the actual beginning of Agriculture Department, with main task of experimenting in coconut plantation, coffee garden and 16 village demonstration plots, shown in Table 7 is the manner of cropping during 1930s.

Table 7

Crop	Area
Paddy	4123 ha
Coconut (other than Nicobar population)	3780 ha
Fruits and Vegetables	367 ha
Coffee and Tea	298 ha
Grazing Land	10000 ha
Total	185688 ha

(Source : Directorate of Agriculture, Port Blair)

After independence, major stress was under area expansion in agricultural development which continued upto the end of 4th five year plan. However the programme came to a standstill with report of McVean in 1976 on 'Land Use in the Andaman and Nicobar Islands', which emphatically indicated that these islands are essentially forest terrains and not suitable for large scale agricultural settlement of agriculture based enterprises. Thus the thrust was diverted from area expansion to intensive agriculture practices and development of plantation on the hilly lands. The present cropwise distribution of the area in Andaman and Nicobar Islands is shown in Table 8 below :

Table 8

Crop	Area
Rice	12163
Pulses	700
Oilseeds	330
Vegetables	3832
Coconut	24746
Arecanut	3596
Fruits	3837
Blackpepper	426
Clove	93
Cinnamon	48
Cashewnut	872
Ginger	385
Sugarcane	188
Total	51216

(Source : Directorate of Agriculture, Port Blair)

The area and production of pulses, oilseeds, sugarcane, spices, coconut, arecanut, fruit during the last 5 years (1994-95 to 1998-99) is shown in Table 9 to 12.

Table 9 : Area and Production of Pulses, Oilseeds and Sugarcane in A & N Islands

Crop	94-95		95-96		96-97		97-98		98-99	
	A	P	A	P	A	P	A	P	A	P
Pulses	2060	1030	2004	1002	2040	1020	2400	1650	700	483
Oilseeds	865	415	860	408	894	420	1300	650	330	153
Sugarcane	183	4568	265	6625	266	6650	190	4750	186	4700

(Source : Directorate of Agriculture, Port Blair)

Table 10 : Area and Production of Spices in A & N Islands

Crop	94-95		95-96		96-97		97-98		98-99	
	A	P	A	P	A	P	A	P	A	P
Blackpepper	413	78	415	80	425	82	426	82	426	83
Clove	91	1.92	91.35	2.18	92	3.00	93	3.5	93	4.00
Cinnamon	44	4.95	45	5.00	47	5.50	48	6.00	48	6.60
Ginger	369	428	371	1130	380	1155	385	1160	385	1165

(Source : Directorate of Agriculture, Port Blair)

Table 11 : Area and Production of Coconut and Arecanut in A & N Islands

Crop	94-95		95-96		96-97		97-98		98-99	
	A	P	A	P	A	P	A	P	A	P
Coconut	24390	85.38	24417	85.44	24746	86.59	24746	86.61	24746	87.5
Arecanut	3465	4970	3480	4993	3596	5142	3596	5174	3596	5500

Coconut in million nuts; *Arecanut in tonnes*

(Source : Directorate of Agriculture, Port Blair)

Table 12 : Area and Production of Fruits in A & N Islands (Last 5 years figure)

Crop	94-95		95-96		96-97		97-98		98-99	
	A	P	A	P	A	P	A	P	A	P
Mango	726.25	3610	727.25	3611	728	3615	767	4659	767	5369
Citrus	220	350	220	350	225	563	230	600	230	615
Pineapple	330	1220	330	1220	336	1344	336	1855	336	1975
Guava	175	466	175.75	467	185	555	190	800	190	817
Sapota	179	533	179	533	180	540	184	677	184	699
Pomegranate	80	160	80	160	100	200	105	250	105	263
Ber	60	120	60	120	80	160	85	200	85	213
Papaya	223.75	1825	225	1826	150	1200	153	1482	153	1500
Jack Fruit	159	531	160	532	170	650	175	700	175	788
Banana	1572	7850	1573	7851	1578	7853	1612	9952	1612	11532
Total	3725	16665	3730	16670	3732	16680	3837	21175	3837	23771

(Source : Directorate of Agriculture, Port Blair)

1.7 CROPPING PATTERN OF ANDAMAN AND NICOBAR ISLANDS

Out of the total geographical area of 8249 sq. km, only 6%, i.e., 50,000 ha of land is available for agriculture and there is not much scope for increasing the area under cultivation due to prevailing fragile ecological condition. The agro-climatic conditions of these islands do not permit complete transplantation of agro-technology developed in the country for these islands. It needs in-situ development of technology for adoption in the island situations. Out of 50,000 ha of land, 12,000 ha is under paddy cultivation in the valley land and remaining 38,000 ha of available hilly land is suitable for plantation, horticulture, spices, red soil plam, cashew, rubber and other miscellaneous crops. The cultivation in general is carried out in rainfed conditions.

The lack of water and irrigation facilities restrict the cultivation in rabi season. In the rabi season, the paddy land generally lies fallow, being turned over to grazing purposes and 20-25% of paddy fallow is utilized for vegetable, oil seeds and pulses where irrigation facilities are available. However, vegetables are grown in the limited area of Neil, Havelock, Maccapahar and Little Andaman in Kharif season, where the soils are mostly porous and well drained. Due to limited land available for agriculture, the production of various crops can not be increased many folds through area expansion. Efforts have been made to take maximum production per unit area by adopting multiple and multi-tier cropping system with utmost care of conserving soil and water. Cropping pattern should be in such a way that adequate rice and vegetables, other commercial crops like coconut, arecanut, spices, fruits, vegetables in polyhouses, cultivation of flowers and orchids, high value products of coconut and arecanut, extraction of oil and oleoresins from spices, fruit products from surplus fruits may be made available to meet up demand for daily livelihood and increase the income of the farmers for sustained development. The use of bio-fertilizers and biocontrol agents instead of chemical fertilizers and PP chemicals needs to be encouraged for ecofriendly

agronomic practices.

Broadly the following cropping pattern may be adopted in these islands. The uniform cropping pattern throughout the islands is not recommended because of variation of soil type, slope, texture, structure, physiography aspects.

(I) Cropping pattern in valley/flat land

In accordance to the recommendations of the experts from government of India, the valley land can be utilized either for double cropping of paddy if irrigation is available during moisture stress period. One crop of paddy cultivation is practiced under rainfed condition followed by vegetable, pulses, oilseeds in paddy fallow in rabi season utilising residual moisture and life saving irrigation where available from nallah and minor irrigation pond and the cropping pattern may be as follows :

(1) Paddy-Paddy-Vegetables/pulses/oilseeds

(2) Paddy/vegetables/pulses/oilseeds

However, some land in Neil, Havelock and Little Andaman have been utilized for vegetable cultivation in the Kharif season where soils are porous and well drained and paddy cultivation is not possible. These lands are also utilized for vegetables, pulses, oil seeds in rabi season utilizing irrigation facilities.

(II) Cropping Pattern for Hilly/Undulating Lands

The hilly/undulating land is utilized for cultivation of plantation crops (coconut/arecanut), horticulture crops (fruits, cashew, etc.) and spices crops (Cinnamon, black pepper, clove, nutmeg, ginger, etc.) either as multiple cropping or multi-tier cropping system along with tuber crops, pineapple and vegetables with minimum tillage to avoid soil erosion. Some of the models of cropping pattern are as follows, which can be adopted considering the slope, type of soil, etc.

(1) Coconut/arecanut + banana for first three years + pepper on arecanut after three years + turmeric/ginger.

(2) Coconut + banana for first three years + pepper on coconut + clove/nutmeg/Cinnamon + ginger/turmeric

(3) Arecanut + banana for first three years + pepper on arecanut + clove/nutmeg/cinnamon + ginger.

(4) Coconut + Subabul (as shade and green manuring) + papper on coconut + turmeric/ginger.

(5) Mango/sapota + banana for first three years

(6) Orange/Mussambe + banana for first three years + cinnamon + ginger

(7) Lime/Mussambe + banana for first three years + cinnamon + ginger

(8) Coconut + chillies + other vegetables with minimum tillage

(9) Arecanut + betelvine + citrus plants + banana.

(10) Coconut + cinnamon + root crops for first three years + ginger

In Nicobar district where the soils are sandy loam to loamy the cropping pattern may be adjusted as follows :

(1) Coconut/arecanut + banana + tuber crops + pepper on coconut + arecanut

(2) Coconut + fruit crops (with proper spacing) + root crops.

(3) Coconut + cinnamon + clove + banana

(4) Coconut + clove + banana + root crops

(5) Arecanut + banana for first three years + pepper on arecanut + cinnamon + tuber crops.

1.8 OBJECTIVE OF CURRENT STUDY

The urgent implementation of watershed management in most island is needed for sustainable development. On most islands, distance between highlands and coastal areas tend to be short. Under such conditions, the role of forest ecosystem as regulators of water supplies for the island crop environment and soil

formation and protection is especially critical. In spite of the significance of forests and tree-based resources, present trends are not encouraging; forest resources are poorly managed and not used rationally in many parts of the islands. Population growth and demands for construction material, housing, resort development and fuel wood could lead to depletion of forest cover.

Thus the study involves the effect of rainfed area watershed management and its impact on the limited agricultural land area and the island's comparative fragile ecosystem.

The benefits accurred from soil and water conservation programme are numerous/multiple. Thus this study looks into the socio-economic benefits namely crop production from the catchment restoration, through soil and water conservation, production from trees, horticultural plants, grasses etc., production through animal resources, increase in net time and reduction in income inequality.

The protective or ecological benefits which included the protection against erosion such as gullying, stream bank erosion, etc.

The environmental benefits which include protection of soil, water and air-quality, biodiversity, maintenance and better microclimate.

Employment generation namely casual employment generated during introduction of treatment, such as tree planting, construction of structures and carrying out soil and water conservation works. Regular employment which has lead to change in the cropping intensity and other cultivation practices. Service opportunities which have opened up and needed for maintenance activities.

Chapter 2

REVIEW OF LITERATURE

2.1 GENERAL

A drainage basin or catchment is the area of land that drains water, sediment, dissolved materials, and biota to common outlet at some point along a stream channel. If the area is large (hundreds of square kilometers) it is a drainage basin, if it is small (acres to square kilometer), it is a catchment. Watershed is technically defined as the topographical divide (drainage divide) that separates catchments. In USA, the usage of watershed to mean catchment and drainage divide to mean watershed is common.

Internationally a watershed is defined as the area of land that drains water, sediment, dissolved materials, biota, etc., to a common outlet at some point along a stream channel (watershed outlet). A watershed is a naturally delineated unit of land. Thus a watershed is all the land and water area which contributes runoff to a common point. The watershed above any point on a defined drainage channel is therefore all the land and water areas which drain through that point. It is marked by an elevated line that forms a division between two areas defined by separate streams, systems or bodies of water.

A typical small watershed project concentrates first on land treatment. Development starts at the top of the drainage basin and proceeds gradually down the slopes to the lowlands. In humid areas, the highest elevations are usually forest, and forest is often the resource most in need of repairs. In many steep watersheds where forests have been cut, the answer is to replant them.

The most important features of the 3 predominant reaches of a watershed is shown in Table 13.

Table 13

Factor or characteristic (1)	Typology III Upper Reaches "Escarpment" (2)	Typology II Middle Reaches "Middle Catchment" (3)	Typology I Lower Reaches "Lower Valley" (4)
Topography	Undulated	Moderate slopes	Flat lands
Rainfall	High & intense	Moderate	Low, normally less intense
Soil cover	Shallow, light, stony	Moderate to shallow, light	Deep, silty to clay, fine, textured
Vegetation	Jungle-degraded shrubs, bushes, grass lands	Pastures, rainfed agricultural lands, bushes	Irrigated farmlands, commercial farming and plantation
Runoff	Immediate, high velocity, erosive	Slightly delayed moderate velocity	Delayed and long lasting low velocity, depositional
Erosion of soil	Very high	Moderate to high	Low, soil loss compensated by transported soil
Primary occupation	Hunting, gathering forest produce, pastoralism	Dry land agriculture, pastoralism	Irrigated farming, allied activities, industrial activities
Population density and nature	Very low, backward classes	Moderately low, few immigrants	Very high, recent immigrants, urbanized
Energy use	Negligible	Moderate low	Very high
Development effects inputs	Negligible	Low, recent phenomenon	Very high as a convention

(Source : Watershed management : Guidelines for Indian Condition – E. M. Tideman)

Water yield is the sum of stream flow and groundwater discharge from a contributing land area. The following estimates of the earth's water supplies provide a feel for the relative size of the compartments of the global hydrologic cycle. There are roughly 287,131,678 cubic miles of water on earth, 96.5% of

which is salt water contained in oceans. Only 2.5% of the water on earth is fresh water. Table 14 shows where the fresh water is located and it is noted that only an estimated 0.336% of the earth's fresh waters are in a liquid form as surface water (lakes, marshes, rivers, etc.)

Table 14

Freshwater compartment	Volume (Cubic mile)	Percent of fresh water
Polar ice	4,976,900	68.6
Ground water	2,181,479	30.1
Snow pack	70,561	0.98
Lakes	18,852	0.25
Atmosphere	2,672	0.35
Marshes/watersheds	2,376	0.026
Rivers/streams	439	0.006
Living organisms	232	0.003
Total	7,253,511	100

(Source : UCCE Rangeland Watershed Factsheet No. 33)

Watershed management focuses on water and its interrelationship with everything else on the watershed namely soil, vegetation which are the vital natural resources for the survival of man and his animals.

Watershed management is the management of land and other resources on a watershed to achieve well defined environmental, social and economic goals. Unique to concept of watershed management is recognition of the relationship between land use, soil loss and productivity, water quantity and quality, wildlife population and habitat, social factors, and economic factors. Upstream and downstream landareas and entities are linked on a watershed through the hydrologic cycle. Thus watershed management practices are those non-structural and structural activities employed on a watershed to achieve clearly defined

management goals. Watershed management practices are in fact natural resources management practices. The difference is in how and at what scale the practices are used and evaluated.

Watershed Hydrology

From hydrologic viewpoint, the first step of watershed is to evaluate past, present and proposed management practices on a watershed with respect to the watershed water balance. Watershed water balance refers to the balance between the inflow of water to a watershed as precipitation and the outflow of water from the watershed as evapotranspiration, groundwater discharge, and stream flow. Watershed water balance is an accounting tool to keep track of conjunction with probability analysis one can evaluate the hydrologic, economic and ecological feasibility of past, present and potential activities on a watershed.

Watershed water balance is best illustrated as an equation which is as follows :

$$P = ET + SF + GWD \pm SMC \pm GWS$$

P = Precipitation (gain)

ET = Evapotranspiration (loss)

SF = Stream flow (loss)

GWD = Ground water discharge (loss)

SMC = Soil moisture content (gain or loss)

GWS = Ground water storage (gain or loss)

The difficulty lies in the accuracy and the precision at which we can measure and/or predict components of the equation. Accuracy refers to how close a measurement or estimate is to the "true" value. Precision refers to how exact or fine our measuring device might be (i.e., inches versus feet) and unfortunately, hydrology is plagued by precisely, yet inaccurately measured components.

2.2 OBJECTIVES OF WATERSHED MANAGEMENT

Technical objectives of the watershed management are :

(1) To rehabilitate the watershed through proper land use and protection/conservation measures in order to minimize erosion and simultaneously increase productivity of the land and the income of the farmers.

(2) To protect, improve or manage the watershed for the benefit of water resources development (domestic water supply, irrigation, hydropower, etc.)

(3) To manage the watershed in order to minimize natural disasters such as flood, drought and landslides, etc.

(4) To develop rural areas in the watershed for the benefit of the people and the economics of the region.

(5) Combination of the above.

Different objectives call for different techniques, manpower, inputs and approaches in planning.

2.3 EFFECT OF WATERSHED ON THE PEOPLE

A watershed affects the people in every sphere of life. The sustained productivity of food, fuel, forage, fibre, fruit and water by the management of vital resources of water, soil, vegetation and phenomena like floods and droughts are determined by the nature of watershed functioning.

Water : Watershed conditions affect and influence water quality, quantity and regime. By manipulating different watershed characteristics the quality, quantity and regime can be regulated according to requirement.

Erosion and Sedimentation : The rate and quantity of sediment produced and transported are of vital importance. Erosion affects productivity of land, situation of reservoirs causing floods, damage of lands and property.

Vegetation : Production from all lands is dependent upon the availability of the right quality and quantity of water at the right time which in turn is dependent upon the conditions of watershed. Production is also dependent upon erosion rate and deposition taking place in the watershed.

Floods : Floods cannot be estimated but they can be greatly mitigated by sound watershed treatment and management.

Drought : Droughts also can be mitigated by sound watershed management programmes aiming at moisture conservation and evolving sound landuse programmes.

2.4 WATERSHED DETERIORATION – CAUSES AND CONSEQUENCES

Watershed deterioration takes place due to the uncontrolled, unplanned, unscientific landuse and activities of men. These activities could be as follows.

Agricultural Land : Cultivation on sloping land without adequate precautions; cultivation along nalah or stream banks; cultivation of erosion – permitting crops; over-cropping areas without replenishing soil fertility.

Forest Land : Clear felling on steep slopes; drastic thinnings of plantations along slopes; faulty logging, roads and disturbance of forest floors during removal of the felled trees.

Grass Lands : Excessive grazing resulting in disappearance of protective cover; development of cattle tracks into channels, gullies, etc; compaction of soil resulting in lower infiltration rates, etc.

Fire : Intentional or accidental fire resulting in loss of vegetation, organic matter and micro-organisms. Fire disturbs the hydrological behaviour of the watershed very seriously and for a long period.

Shifting Cultivation : Shifting cultivation destroys protective and productive vegetation in preference for a brief period of immediate crop production and results in soil loss and other consequential damages. This practice cause widespread destruction in the watershed.

Unscientific Mining and Quarrying : This practice results in exposure and digging up of slopes, which causes considerable damage to the landscape by destroying vegetation. Haphazard disposal of mine spoils blocks drainage channels and covers up pastures or agricultural fields.

Bad Road Alignment and Construction : This causes a lot of dislocation of life in watersheds located in hilly areas. In Himalayan watersheds the large coarse sediment contribute to the blockage of flow in drainage channels.

Non Cooperation of the People : An important factor in any watershed is that without people's cooperation, no watershed can remain undisturbed and it is the people's non-cooperation which results in people's ills.

Consequences of Watershed Deterioration

Low productivity of land, erosion and denudation, siltation of reservoirs, poor quality water yield due to sediments, frequent floods and draughts, and por health of people and cattle.

2.5 PEOPLE'S PARTICIPATION IN WATERSHED MANAGEMENT

People's participation is defined as employing methods where associated communities are motivated to function and contribute as a group to perform a predetermined task. All persons cannot address the problems and prospects of integrated watershed management equally hence an organization like a watershed committee and implement community decisions. The committee should be registered under an appropriate act, should have wide representation covering all sections of the community and formed separately in addition to existing Panchayat

Samiti if any within the watershed.

The basic function of a watershed committee includes

(1) a forum to interact with external agencies interested in supporting developmental works.

(2) Disseminate the implications of integrated watershed management to people in general.

(3) Mobilize direct and indirect contributions from the beneficiaries to form a community fund and administer the same professionally so as to maintain the community assets created under the programme.

(4) Promote and support creation of other functional groups, e.g. nursery raising groups, milk and vegetable producer's union, agro-processing groups, etc.

(5) Resolve conflicts locally and democratically.

(6) Form and implement collective decisions on matters related to watershed management.

2.5.1 Case Studies on Participatory Watershed Management

The Indo-German Watershed Development Programme is a bilaterally assisted programme being implemented through NGOs in Maharashtra involving village self help groups for integrated natural resources management on a watershed basis. The two phases of the programme namely capacity building and full implementation phase are administered and managed by WOTR (Watershed Organisation Trust) and NABARD (National Bank for Agriculture and Rural Development) respectively with the support of the Government of Maharashtra and the financial support of the GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit) and the KfW (Kseditanstalt für Wiederaufbay) respectively.

The catalytic development support agency (WTOR) imparted special efforts in technical, social and managerial skills to large body of village community and

grass-root NGOs. Under the participatory capacity building phase, the programme concentrated on building the institutional capacities of grass-root NGOs and capacity of the village communities to regenerate and manage their environment on a sustainable basis. Watershed Organisation Trust (WOTR) acted as a link between the capacity building phase and the full implementation phase of the programme.

The outcome after 3 years of the launch of capacity building phase of the programme and establishment of Watershed Organisation Trust (WOTR), the programme is actively involved in assistance to 81 village communities and 53 NGOs to undertake participatory watershed development potentially covering an area of approximately 100000 ha in the drought prone regions of Maharashtra state. *WOTR brought about the following key institutional and managerial changes.*

(i) Increased the programme and project level capabilities with emphasis on the improving the administrative and managerial responses of the NGOs for participatory watershed development.

(ii) Development of training aids including publicity material, operation manuals, newsletters in close collaboration with its partners and end users.

(iii) Action research studies to address the needs of the communities for constant review and reflection.

(iv) Coordination and liaison with the local, regional and state level government agencies for effective implementation of the collaborative efforts under the watershed programme.

(v) Net area planning practice where detailed asessment of the farmers plot characteristics along with the appropriate treatments to de-mystify the traditional land use planning methods using contour maps.

(vi) Development of situation specific training approaches involving combination of the structured and non-formal methods designed for village comunities and NGO staff.

2.5.2 Shared Control of Natural Resources in Watersheds : Sri Lanka

The community based participatory watershed management project namely Shared Control of Natural Resources (SCOR), funded by the United States Agency for International Development (USAID) implemented by Irrigation Management Institute (IIMI) in collaboration with the Government of Sri Lanka is spearheaded by a core group of experts including senior government officials closely associated with the management of the land and water resources of Sri Lanka. It reviewed the past experiences in the management of natural resources in Sri Lanka and elsewhere, in consultation with a cross-section of resource users, government officials at various levels, development banks and representatives of non-government organisations (NGOs). Its organisational approach coupled with appropriate technologies for integrated land and water resources management on a watershed basis was tested and demonstrated in two pilot watersheds in Sri Lanka (namely Huruluwewa in North Central Province and Nilwala in the Southern Province). The strategy used was to catalyze a process to motivate partners to use an integrated package of technology, organisation, resources and policies through collaborative initiatives.

The use of mixed group of participants including resource users, local officers, scientists and catalysts; developed a "sense of ownership" belonging and commitment for action by users and partners. For the field activities which commenced in October 1993, SCOR project selected 25 sub-watersheds ranging from 75 ha to 100 ha for interventions.

The SCOR project promoted small farmer companies in Sri Lanka which paved way for the small farmer to become an active partner in the market economy while conserving their production base. Four such companies have been formed which are responsible for organizing conservation based production processes for special markets, capturing economies and scale in input and output markets, collection, storage, quality control and value added production.

The project emphasized the rationale for using watershed as the basic unit for integrated planning of (land and water) resources utilisation, i.e., the way in which the water in the upper parts of the watershed are used affect the way in which it can be used downstream which in turn affected the associated land resource.

The users , rights to earn economic and other benefits from the (participatory) conservation of natural resources was found to be more effective in protecting environmentally fragile lands in water basin and watersheds.

In the process of participatory and market oriented natural resources management resource users grouped and united for various purposes, ranging from groups for fish farming through small hydropower plants, etc.

Group action in conservation farming techniques, for water saving and conservation practices, promotion and adoption of crops with comparative advantage, has developed the ecologically sound land use in watersheds (including both irrigated and rainfed areas).

2.5.3 Community Based Watershed Management in Nicaragua

The Calico river watershed is located in the southern part of river Matagalpa, Nicaragua. The Calico river is a tributary of the Great Matagalapa river and covers an extension of about 170 square kilometers. The watershed is characterized by a semi-arid climate (1,100-1,600 mm of rainfall per year with altitudes ranging from 450 to 1250 mts) and mainly small farmer production systems based on a combination of corn-beans, dual purpose live stock and coffee in the higher altitude zone. The key problems affecting the landscape and the livelihood of the population at various levels (community, microwatershed and watershed) were land degradation, deforestation and water scarcity and pollution.

In 1997 an organization called CIAT hillside was built which involved local organization as means to change the ways in which local groups interact with each other as well as with broader society. The goal was greater and more equitable

control over resources, amplifying the range of options the less privileged people have (e.g. women, ethnic minorities, the landless), enhancing their involvement in policy making processes at the regional or national level as well as of improving the quality of their involvement.

The stakeholders, i.e., direct and indirect users under the watershed resources functioned under an organized set of rules and norms which was executed by a informed communities (consisting of user groups, stakeholders). These communities engage in dialogue and undertake particular tasks which are in turn supported by appropriate community or grassroot organisation based on managerial capacity at local level involving both rural institutions and rural organisations.

To strengthen organizational processes the CIAT hillside team formed an agreement with local agricultural research committees (Campesino a Campesino Program in San Dionisio in Spanish Known as CIAL). The committees provide local communities with methodology to carry out participatory research process focussing on and solving locally felt natural resource management problem. Currently 4 CIALs are functioning carrying out research process, involving a number of new farmer-leaders (men and women). The CIALs are linked to each other (exchange of ideas and results within the watershed) and also linked with other research and technology entities such as Nicaraguan Institute for Agricultural Technology (INTA).

The participatory action research process has given local people the opportunity to collectively analyse and reflect upon their own situation and discover linkages among various levels of the ecological and socio-economic organization within the watershed.

The resource assessment and resource monitoring by the local people has helped to raise awareness among local decision makers about the interdependencies of resources and by carrying out the work collectively created ownership, skills, confidence and credibility.

Chapter 3

DESCRIPTION OF PROJECT AREA

3.1 GENERAL

The topography of land in these islands is varying from level to undulated with high steep slopes. The slope percentage ranges from 1-35%. The soil is heterogeneous in nature varying from sandy to clay. Due to high intensity of rainfall and vegetation, the nature of the soil is slightly acidic. The fertility status of soil is poor in exposed cultivated land whereas the forest land has good cover of humus. The undulated land and high terrain causes high velocity of runoff causing severe surface erosion. The eroded soil is deposited in the sea causing shallow water level on the sea bank. As the island is surrounded by sea about 1300 ha of land has so far been identified as affected by salinity. However in some places drainage problem also exists.

Rain is received for seven to eight months of the year from May to December, but 50% to 90% of the rain water is almost lost immediately to the sea due to steep slopes. The lack of any perennial water source coupled with dry spell period for four months of the year from January to April cause not only problems of irrigation but also causes an acute shortage of drinking water. Thus despite being one of the wettest regions in the country, the Union Territory of Andaman & Nicobar Islands has still got to contend with problems of scarcity of water.

Taking into consideration the highly fragile ecosystem the Andaman Islands are ideally suited for taking up watershed project for rainfed area with the objective to manage and utilize runoff for useful purposes by increasing the infiltration into soil and controlling damaging excess runoff. With the emphasis on optimum crop production a package of agricultural practices was introduced to effectively transfer technologies to the farming community to attain sustainable

agriculture productivity.

The National level programme for the development of rainfed areas in the National Watershed Development Project for Rainfed Areas (NWDPRA), Government of India has been implemented by the Department of Agriculture in the Union Territory of Andaman & Nicobar Islands from the VIIIth five year plan starting from September 1993 onwards. Four projects have been completed and the details of the project area is as under.

(1) Ramnagar Watershed project in CD Block, Diglipur, North Andaman (September 1993).

(2) Rampur Watershed Project in CD Block, Rangat, Mayabunder Tehsil (August 1994).

(3) Uttara Watershed Project in CD Block, Rangat, Middle Andaman (August 1994)

(4) Mannarghat Watershed Project in CD Block, Ferrargunj, South Andaman (June 1994).

For the study purpose the above project areas have been taken into consideration.

3.2 RAMNAGAR WATERSHED PROJECT

The Ramnagar watershed is located in Diglipur Tehsil in North Andaman sland. The watershed has a total length of 12.5 km with an average width of 9.6 kms. The water shed start from the edge of the sea, i.e., 0 m MSL and rises upto 406 m MSL. The slope in the catchment varies from 3% to 30%. The total area of the watershed is 4313 ha, out of this about 71.2%, i.e., 3073 ha is under tropical evergreen forest and 692 ha is under the revenue and forest. An area of 52.47 ha is not available for cultivation as it is under road stream and building etc. The balance area 1189 ha is allotted to the farmers for agricultural, plantation, homestead and for housing. As per records, the farmers of the watershed area have been allotted 237 ha of paddy land and 221 ha of hilly land. About 7.10 ha of land is affected by salinity.

The entire area is under rainfed agriculture about 12 small streams originated from the hills, surrounding the catchment area and flowing into the main Ramnagar Nallah.

Apart from one paddy crop cultivation under rainfed condition each house maintains a kitchen garden. Banana, vegetables, pulses and oilseeds are grown in Rabi season utilizing residual moisture and life saving irrigation which is available from Nallah and minor irrigation pond. Poultry and other livestock are also a source of income and a few families supplement their income by fishing.

The farmers in the area have been settled with 4 ha of land each, 2 ha of paddy land and 2 ha of hilly land. Originally, they are Ranchies and Bengalies. Both the communities live together peacefully displaying a community feeling and interdependence that comes easily to people who have little to depend upon their land and their own efforts. The area village is connected to the Tehsil headquarters, by road constructed a few years back.

The area delineated under the project area is shown in Figure 8 and project area details is given in Table 15.

3.3 RAMPUR WATERSHED PROJECT

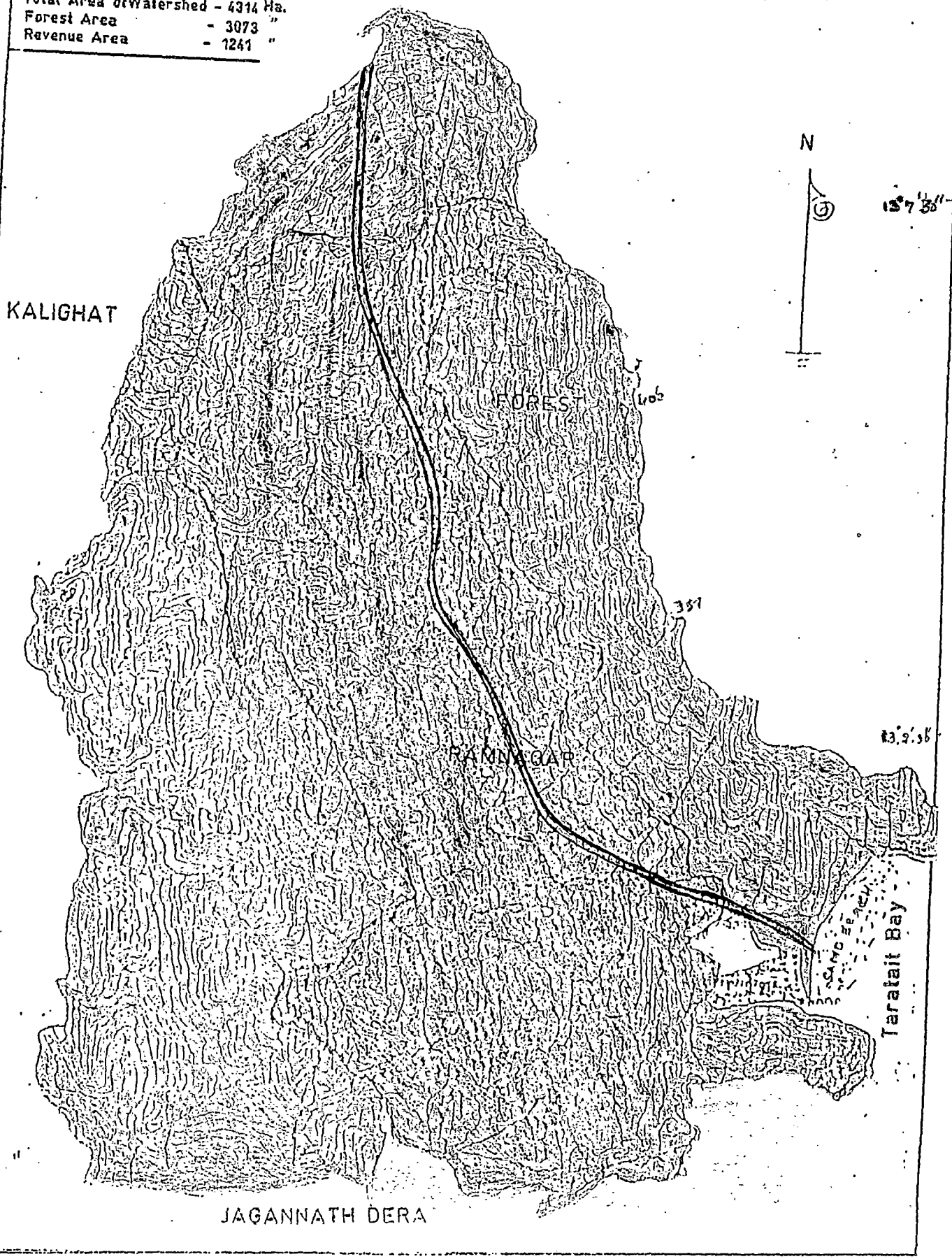
The watershed is in the Rampur village of Mayabunder Tehsil. The watershed is situated about 4.5 km away from Mayabunder. It is located between 12°51'48" and 12°53'37" North latitude and between 92°53'45" and 92°55'25" east longitude. The total length of the watershed is 2.75 km and with an average width of 2.125 km. The slope varies from 3% to 25%. The total area of the watershed is 430.25 ha out of this about 31.87%, i.e., 137.13 ha of land is under forest and the balance 293.12 ha is under revenue land. 15.08 ha which is not available for cultivation as it is under road, stream, nallah and building etc. Out of the total area of the watershed, the farmers have been allotted 123.10 ha of paddy land, 9.12 ha of hilly land and 0.18 ha of house site/homestead land for agriculture, plantation, etc. About 7 ha of land is affected by salinity problem. The entire watershed is under rainfed agriculture. There are about 7 small streams, which collect the rain

RAMNAGAR WATERSHED

INDEX

Total Area of Watershed - 4314 Ha.
Forest Area - 3073 "
Revenue Area - 1241 "

SCALE: 1cm = 250mts.



water from the catchment area and drain it into the adjoining sea. Bulk of the hilly land allotted to the farmers are covered under forest.

Two numbers of minor irrigation ponds exist in Rampur village which have been constructed under loan cum subsidy scheme. Only a single crop of paddy is cultivated apart from some cultivation of pulses, oilseeds and vegetables are also grown in the watershed area.

The Rampur village in Mayabunder Tehsil is one of the oldest settlement of Middle and North Andaman. The settlement took place somewhere in 1930s. Most of the farmers of the watershed comprises of old inhabitants, mostly Tamilians and Ranchi families.

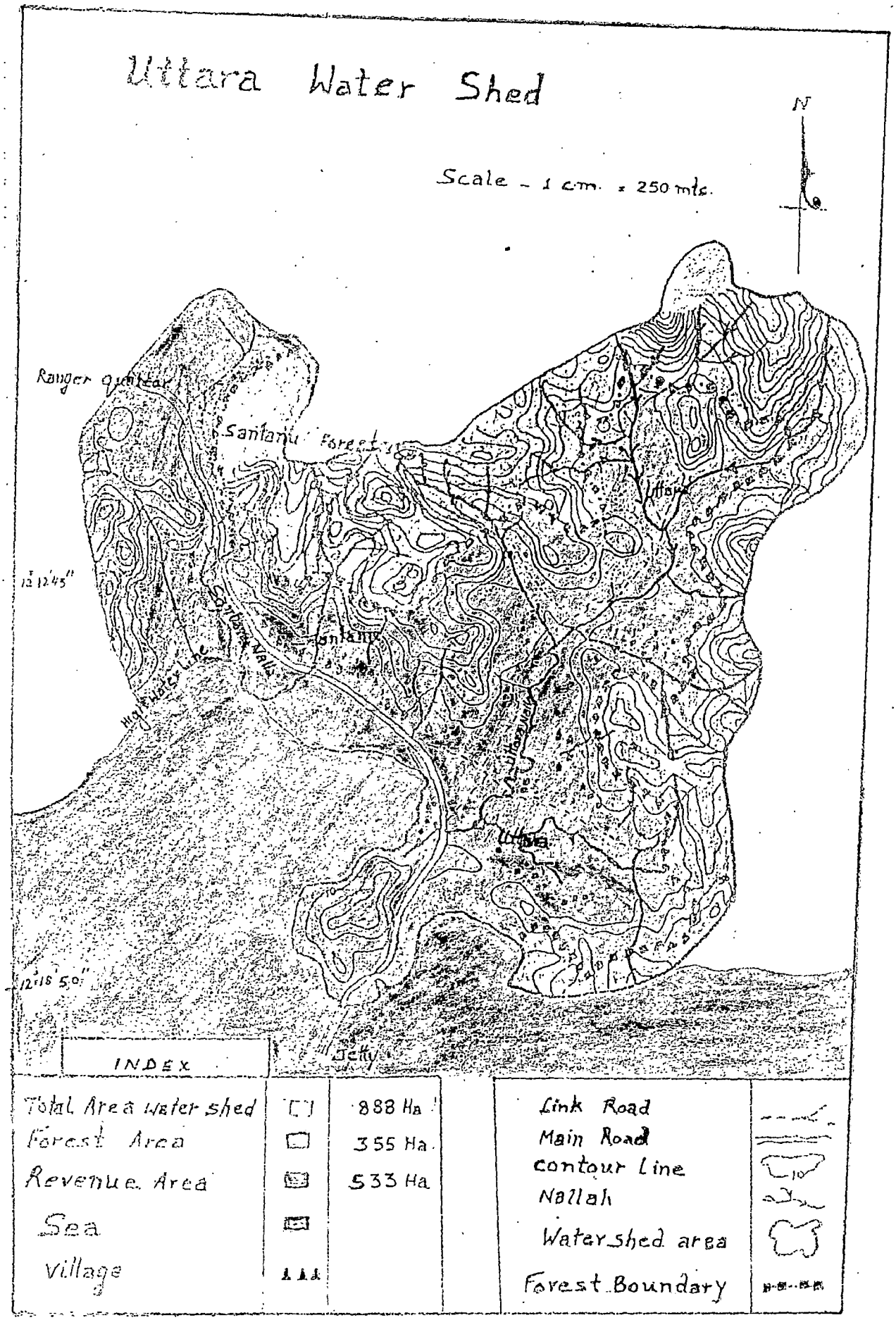
There is a middle school and a health sub centre within the catchment area. A college of arts and science is hardly half kilometer from the eastern edge of the watershed. A road traverses the entire catchment area and it is well connected to Mayabunder and Rangat Tehsil by road. The Mayabunder jetty is 5 km away from the watershed area. Therefore transportation and communication is not a major problem for the people settled in these islands.

About 7 ha of land situated very close to coast which is very badly affected by soil salinity problem because of submergence and intrusion of sea water. There are 5 wells in this watershed and drinking water to the villages are being supplied by Andaman Public Works Department through pipe line. The wells get dried up during the months of summer.

The area delineated under the project is shown in Fig. 9 and project area detail is given in Table 15.

3.4 UTTARA WATERSHED PROJECT

The watershed consisting of the Uttara, Santanu village and part of Kadamtala villages is located in Rangat Tehsil in Middle Andaman. The watershed is situated about half a kilometer from Uttara Jetty and about 50 km from Rangat town. The watershed is located between 92°46'35" to 92°48'58" East longitude and 12°18' to 12°21' North latitude. The watershed has total length of 3.5 kms with an


Uttara Water Shed
N
Scale - 1 cm. = 250 mts.
Ranger quarter
Santanu Forest
Uttara
12°12'45"
Santanu
High Water Line
Uttara
12°11'50"
Jetty
INDEX
Total Area water shed
888 Ha
Forest Area
355 Ha
Revenue Area
533 Ha
Sea
Village
Link Road
Main Road
contour Line
Nallah
Water shed area
Forest Boundary

average width of 2.6 kms. The watershed starts from the edge of the sea and rises upto 120 MSL. The slope in the catchment varies from 3% to 30%. The total area of the watershed is 888 ha, out of this about 40%, i.e., 355 ha is under tropical forest and 533 ha is under the revenue land. An area of 35 ha is not available for cultivation as it is under roads, streams and building etc. Out of the total area of watershed project, 385 ha of land is allotted to the farmers for agriculture, plantation, homestead and housing. As per the records, the farmers of the watershed area have been allotted 183.15 ha of hilly land. About 3.00 ha of land is affected by salinity.

The entire area is under rainfed agriculture surrounding. Nine smaller drains are in the area. The forest cover is thick and there is sufficient vegetation along the drainage line.

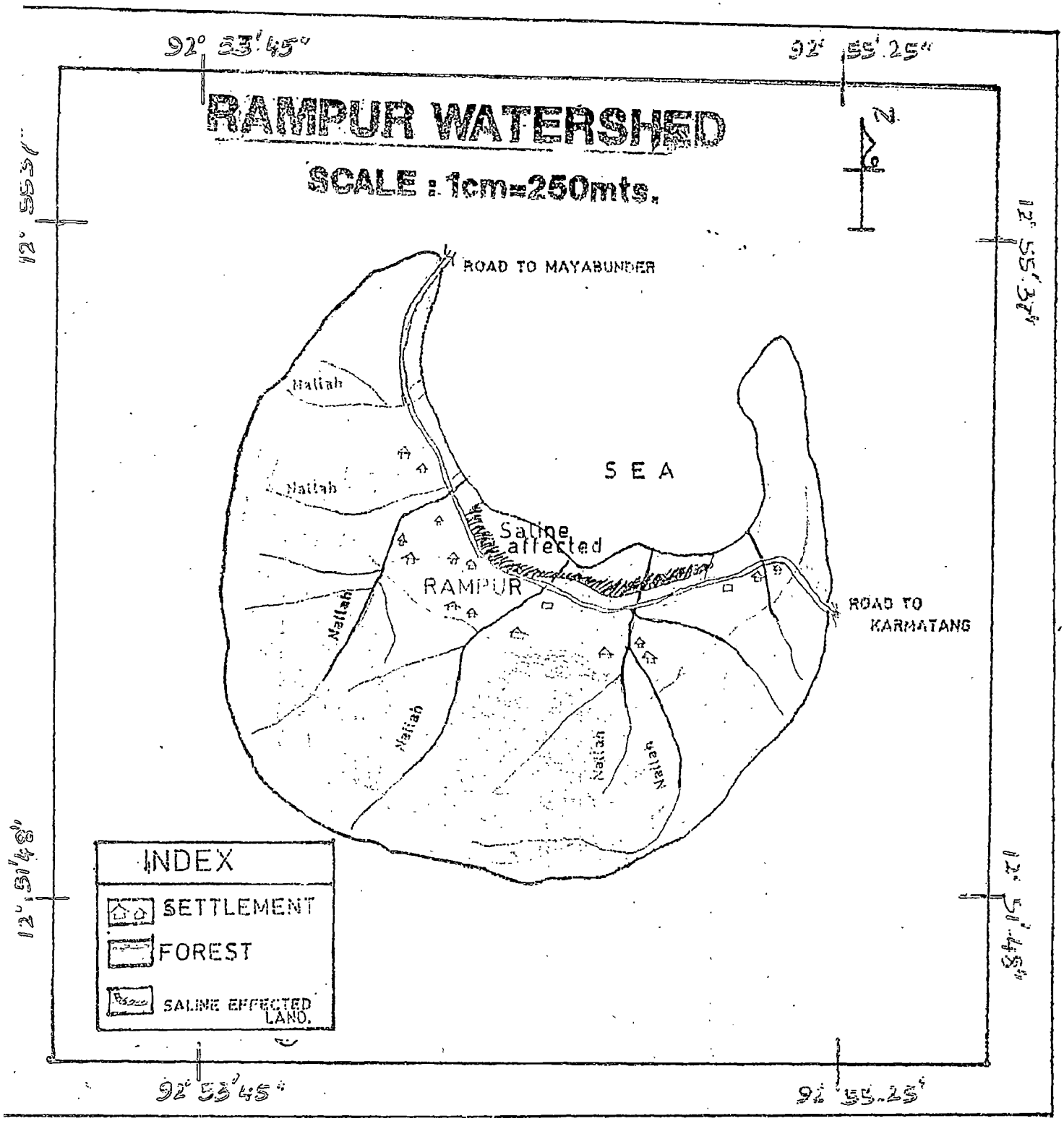
The farmers are mainly East Pakistan migrants and fishermen families. The Andaman trunk Road running through the watershed connects the village to Rangat Tehsil and Mayabunder Sub-Divisional headquarters. Apart from one paddy crop, each house maintains a kitchen garden with banana and other fruit bearing trees as well as poultry and livestock.

Five numbers of minor irrigation ponds in Uttara and 4 numbers in Santanu existed in these villages which have been constructed under loan cum subsidy scheme being extended by the Department of Agriculture.

The area delineated under the project is shown in Fig. 10 and project area detail is given in Table 15.

3.5 MANNARGHAT WATERSHED PROJECT

The project area covers three villages namely Mannarghat, Malapuram, Wright Myo located in Furrargunj Tehsil of South Andaman Island. The watershed is situated about 6 km from Bambooflat Jetty. The geographical location of Mannarghat is between 11°45' to 11°46'45" North latitude and 92°41'55" to 92°42'45" East longitude, situated at an altitude of 0-250 m above sea level. The watershed has a total length of 9 km with an average width of 4.6 km. The


92° 53'45"
92° 55'.25"
RAMPUR WATERSHED
SCALE : 1cm=250mts.
N.
12° 55'37"
12° 55'37"
ROAD TO MAYABUNDER
Nallah
Nallah
SEA
Saline affected
RAMPUR
Nallah
ROAD TO KARMATANG
Nallah
Nallah
Nallah
12° 51'48"
12° 51'48"
INDEX
SETTLEMENT
FOREST
SALINE EFFECTED LAND.
92° 53'45"
92° 55.25"

watershed starts from the edge of the sea, i.e. 0 and rises upto 350 MSL. The Mannarghat watershed village covers an area of 704 ha. Comprising of 499 ha under non arable land 205 ha under arable land. The topography of land is mostly undulating with steep slope from 1 to 35%. The total area of the watershed is 1942 ha. Out of this about 71.2%, i.e., 1199 ha is under tropical evergreen forests and 499 ha is under the revenue forest. An area of 35 ha is not available for cultivation as it is under road, streams and building etc. The balance area of 205 ha are allotted to the farmers for plantation, homestead and housing. As per records, the farmers of the watershed area have been allotted 112.19 ha of paddy land and 92.91 ha of hilly land. About 5.00 ha of land is affected by salinity.

The entire area is under rainfed agriculture. About 14 small stream originated from the hill surrounding the catchment area and flow into the main Nallah. Only a single crop of paddy is cultivated. Apart from this each house maintains a kitchen garden and few families supplement their income by fishing.

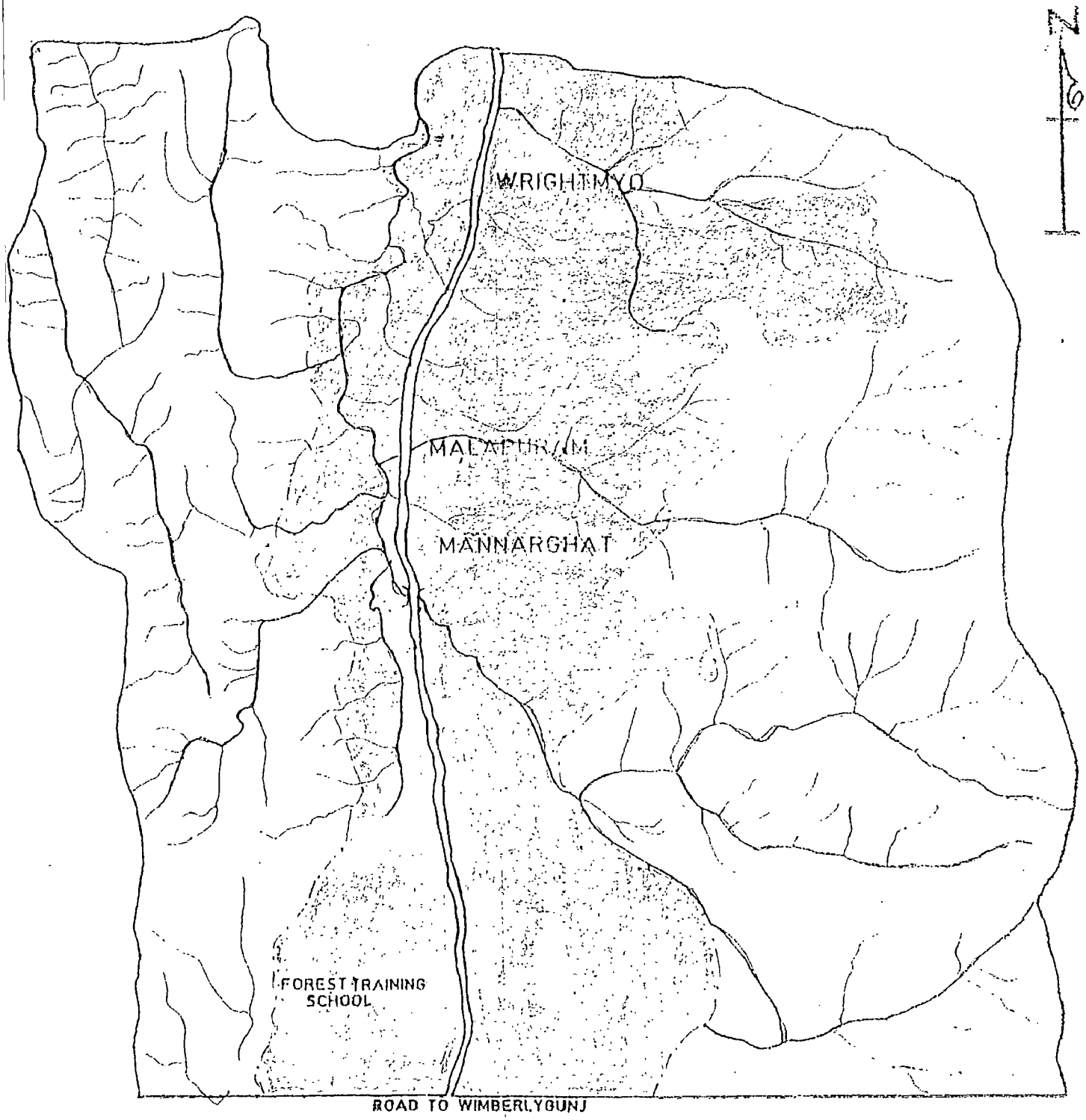
The farmers are mainly Moplahs and Ranchies by origin. The watershed area is well connected by road with Tehsil headquarters. One minor irrigation pond has been constructed in Mannarghat area on loan cum subsidy basis. The water from this is used for life saving irrigation only. A few farmers who have land very close to the stream, irrigate small areas by lifting water from the stream. The drinking water to the entire villages is supplied through pipe line maintained by Andaman Public Works Department.

The area delineated under the project is shown in Fig. 11 and project area detail is given in Table 15.

MANNARGHAT WATERSHED

CONSISTING MANNARGHAT, MALAPURAM & WRIGHTMYO VILLAGES.

SCALE - 1cm = 250mts



INDEX	
REVENUE AREA	
FOREST AREA	

Table 15 : Detail of project commencement, area covered, unit & total cost

S. No.	Description	Watershed Mannarghat	Watershed Uttara	Watershed Rampur	Watershed Ramnagar
1	Date of commencement	June'94	August'94	August'94	Sept'93
2	Geographical area of the watershed (in ha)	1942 ha	888 ha	430.25 ha	4314 ha
3	Area not available for project activities (in ha)	39 ha	35 ha	15 ha	3125 ha
4	Area to be taken under homestead (in ha)	93 ha	201 ha	21 ha	221 ha
5	Effective project are (in ha)	704 ha	498 ha	278 ha	1189 ha
	(i) Arable land (in ha)	205 ha	385 ha	146 ha	458.35 ha
	(ii) Non arable land (in ha)	499 ha	113 ha	132 ha	730.65 ha
6	Unit cost (Rs.)	Rs. 5000/-	Rs. 5000/-	Rs. 5000/-	Rs. 5000/-
7	Total cost (in Lakhs)	Rs. 34.076	Rs. 24.90	Rs. 13.90	Rs. 59.45

(Source : Directorate of Agriculture, Port Blair)

S/o 461

Apart from the 4 completed watershed projects mentioned earlier additional four number of NWDPRA projects are currently under progress which have been taken up during the IXth five year plan. The details of the newly commenced watershed projects is as under :

(1) Karmatang Watershed Project in C.D. Block Rangat, Mayabunder Tehsil (August'98)

(2) Nabagram Watershed project in C.D. Block Diglipur, North Andaman (September'98)

(3) Kadamtala Watershed Project in C.D. Block , Rangat, Middle Andaman (October'98)

(4) Wimberlygunj Watershed Project in C.D. Block, Ferrargunj South (October'98).

NATIONAL WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS (NWDPRA)

4.1 GENERAL

National Watershed Development Project for Rainfed Areas (NWDPRA) was launched by Ministry of Agriculture in 1990-91 in 25 states and two union territories and continues to be implemented during IX plan.

National Watershed Development Project for Rainfed Areas was envisaged, conceptualized and concretized with an Area Development Approach in the field of agriculture and rural devleopment.

The two broadly categorised approach are

(1) Command Area Development : This approach is adopted for comprehensive development of irrigated areas. Availability of water, the most critical factor, is almost assured and intensive production system of specialised nature are practised for maximizing production.

(2) Watershed Area Development : This approach is pursued in rainfed areas where availability of water is dependent on erratic amount, intensity and distribution of rainfall. The diversified and mixed farming systems are practised which include agriculture, forestry, animal husbandry, fishery etc. to overcome the element of risk that prevades in the production system.

This approach has been followed in India since early sixties for sectoral projects aiming at control of siltation in reservoirs or mitigation of floods. However from experience gained and lesson learnt from past showed the microscopic coverage of the problem area, which would take centuries to treat the problem area by the various schemes implemented by Government and Non-Governmental Organisations.

Table 16

Scheme	Year of Start	Period	% problem area covered in 1990
R.V.P.	1962-63	27 years	3.70%
F.P.R.	1983-84	7 years	2.35%
DPAP and DDP	1973-76	15-17 years	5.70%
IWDP	1973-79	27 years	1.00%

(Source : Ministry of Agriculture & Cooperation, New Delhi)

To accelerate the progress the principles of Integrated Watershed Management was adopted as a national strategy for holistic development of rainfed farming systems.

Watershed is a geo-hydrological unit or a piece of land that drains at a common point. This natural unit is evolved through the interaction of rain water with land mass and typically comprises arable, non arable lands and natural drainage lines in rainfed areas. Sustainable production depends on health, vitality and purity of production environment of which land and water are important constituents. For scientific utilization of the natural resource base of land and water, the ideal geographical unit is the product of interaction of rain with land, i.e., the watershed.

The watershed approach aimed at augmentation and stabilization of production and productivity, minimizing ecological degradation, reduction in regional disparity, opening up of greater opportunities for employment of rural poor in the rainfed areas. A similar approach has been adopted for developing the more resource poor areas – drought prone, desert and watersheds – and to provide sustainable means of livelihood to the rural poor in these areas.

A 25 year perspective plan for holistic and integrated devleopment of rainfed areas, prepared by the Planning commission, envisages treatment of about 63 million hectares of land involving an estimated outlay of Rs. 76,000 crores through various watershed development projects/programme. These include the watershed development projects of three central Ministries of Government of India (Agriculture, Rural Development, Environment and Forest) as well as several externally aided projects.

4.2 OBJECTIVES OF NWDPRA : DEPARTMENT OF AGRICULTURE & COOPERATION, MINISTRY OF AGRICULTURE

The project endeavours to achieve the twin objectives of sustainable production of biomass and restoration of ecological balance in the vast tracts of rainfed areas in the country. It specifically focused on :

(1) Conservation, upgradation and utilisation of natural endowments like land, water, plant, animal and human resources in a harmonious and integrated manner. Aiming 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 system.

(2) Generation of massive employment during the project period and regular employment after the project completion for enhancing the employment opportunities in the backward rainfed areas to assure livelihood security particularly for underprivileged sections of the rural population like small and marginal farmers, landless labourers, tribals etc.

(3) Improvement of production environment and restoration of ecological balance through scientific management of land and rainwater. In the process, in-situ moisture conservation, introduction of scientific production systems, network of runoff management structures and devices for recharge of groundwater to ensure enhanced availability of water for human and livestock drinking purposes, domestic consumption, life saving irrigation and raising of appropriate cash crops according to agro-climatic potentials.

(4) Reduction of inequalities between irrigated and rainfed areas. Ultimately, stable production and processing of bio-mass would contribute towards better life in rural areas. This would reduce large-scale migration from rural areas to the cities.

(5) In addition to food, fuel and fodder, the project enhances cash flow to the rainfed farmers and landless agricultural labourers through increased casual employment, marketable surplus of agricultural and dairy produce, growing of cash crops like

vegetables, coriander, cumin, medicinal plants, etc., in suitable areas.

The ultimate objective of the project is to develop the natural resource base, sustain its productivity, improve the standard of living of millions of poor farmers and land less labourers and endeavour for restoration of ecological balance. Thus the goal of watershed based management approach is to evolve models of sustainable agriculture in rainfed areas, which can be replicated on a larger scale in the country in a phased manner.

4.3 APPROACH AND STRATEGY

The approach and strategy are primarily based on the twin concepts of integrated watershed management and sustainable farming systems :

4.3.1 Integrated Watershed Development

Spatially watershed consists of three physical sectors : (i) Arable cultivated lands which are privately owned, (ii) Non-arable lands which includes village pastures and grazing grounds, culturable wastelands and barren and unculturable lands and (iii) Network of natural drainage lines.

These three subsectors are hydrologically interspersed and are treated as one organic geo-hydrological entity for project planning and implementation to ensure sustainable use of natural resources of land and water.

4.3.2 Sustainable Farming System

A typical rainfed farmer derives his sustenance partly from his own cultivated land and partly from common property resources and community lands. In addition, his subsistence to a great extent depends upon livestock resources and off-farm activities like wages by working as labourers on government projects and also by working on the fields of other farmers. In some areas specialised activities like sericulture, bee-keeping, lac cultivation, cultivation and collection of medicinal and industrial plants also supplements the incomes of the farmers. The landless labourers, mostly depend upon

common property resources for fuel and fodder. Thus the project treat the following subcomponents of the household farming systems : .

(i) Food sub-component

(ii) Fodder sub-component

(iii) Fuel sub-component, and

(iv) Income generation component – household production systems

The inter-relationship and inter-linkages among various components and subcomponents of the farming system are analysed and treated as part of one organic unit.

4.4 ESSENTIAL FEATURES OF INTEGRATED WATERSHED APPROACH AND HOLISTIC FARMING SYSTEM APPROACH

NWDPRA is an integrated project based on the full understanding that conservation measures are means and production system are ends. Thus, conservation measures and production systems are adopted both on arable land and non-arable lands.

4.4.1 Production Systems on Arable Lands

Though production system was included in orthodox soil conservation scheme, viz., integrated Dry Farming Project launched in 1972-73. The scheme on propagation of water harvesting/conservation technology launched in 1983-84 and the National Watershed Development Programme for Rainfed Agriculture, in the VIIth plan, the approach and strategy was the green revolution approach characterized by yield maximization through

- high yield varieties
- intensive use of chemical fertilizers, chemical pesticides and insecticides

This approach has succeeded in irrigated areas, where assured water was available. It was adversely associated with :

- reduction of bio-diversity (a few ideal varieties of most suited crops are promoted) giving rise to a tendency towards mono-culture.
- Mechanisation, labour saving devices and reduction/elimination of livestock.

This approach did not work well under rainfed eco-systems where there is no control over water and diversity pervades the entire production environment. Therefore, NWDPRA is promoting yield optimisation/stabilisation approach based on :

- Bio-diversity : Diversified production systems including mixed crops, agro-forestry, agro-horticulture etc.
- Bio-organic farming : More reliance on bio fertilizers, integrated nutrient and pest management systems.
- Recycling and home grown inputs rather than market purchased inputs.

4.4.2 Conservation Technology under NWDPRA

Engineering structure based soil conservation technology aimed at safe disposal of runoff water and control of soil erosion, was inappropriate under SAT (Semi-Arid Tropic) climate with small size holdings of resource-poor farmers who adopted inappropriate orthodox soil conservation methods as :

(a) Technology was costly and complex with limited replication by people.

(b) Breaches of structures were common rendering the system not only ineffective but often aggravated the soil erosion, it was designed to control.

(c) Often structure interfered with agricultural operations and adversely affected crop production due to surface ponding and water logging.

(d) Since there is no transparent economic benefits, farmers did not maintain the structures. On the contrary, many farmers cut the bunds to save susceptible crops from temporary water logging.

(e) Rigid masonry structures weathered and collapsed under exposure to tropical thermohydroregime.

Similarly, water is a most critical factor for rainfed livelihood support systems. Under our agro-climatic condition, the entire rainfall is received within 2-3 months of rainy seasons with high intensity storms, followed by dry winter and summer months. The real hydrological challenge is how to reallocate water in time so that water is available throughout the year to meet vital needs of the people.

NWDPRA therefore relies on soil and water technology built upon the collective wisdom of the local people. Its salient features are :

(a) More reliance on vegetation, viz., trees, shrubs and herbs etc. to control erosion from falling and flowing water and promote in-situ moisture conservation.

(b) Use of organic manures to improve moisture holding capacity of soil, enhance soil-aeration, store water and slowly release it to support plant growth during dry spells.

(c) Adopt traditional sunken devices (dug-outs) for water and silt harvesting to primarily recharge groundwater in wells for storing water for winter and summer months.

(d) The technology attempts to convert surface (run-off) into sub-surface flow (deep penetration) and reduces the velocity and volume of water going outside the watershed.

Thus conservation of both water and soil is accomplished.

4.4.3 Equitable Distribution of Benefits : House Production System under NWDPRA

Soil conservation has been a land-based scheme and benefits accurred in proportion to land held by different families.

Eventually, the marginal farmers and landless labourers were further marginalised and were left behind. Hence NWDPRA promoted the household production/processing systems, which constitute the back-bone of the livelihood support system of the rural poor.

Since landless labourers and small and marginal farmers are exercising increasing pressure on common property resources for collection of fodder, fuel, etc., the strengthening and improving of the productivity of their household production systems would facilitate regeneration of degraded non-arable land.

The household production systems can be broadly classified into following categories :

(a) Small livestock systems :

This include poultry, duckery, piggery, rabbit rearing, goat rearing, sheep rearing, etc.

A package comprising a few birds of improved breeds (5 to 15 birds comprising male and female in appropriate ratio), appropriate housing, initial feed and primary health care is provided under poultry and duckery. Indigenous as well as exotic breeds are promoted as per the preference of beneficiaries and demand of market.

The package under goat rearing comprise 3 to 4 kids (1 male and 2 to 3 females) of improved breeds, bamboo stalls and nylon netting to promote stall feeding and primary health care like deworming, disinfection and use of preventive medication.

The package under rabbit rearing includes 3 to 4 kids (1 male and 2 to 3 females) and 3 low cost cages. One cage is meant for male rabbit. The second for females which have conceived and the third for the females which have not conceived. Primary health care like disinfection and preventive medication is also provided.

(b) Bio-mass/Agro-processing :

This include basket making, rope making, mat making, various handicrafts (wood carving, toy making, etc.), leaf plates and saucer making, oil extraction (improved ghani), cottage scale food processing (pickles, jams, jelly, etc.), improved looms, pottery and ceramics.

The package under the basket making and rope making include supply of tool kits and initial cost of raw materials.

With the emphasis of household production system towards inter-locked and inter-related activities to watershed development with backward linkages, the raw materials required for rope making and mat making like sissal and grasses are planted in the watershed as conservation/production flora. Similarly for making leaf plates and saucers, the appropriate species like Dhak, Mahuwa, Shal and other appropriate flora are planted and promoted.

(c) Service Sectors

This include carpentry, black smithy, tool kits for castration by para-vets (Gopals), plant protection equipments like sprayers, dusters, etc. to selected and promising literate/school drop-out boys/girls.

The package under carpentry and blacksmithy include the supply of improved tool kits and some working cost for raw materials.

(d) Other Household Income Generating Activities

This includes bee-keeping, sericulture, mushroom cultivation, production of bio-fertilizers etc.

The package under bee-keeping, activity include the cost of bee-hives, bee-boxes, initial cost of bee colonies of improved species and cost of bottles for packing of produce. One honey extraction machine is given to a group of 5-7 bee-keeping families.

To envisage the inter-locked and inter-related activities to watershed development with forward linkages, need based vocational training/advance training programme are arranged for the groups/individuals who are expected to take up some activities like training in mushroom cultivation, bee keeping, sericulture etc.

4.4.4 Survey and Projectisation

For the study of project impacts adequate scientific data base and proper documentation is required, NWDPRA provides for integrated survey, including :

(a) Hydrological survey

(b) Land resources survey

(c) Vegetation resources survey

(d) Livestock resources survey

(e) Socio-economic survey

(f) Infrastructural survey

A financial provision of 1 to 2% of funds are allocated for conducting surveys and a provision of 10% of the project cost is provided for survey and projectisation for procurement/replacement of all types of survey equipments and materials and also for proper documentation of the data so that a techno-economic basis is developed for future project planning.

4.4.5 Composite Nurseries

In the watershed area, it is very important to provide suitable combination of grasses, herbs, shrubs and trees. The herbs and grasses check soil erosion by both falling and flowing water during rainy season. The shrubs intercept falling rain water to some extent, whereas rainwater is mainly intercepted by the canopy of trees which later drips off to the ground below in large drops with great erosive force.

The main features of composite nurseries are :

(a) Nurseries would produce planting materials for horticultural, forestry, medicinal and aromatic utility and cottage industry material, flora for use in the watershed and adjoining areas.

(b) Seeds/planting materials of grasses and shrubs would be multiplied for use in project and surrounding areas.

(c) Serve as testing ground for evaluation and screening of exotic flora.

(d) Serve as field laboratories for working out production techniques for local grasses, shrubs and legumes.

(e) Serve as crop cafeteria for different varieties of crop plants – improved and local.

(f) Training facilities for mushroom cultivation.

(g) Fish hatchery facilities, wherever appropriate.

(h) A museum of local farming systems through models, charts, samples of crops, fruits, vegetables, birds, animal breeds, etc.

(i) A meeting group for farmers and field worker interaction.

(j) Serve as a model site for water resources utilisation, recharge ponds, wells and recycling as sustainable technique of rain-water management.

(k) Site for meteorological observatory for documenting climate parameters, viz., rainfall, evaporation, E.T. sunshine, wind velocity, temperature, etc.

The composite nurseries are managed and operated by the Self-Help Thrift Groups (SHGs) after some initial training and 'hands on' experience in an operating nursery. Voluntary agencies can approach the people namely by organising training of farmers, land less labourers, school drop-outs and women in the basic knowledge of nursery techniques and organising them into Self-Help Thrift Groups. A group of 5-6 and upto 10 local families can be selected and promoted to constitute a Self-Help Thrift Group. To ensure that the 'SHG's' running these nurseries may later on become self reliant, Self-Help Groups may also be motivated to form Self-Help Thrift Groups so that they can develop the saving habit, each family contributing the same amount to the common kitty on a weekly/monthly basis. A group account is opened in the nearest Bank with the President and Secretary of the Group, elected for a one year term, operating the account on behalf of the Group. After the Self-Help Thrift Group has been in existence for about six months or more, the Bank would be in a position to extend loan upto four times the savings mobilised by the Group.

The step-by-step transfer of the nurseries to Self-Help Groups in a phased manner is detailed as under :

(a) In the first year, members of nursery Self-Help Groups are paid wages and advised to make some savings.

(b) In the second year, one fourth of the nursery area is allotted to SHG to raise planting materials by utilising their savings under buy-back arrangement. All infrastructural facilities such as watering tools, etc. are

supplied to Self-Help Groups.

(c) In the third year, one-half of the nursery area is allotted to SHGs who would raise planting materials from their savings and profits earned in second year.

(d) Similarly, three fourth area is given to SHGs in the fourth year.

(e) In the fifth year, Self-Help Group would have acquired the skill and accumulated savings to produce planting material under pay-back arrangement.

(f) During and after the project period, the SHGs produce and sell planting materials of trees, vegetables, flowers etc., on commercial lines within and outside the watershed.

Thus composite nursery lay a foundation for greening the rainfed areas on a continuing basis.

4.4.6 Energy Conservation and Renewable Energy

In a watershed, biomass conservation, production and controlled use, without coming in conflict with ecology, can improve canopy cover, help minimise erosion hazards by checking soil, water and nutrient losses, serves as a potent source of fuelwood, fodder, fibre and fertilizers. Under the biomass production and integrated nutrient management programme component of NWDPRA these activities are adopted on priority by

(a) Fuelwood plantation : Involves growing agro-climatically suitable and multipurpose fuelwood trees especially in the upper reaches of non-arable lands, community and waste lands. Multi-purpose fuelwood plants suitable for rainfed/watershed areas are Acacia, Albizza, Leucaena, Parkinsonia, Casia, Prosopis and Ablers.

(b) Biogas Plant and Use of Biogas Slurry : Biogas technology makes best possible utilisation of cattle dung and other organic wastes for producing

clean cooking fuel. Biogas saves considerable amount of non-renewable energy, indirectly checking deforestation, helps reduce drudgery and protect environmental degradation.

(c) Renewable Cooking Energy System : The development of energy efficient cooking and dehydration devices such as improved type of biogas burner, biogas stove, smokeless Chulha, solar cooker and dehydrator saves the conventional/renewable fuel, keeping the environment clean, reduce drudgery, help preserve high-value crop.

(d) Conservation of Terrestrial and Aquatic Weeds as Biomass : Wild and semi-wild terrestrial hardy and aquatic weed species can be conserved to add biomass to arable and non-arable farming systems in rainfed areas. It includes the use as manure after composting as feed-stock to biogas plant (e.g., water hyacinth) and mulching as a soil conservation measure for gully plugging and drainage line treatment etc.

4.4.7 Farming Systems Approach

Indian agriculture is predominantly rainfed covering about 68% of the cropped area, contributing 40% of the total food grain production of the country.

To circumvent the possibility of total crop failure and economic losses the 'Farming System' envisaged an integrated farming system approach including a blending of diversified and mix farming consisting of crop husbandry, agro-forestry, dry-land horticulture, pisiculture (including fish farming) livestock, pasture and fodder development.

Multiple Cropping System and Diversified Cropping Systems

The components of multiple cropping systems are :

(i) Mix cropping : growing a number of crops in the same field in one season.

(ii) Inter-cropping : growing one minor crop, generally leguminous with one major crop, generally cereals (prominent in arid, semi-arid and sub-humid zones).

(iii) Strip cropping : growing a few rows of erosion resistant and erosion-permitting crops in alternate strips on contours or across the slope. Crop mix usually involves grasses, legumes, cereals, short-duration horticultural crop.

(iv) Relay cropping and crop rotation : while the former system entails growing different mono-crops sequentially and spread over 2-3 seasons in a year, the latter also follows the same system and pattern only with replacement of previous year's crops with other crop in subsequent year(s).

Diversified cropping system includes the mix of trees, shrubs and herbs and the components of this system are :

(i) Ally cropping : Essentially a tree cum crop farming system

(ii) Ley farming : crop cycle includes a period of pasture development, preferably with a mix of grass and legume fodder.

(iii) Agri-horticulture : A mix of crop husbandry and growing short and/or long duration horticulture crops (viz., fruits, vegetables, spices, floriculture).

(iv) Silvi-pasture : a mix of growing multipurpose forest tree spices (fast growing) with pasture (preferably grass and legume mix) to provide fibre, fuel, fodder, forage and timber.

NWDPRA promote a diversified plant mix on arable lands including annual crops (mixture, inter cropping, double cropping) duly fortified with agro-forestry and rainfed horticulture in a mosaic pattern and not as a block plantation of commercial elite trees. Trees all over the watershed in tune with soil and moisture regime and not in blocks in limited areas to generate ecological impacts. Since isolated trees/cluster of 2-5 trees have vigorous growth as compared to block planted orchards.

In addition to above, promotion of holistic farming systems is adopted which include animal husbandry, household production systems, consisting of small reminants, poultry, duckery, bee-keeping, sericulture, basket making, rope making, poultry, carpentry, etc. as explained earlier. Also production in non-arable land is undertaken by cultivating fibre, fodder, fuel, fruits, medicinal and aromatic plants etc. The flow chart showing the activities under integrated rainfed farming system is indicated in Fig. 12.

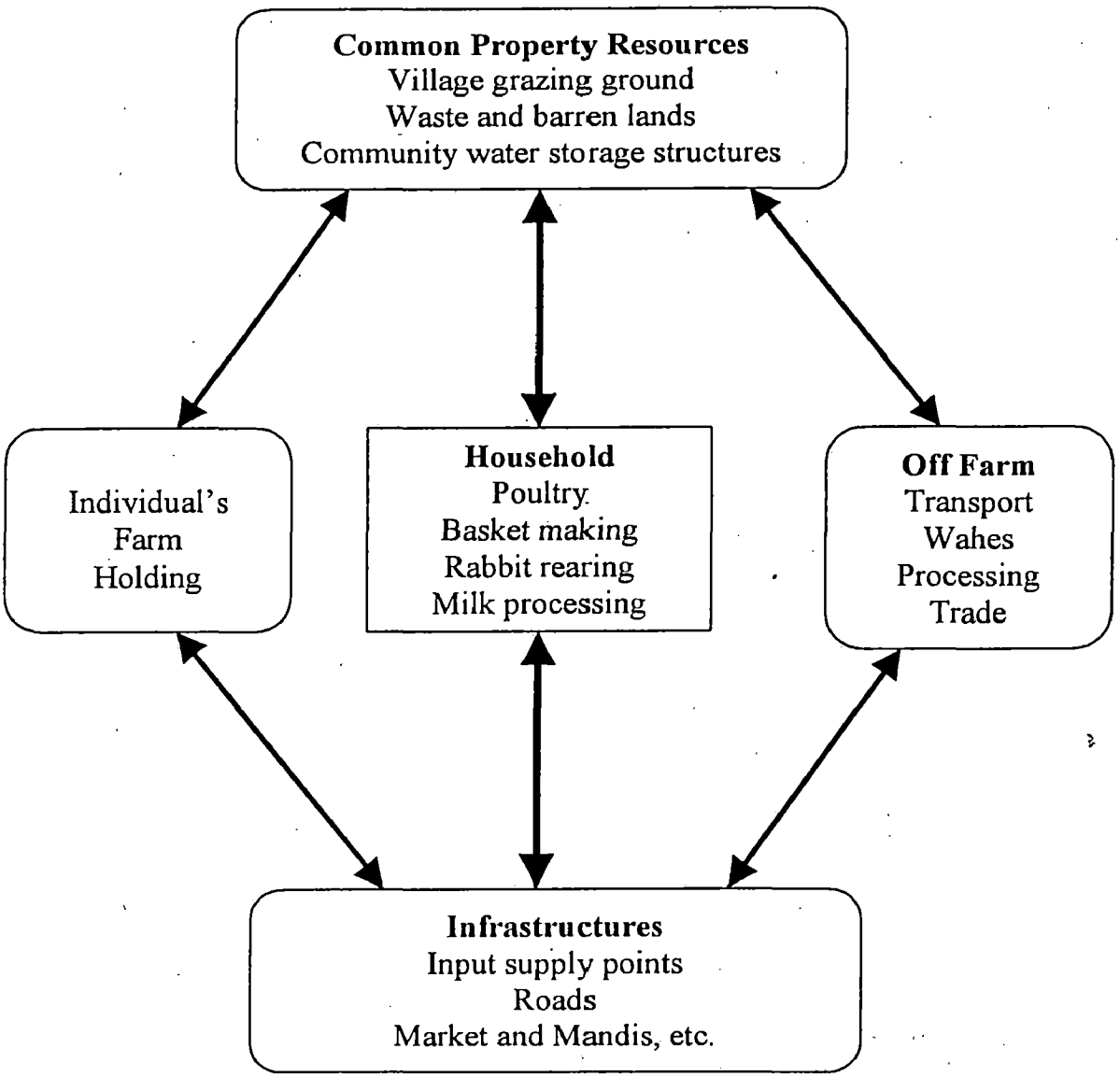


Fig. 12 : Integrated Rainfed Farming System

4.4.8 Organic Farming Integrated Nutrient and Pest Management

Under the project the activities related to horticulture, livestock, etc. and other subsidiary income generating activities, etc. generate bio-mass for production of organic manures. Managing the organic resources is cheap and easy and involves no risk factor when compared to agro-chemicals. Besides supplying essential plant nutrients, effects of organic manures on physical and biological properties, help in conservation of moisture in the rainfed areas.

Integrated Nutrient Management (INM)

NWDPRA adopts agricultural production in arable and non-arable areas in watersheds which requires to be stabilized with regular supply of required quantity of plant nutrients. Since the agro-chemicals are costly and often inaccessible in remote areas, its indiscriminate use has also inherent ill effects. To overcome this organic manures are used to improve physical properties of soil which in turn increase water holding capacity of soil.

The management of organic sources in rainfed areas involves utilisation of :

(a) Bio-mass generated in arable as well as non-arable area.

(b) Livestock wastes – with proper collection and compost making.

(c) Poultry manure – Organic wastes of poultry, duckery, piggery, etc. are collected, decomposed and used.

(d) By-products of other household production activities like carpentry, toy making, leaf plate making, home scape, food processing units, oil cakes, etc.

(e) Aquatic plants and tank silts.

(f) The use of green manures, by growing leguminous crops for their nitrogen-fixing potential and for generating in-situ biomass.

(g) Bio-fertilizers is more relevant amongst the farmers of rainfed areas since they grow crops instead of green manures with a view to cultivate with uncertain rains. Bio-fertilizers are cheap and available with bio-fertilizers production units in

the states. The microorganisms such as Azotobacter, Azospirillum, Rhizobium and Frankia are used as nitrogenous biofertiliazers whereas, Myocorrhibizae and P-solublizer as phosphatic biofertilizers.

Integrated Pest Management (IPM)

In rainfed area, the protection of crops and farm produce from pests is of prime concern. Integrated pest management (IPM) is a broad-based ecological concept of pest and weed control employing methods namely cultural, mechanical, biological and chemical in a compatible manner to keep pest and weed management below the economic injury level and help minimize the environment pollution due to chemicals.

The potential management activities are multifarious, which can be classified as under :

(i) Natural control, including the release, enhancement or application of parasites, predators and pathogens.

(ii) The deliberate adoption of pest resistant crop varieties. This has been most successful in the case of disease resistance.

(iii) The strategic application of suitable pesticides in the correct manner, and at the correct time.

(iv) A range of other management option – such as deliberate selection of a time slot for sowing a crop (to ensure a pest is avoided), light trapping (to remove reproductively active insects), deep cultivation (to bury disease propagules, weed seeds, or to damage or expose soil insects to bird predation), and various patterns of intercropping or multicropping that are known to optimise natural control.

4.4.9 Drainage-Line Treatment and Rain-Water Management

Since water in rainfed area is in the form of rainfall it is the most critical factor of rainfed livelihood support system. High intensity storms of undulating and denuable trend generate tremendous runoff and consequent loss of water resulting in active water

scarcity.

The traditional rain-water management is supported from the village ponds which collect water flowing from the inhabited areas. Further, a number of ponds/dug-outs, sunken devices constructed all along the land accumulates collected surface flow. These structures/devices, convert surface flow into sub-surface flow and recharge the network of wells. The indigenous system is in tune with hydrological assets of different rainfed areas in the country. Whereas the soil conservation systems involving heading type of water harvesting structures like bunds, dams, dikes, etc. are meant for safe disposal of runoff at non-erosive velocity and not for water conservation.

The drainage line treatment under NWDPRA builds upon the integration of indigenous and traditional system of rain-water management through sunken device and network of recharge wells. Thus, instead of safe disposal of water outside the surface the effort is made to hold water below the soil surface in the network of wells for future use in winter and summer.

4.4.10 Promotion of People's Participation through NGOs, MKMs and Self-Help Groups

Government system is efficient in book-keeping, accounting and technology, whereas NGO system is good in organising and inspiring the people. The later also possess dedication and commitment for social service. The local people have cumulative wisdom, skills and knowledge of the production environment encompassing land, water, vegetation, etc. Sustainable development takes place when all these players, viz., Government, NGO and Watershed Community join hands with the object of enabling the local communities to organise themselves and develop self-help culture.

A tripartite Memorandum of Understanding has been evolved involving Government, NGO and Watershed Community as detailed in Annexure I.

Watershed Community is represented by a group of five Mitra Kisans, two of them will be landless labourers. One of whom would be called as "Gopal" and will

represent the interest of livestock management, the other will be artisan who would represent the village service sector. Out of other three Mitra Kisans, one will be a progressive farmer and two of them would be women; of whom one wil represent women in agriculture and the other represent the household production system. Thus a watershed which usually constitute 5-6 villages, will identify 25-30 Gopals and Mitra Kisans. This group of 25-30 persons is known as Mitra Krishak Mandal.

The responsibilities of Mitra Krishak Mandals are :

(a) to organise from time-to-time different training courses for farmers, livestock rearers and artisans.

(b) to help formulate different programme contents from time-to-time and to resolve conflicts.

(c) to review progress in implementation of watershed development programme.

(d) to evaluate the impact of different components of NWDPRA.

(e) to render needed assistance and guidance in formation of Self-Help Thrift Groups to accelerate the pace of implementation of different programme, through active participation of such groups. Hamletwise Self-Help Groups may include husband and wife, whereas self-help groups for women should also specifically be formed to carry out women oriented activities.

(f) to play a pivotal role in carrying out market surveys and help promote marketing of the surplus agro-horticultural produce of water shed areas in order to provide market outlets for farm produce.

4.4.11 Use of Sumangal Diary (Farmers' Pass Book)

In NWDPRA, it is envisaged that every farmer beneficiary of a micro-watershed project should possess a pass book and the same is given the name of Sumangal Diary which would have a record of all the benefits the farmer is likely to derive from the micro-watershed project as well as various achievements made by the farmer under the

project. For landless agricultural workers, the work done by them could be grouped activitywise, particularly on the common lands so that the sumangal diary of landless persons would be in groups of such beneficiaries according to the specific activity they would be engaged while developing the Common Property Resources (CPR). This is given the name Beneficiary Index Card. Use of Sumangal Diary/Beneficiary Index Card, facilitates monitoring by farmers/beneficiaries themselves. Both serve the purpose of Identity Card-Cum- record of activities/benefits realised by individuals in a given micro-watershed. It serves many purposes as detailed below :

(a) a source of benchmark data

(b) a record of activities under NWDPRA and progress at farmer's level.

(c) a monitoring device for WDT inspecting team to measure change/improvement over time.

(d) a self-monitoring and assessment tool for beneficiaries.

(e) a device to identify, discuss and solve problems at farmer's level and tool to measure the performance of other line departments.

(f) a source of data for evaluation teams and

(g) a development device to build awareness among farmers.

(h) the maintenance of Sumangal Diary/Beneficiary Index Card will ensure that assistance of not more than Rs. 5000/- in the entire project will be provided to any farmer beneficiary. The Diary is filled by PG apprentice, WDT leader, other concerned agencies and inspecting officials on relevant pages as indicated in the diary (Annexure II). Periodic review of the card provides information about changes occurring in the life style of the people.

4.4.12 Research, Training and Festival Under NWDPRA

Nominal provision has been made for research for the following purposes under NWDPRA :

(a) on site testing

(b) observation etc. to be taken up by scientists of the State Agriculture University/ICAR Research Centres

(c) provide mobility, incentives, inputs and equipments, stationery and publication support for such on site research in the selected watershets located in the vicinity of research centres.

The nodal agencies for farmers trainings are the KVKs (Krishi Vigyan Kendras), the FTCs (Farmers Training Centres), the regional research stations and other such centres where farmers training facilities are available.

The three-day institutional training programme apart from concentrating on crop production also involves on management of community assets and common property resources and give an overview of the integrated farming system which is nearer to the reality of the farming situation. The broad parameters of the three day institutional trainings are as follows :

(i) First day : Concept of integrated farming system approach, analysing interdependence of private and common property resource, etc. Problems of the micro-watershed as a whole.

(ii) Second day : Management of cultivated lands to maximize production, both crops as well as allied agricultural activities.

(iii) Third day : Optimal management of common lands including village forests, pastures, grazing lands, etc. Other activities like animal husbandry, dairy, poultry, fisheries, etc.

Under optimal management of common lands Mitra Kisans are trained about agro-forestry in the three-tier management of common lands to cover three kinds of vegetation depending upon the type of common lands for optimum promotion of animal husbandry and vegetation.

(i) Grasses for sheep which graze

(ii) Shrubs for goats which browse and

(iii) Trees as resources of fodder for stalled animals as well as fuel and fruits for humans.

Apart from the 3-day institutional training programme, the training programme for grass-root level project functionaries in contact with WDT leaders at Block level and District level and nodal officers on the approaches, strategies, guidelines, technical contents as well as various programme measure of NWDPRA is also organised. The 6-day comprehensive training courses for the Mitra Kisans/Soil Conservation Inspectors/Sub-Inspectors/Agriculture Development Officers, etc., at the Block/Watershed levels broadly cover the following topics :

(i) Watershed approach and understanding of NWDPRA

(ii) Three-day institutional training programme

(iii) Projectisation

(iv) Use of Sumangal Diary

(v) Farming system approach

(vi) Household production system

(vii) Management of common property resources

(viii) Establishment of composite nurseries

(ix) Drainage line treatment and rainwater conservation

(x) Organic farming and integrated nutrient and pest management.

(xi) Energy conservation and Renewable Energy Development

(xii) Promotion of People's participation through NGO, MKM and Self-Help Thrift Groups.

(xiii) NICNET reporting system

(xiv) Field visit, audio-video sessions and group discussions.

Watershed Lamp Festival (Jalagam Vikas Deep Yagna) of each micro watershed under the NWDPRA is organized at the Baramati Chetna Kendra each year on any two consecutive convenient dates. The objective is that for successful implementation of the programme through utilisation of every drop of rain water for supporting agricultural and

allied farm activities, each member of the watershed community has to actively participate, this is achieved through a peoples awareness programme called "Water Lamp Festival" with the assistance of volunteers of Yug Nirman Mission, Shanti Kunj, Haridwar (Uttaranchal).

On the first day in every village of watershed, draft village level developmental plan is prepared in consultation between Mitra Kisans and distributed, explained and discussed and suggestions received in the process are suitably incorporated in the draft before giving it a final shape. In subsequent years this day is utilized to review the progress over the previous year and shortcomings thereon in planning for the next year. Thereafter the first day is spent in collecting water and soil samples from places/spots of all religious/faith, beliefs, wells in village to symbolize auspicious 'life-giving bond', which is the essence of the lamp festival under NWDPRA. Fifty male and fifty female from village comprising the watershed who will participate in the lamp festival on the following day at the Barani Chetna Kendra is selected on the first day by common consent.

On day two, the festival commence from mid-day onwards by initiating a discussion on the village development plan already distributed. After the deliberations, a consensus on the plan is reached by the project level functionaries and Mitra Kisan a detailed preparation and realistic project plan for the concerned watershed for future emerges. In subsequent years, this time is utilized for review of progress made as well as for planning for the next year. The ceremony of the Lamp Festival is then conducted by the volunteers of Yug Nirman Mission.

4.4.13 Project Review, Inspections and Monitoring System

For ensuring effective implementation of NWDPRA a standard system has been evolved which includes systematic and periodical evaluation of the progress made in physical and financial achievements by conducting state level reviews, followed by Regional and National Level Reviews. The standard guidelines for Intensive State Level

Review of the NWDPRA has been developed together with prescribed format for monitoring and review of Physical and Financial progress. A copy of the same is appended as Annexure III for reference.

A computer based monitoring system has been developed by the National Informatics Centre and Ministry of Agriculture in order to :

(a) help the supervisory officers at the District, State and Central levels to monitor the progress in implementation of watershed development plans.

(b) to provide the authorities with data management and decision making support for effective management and monitoring of project.

(c) using this system, the authorities may identify critical activities not receiving required attention and take corrective action.

Based upon information requirements, their sources and frequency of information transfer, the data items were grouped into four proformas, shown in Table 17 below :

Table 17

Proforma	Reporting Officer	Frequency	Data Entry at
Block Quarterly	PG Apprentice/ WDT Leader	Quarterly	NIC District Centre
District Quarterly	District Nodal Officer	Quarterly	NIC District Centre
State Quarterly	State Nodal Officer	Quarterly	NIC State Centre
Block Annual	PG Apprentice/ WDT Leader	Annual	NIC District Centre

The formats of the reports are annexed as Annexure IV for reference. The format/performa for recording the activities under livestock development component of NWDPRA is appended as Annexure V to VIII.

Chapter 5

METHODOLOGY

The project at hand are the ones which were implemented by Department of Agriculture, A & N Islands, from VIIIth plan onwards under the National Watershed Development Programme for Rainfed Areas, namely the Manarghat Watershed Project, South Andaman, Uttara Watershed Project, Middle Andaman, Rampur Watershed Project, Middle Andaman and Ramnagar project, North Andaman.

The aim of the study involves

(1) The processes of identification, demarcation and selection of watersheds.

(2) The formulation, implementation, extent of people's participation and partnership with officials of watershed development.

(3) To examine the technological options, cost effectiveness and other technical aspects of watershed development.

(4) To assess socio-economic and environmental changes within qualitative and quantitative terms and its impact on the beneficiaries of the project area.

Information and data relating to the study were collected from primary and secondary sources. The data on primary sources were collected from beneficiaries and secondary data/information were collected from reports, literature and government sources.

The format used for obtaining information form the beneficiaries on socio-economic, agricultural production, farmers' reaction to the scheme is shown in Annexure IX.

5.1 GENERAL

The basic characteristics of a watershed is as follows :

Physiography

(a) Size : The size or area of watershed is an important parameter in determining the peak rate of runoff. The rate and volume of runoff increases with increase in size of the watershed area.

(b) Shape : Long and narrow watersheds are likely to have longer time of concentration resulting in lower runoff rates than square watersheds of the same size. The longer it takes water to leave the watershed, the more the opportunity for the water to infiltrate in the soil.

(c) Land Slope : The speed and extent of runoff depends on slope of the land. The velocity of flow of the runoff water increases with increase in the land slope. The erosive capacity of runoff varies in direct proportion with the slope of the land on which the runoff occurs. Thus, soil erosion also increases with increase in the land slope. The land use is also determined by the slope.

(d) Drainage Density and Pattern : High drainage density watershed drains runoff water rapidly. Drainage pattern is influenced by the slope, lithology, structure, distribution of rock systems, etc. The coarser the drainage texture, the higher the conductivity. Thus erosion hazards are very severe in dendritic and radial drainage patterns and very less in trellis, rectangular and annular drainage patterns.

Land Use

The land in a watershed has to be used for numerous purposes like cultivation, livestock production, housing, water harvesting, etc. The land use affects rates of runoff, infiltration and types and quality of vegetation. Suitable land use minimizes the soil erosion and reduces the runoff.

Edaphic Conditions

The soil and geology of the watershed determines the infiltration of water, percolation of water, runoff and soil erosion. Planning of watershed management thus

involving the mechanism through which plants feed from the soil, and the conditions that should be satisfied so that the soil can adequately feed the plant.

Vegetative Cover

The type, quantity and quality of vegetative cover in watershed influences runoff, erosion and sediment production, rate of evaporation and infiltration rate. The vegetation intercepts delays precipitation which prolongs the period of rainfall at the ground surface and tends to increase infiltration into the ground. It also protect and shade the soil, i.e., the leaves reduce raindrop velocity and roots anchor soil particles.

Vegetation thus shields the surface from impact, by roots opening channels in the soil for transmission of water, by falling leaves becoming a mulch on the soil surface and through the process of transpiration creating moisture deficiency or storage potential.

Rainfall

The amount, frequency and intensity of rainfall determines the behaviour of watershed. Evenly dispersed rainfall is less damaging to soil and water than sudden, sharp showers.

Thus higher precipitation amounts to greater runoff, greater evapotranspiration and greater percolation. Higher precipitation intensities amounts to greater runoff, lower evapotranspiration and lower percolation.

Longer precipitation duration amounts to lower runoff, greater evapotranspiration and greater percolation, and

Greater areal extent of precipitation amounts to greater runoff, greater evapotranspiration and greater percolation.

Socio-Economic Factors

(a) Demographic profile : Total population of the area, sex-age-ethnic group stratification, location and occupation of the population, migration, future demographic trends decide the behavioural characteristics of watershed.

(b) *Sociological stratification* : Caste, lineage, families, lines of authority, heterogeneity, political organization, groupings, social status and political role of individual members, relations between members, spatial distribution of the community and CPR modify the watershed characteristics.

(c) Farm structure : Area of farm, number of farm workers, diversion of labour on farm, collective/individual farming, traditional cropping area, agricultural techniques, land management systems are important factors affecting the watershed.

(d) Attitudes and Behaviour : Attitudes, aptitudes and behavioural patterns, value systems, belief systems may also play an important role in the performance of the watershed.

(e) Land tenures systems : Land holding sizes, dominant classes, land holding classes and castes, methods of land acquisition, alienation of land rights, relationship between land rights and social, political or religious systems, land leasing, share cropping, marketing system of agricultural produce affects watershed functioning.

Design of Peak Runoff rate

Peak run-off rate for a watershed has to be estimated as watershed operations and treatment would depend upon it. For the design of hydrologic structures, quantitative estimates of peak runoff and volumes are to be worked out.

Organisational Structure

People's participation in watershed operation is a crucial feature which can develop watershed in a holistic and integrated fashion. The ideal size of the micro-watershed in which community can be organised effectively, could be between 400-500 ha. The organisation should be capable of integratiing backward, forward and vertical linkages. The Water Development Committee (WDC) consisting of representatives of the community could execute and implement the plan at micro-watershed level.

5.2 SURVEYS FOR WATERSHED PLANNING AND PREPARATION OF BASE MAPS

It is essential to collect information on the basic resources of the watershed, present level of productivity, production problems and the needs of the watershed and potential of the area based on which suitable measures and practices can be recommended for achieving effective soil conservation and rain water management, crop production, forest and pasture development, animal husbandry, pisciculture and sericulture which are the major components of the watershed programme:

5.2.1 Land Resource Survey

(1) General Description

(a) Location : Indicate latitudes and longitudes, elevation, village(s), district, state and distance from the nearest important town.

(b) Extent : area in hectares

(c) Climate : The information collected include :

(i) Rainfall amounts and its daily, weekly, monthly and yearly distribution

(ii) Rainfall intensities, duration and frequency

(iii) Temperature (max. min and mean) : daily, monthly and yearly

(iv) Open pan evaporation

(v) Wind velocity and direction

(vi) Bright sub

(d) Physiography and drainage : Shape of the watershed, length of the major stream, watershed relief, drainage pattern, etc.

(e) Geology and soils

(f) Major vegetations

(2) Preparation of Base Map

The watershed boundary is located by looking at the contour map of the watershed area. The various land features are traced from toposheet. The base map are drawn to the scale in which revenue maps are prepared to show farmers' fields by survey numbers. For this, the watershed map traced from topo-sheet is enlarged to match with the scale of revenue map. All other information such as soil and land use capability, present land use and proposed land use are shown on this base map.

(3) Engineering and Topographic Surveys

To save time, money and human resources required for intensive or detailed engineering surveys, the topo-sheets prepared by the Survey of India are used. The Survey of India give details of all permanent land features such as roads, rail lines, village sites, forests etc. from the contour lines the slope is determined. Where soil and water conservation structures are constructed, grid surveys for obtaining contours at shorter vertical intervals as well as longitudinal section and cross section surveys are done.

(4) Soil and Land Use Capability Survey

Scientific land use plans are prepared based on land use capability classification in which the lands are classified according to its capability to produce. The detailed soil surveys are done to get the soil series, texture, soil depth, occurrence of hard pans, slope, erosion and stoniness, permeability, soil reaction (pH).

For assessing the land productivity organic matter content and content of essential plant nutrients in the soil are determined.

(5) Present Land Use and Agriculture

Data on the areas covered under agriculture (rainfed and irrigated), horticulture, grass lands, forest lands, waste lands (arable and non-arable) and miscellaneous land use such as buildings, roads, rail lines, gullies and nallah courses, water bodies, etc. are collected and shown on a map. The average yields of principal crops, cultivation practices followed, fertilizer use along with major crop production problems under different categories of land such as agricultural land, horticultural land, grazing land, forest land and waste lands, etc. are also recorded.

5.2.2 Water Resources

(1) Perennial streams and spot gauging of low flow and sediment.

(2) Water requirement in terms of crop calender and crop growth factor, potential evapotranspiration and effective rainfall.

(3) Existing water supply schemes.

(4) Water quality determination

(5) Present and projected human and animal water requirement

(6) Wells and spring development sites, ground water table.

(7) Pond sites

(8) Water budgeting for the watersheds so as to bring out the potential for water resource development.

5.2.3 Human Resources and Socio-Economic Survey

(1) Population characteristics – adults (male and female), children, no. of families, literacy levels, nature, customs, etc.

(2) Profession

(3) Socio-economic conditions and per capita income.

(4) Landownership, tenure etc.

(5) Employment status and migration patern.

(6) Outside jobs

(7) Community activities

(8) Distribution and size of land holdings (Marginal : 0 to 0.5 ha, small : 0.5-1.0 ha, medium : 1.0 – 2.0 ha, large : above 2 ha.

5.2.4 Livestock Resources

(1) Herd projection (cows, buffaloes, bullocks, sheep, goat and poultry)

(2) Market outlet for milk

(3) Available fodder resources

(4) Upgrading of local cattle jerseys.

(5) Comparative performance of the cross-breeds and local cows

5.2.5 Infrastructure

(1) Existing government organisational structures.

(2) Staffing pattern of the departments

(3) Government development programmes on health, education and energy.

(4) Market outlets, road, communication, etc.

(5) Panchayat systems

(6) Extension activities and effectiveness

(7) Cooperative societies and their effectiveness

(8) Credit facilities

(9) Private voluntary organisations

(10) Supply of agricultural inputs (HYV seeds, fertilizers, pesticides and fungicides, implements) including system of distribution and distance of input stock.

(11) Voluntary agencies

(12) Watershed management committees/cooperatives or other watershed bodies.

5.2.6 Industries

(1) Cottage industries

(2) Major industries

(3) Minor industries – indicate location, type, raw material, inputs, outputs and employed persons.

These surveys are held in understanding the problems, identifying the needs and assessing the potential for scientific planning of the developmental programmes on a watershed basis. The maps that are required to be prepared and attached with the watershed master plans are location map, topographical map, soil survey and land use capability classification map, present land use map, proposed land use plan.

In order to assess the impact of watershed on the user beneficiaries of the project a sample of 30 beneficiaries from all villages covered under the project were selected through stratified ransom sample techniques.

Considering the integrated nature of efforts of watershed development approach the study process took into account the major project activities and approaches under the project.

5.3 SOIL & WATER CONSERVATION AND VEGETATIVE BARRIERS IN WATERSHED DEVELOPMENT

The basic activity was for promotion of moisture conservation. Alongwith the soil moisture conservation, measures on environment friendly, scientifically sound methods for increasing the productivity of the land on a sustained basis were adopted. These steps were taken up in arable and non arable land as well as also in the household production systems.

The basic soil and water conservation measures include both hardware measures of permanent/semi-permanent nature and software measures for in-situ moisture conservation which are temporary in nature done every year during land preparation. The important conservation measures undertaken in the project areas are :

5.3.1 Graded and Contour Bunds

A suitable waterway to drain overland runoff flow which causes gully erosion is planned, designed and constructed under the watershed programme. In most of the cases, the natural waterways were treated as the outlets. Proper protection by way of mechanical checks are given to all natural and artificial waterways. Also economic species are successfully grown in these water ways.

Graded bunds are meant for diverting the excess water from cropped lands, suitable outlets are provided to safely remove the water so drained into them.

Contour bunds consist of building earthen embankments across the slope of the land, following the contour as closely as possible. A series of such bunds divide the area into strips and act as barriers to the flow of water, thus reducing the amount and velocity of the runoff.

These methods were not used under the project areas. However in specific case, the farmers were assisted to carry out the work under the already constructed soil and water conservation structures.

5.3.2 Vegetative Bunds

Proper maintenance of bunds and waterways is not carried out in real farm situations. This sometimes leads to failure of bunds, strip leveling, waterways and other control structures. The recent thinking is therefore for adoption of rolling lands vegetative bunds utilizing 'Khus'. The other option is the use of grasses to serve as waste weirs or to stabilize bunds.

5.3.3 In-situ-Moisture Conservation Practices

In-situ moisture conservation practices include contour farming. Cultivation operations are done across the slope, i.e., by keeping them on contour or nearly so. The contour furrows so created would form a multitude of mini barriers across the flow path of the runoff which improve vastly the detention storage in-situ. Contour cultivation remains the most effective on the moderate slope of 2 to 7% whereas both on flat or

steep slopes the effectiveness is relatively less.

Effectiveness of contour cultivation on different land slope groups is detailed in Table 18 as follows :

Table 18

Slope groups %	Ratio of soil loss from contour cultivation/up and down cultivation
< 1%	0.6
2 to 7%	0.5
6 to 12%	0.6
7 18 to 24%	0.9

Other conservation measures were vegetative filter strips in place of diversion drains, contour vegetative hedges, supported by trenches/ridges/bunds; repair of the existing conservation measures built by farmers including inter terrace treatments, gully control measures with vegetative measures system, open, contour furrows, contour cultivation, etc.

The view of a check dam site at Mannarghat water project is depicted in Fig. 13.

5.4 FARM PONDS AND DUG OUT STRUCTURES

Farm ponds are also provided for collection of excess run-off in most of the dry areas. Unlined ponds – dug out type in particular are observed to hold water for 10-15 weeks in most soils. Their efficiency can be further increased by providing plastic or brick lining.

5.5 AGRICULTURAL PRODUCTION SYSTEM

To enhance production system crop demonstration were taken up in the farmers field to encourage double cropping of paddy, using short duration, high yielding varieties. Intercropping of coconut and arecanut with spices, pineapple, nutritive grass etc. were encouraged to increase productivity.

The composite nurseries supplement the needs of farmers for planting materials. The view of a composite nursery at Mannarghat watershed area is shown in Fig. 14.

FIG:13 VIEW OF LOOSE BOULDER DAM SITE AT MANNARGHAT WATERSHED.

FIG:14 VIEW OF COMPOSITE NURSERY AT MANNARGHAT WATERSHED.

5.6 HOUSEHOLD PRODUCTION SYSTEMS

To diversify the agro-production system, activities such as sericulture, goat rearing, poultry, backyard horticulture, certain biomass/agro processing activities were identified and farmers encouraged to take up such activity under animal husbandry assistance.

The service sector carpentry, blacksmith had a greater scope in coordination with rural development schemes, the improved tools with TRYSEM training were imparted to selected farmers.

5.7 LIVESTOCK DEVELOPMENT

The aim was to increase the production capacity of each animal/poultry by providing better health care, better nutrition and improvement of genetic quality. The programme was coordinated by Animal Husbandry Department by arranging diagnostic services, frequent visits to households to known reasons of diseases amongst animals and birds.

Trainings were imparted to make proper use of crop residues like paddy straw, etc. treating it with urea and molasses so that they can reduce the costly concentrated feed. Common grazing lands were established for the livestock and farmer were encouraged to reserve about a tenth of their field for growing fodder.

To improve production capacity of cattle and buffaloes, measures were adopted to cross breed with proven bulls and carry out artificial insemination with proven bulls. Likewise backyard poultry system using white leghorn breed of birds for more eggs and introduction of malabari male goats to improve production capacity of meat and milk were undertaken.

5.8 TRAINING AND RESEARCH

Short term trainings were arranged for the farmers by on-farm training, visit to demonstration and elite farms of Department of Agriculture, animal husbandry and Central Agricultural Research Institute (CARI). The Rural Department, Fisheries

Department, Banking Organisations, Co-operative Departments were involved in the training programme. Farmers were taken for education tour from the selected watershed to other watershed project in India for their first hand knowledge.

Progressive farmers were encouraged to take up innovative research or trials like improved and hybrid seed of crop, vegetable, etc. were procured and raised in nurseries and distributed to farmers for trials and adoption.

The scientists from the Integrated Pest Management an INM encouraged the farmers to popularize the new concepts of pest management among the farmers.

Chapter 6

RESULTS AND DISCUSSION

6.1 OUTCOME OF PROJECTS : FINDINGS OF STUDY

Establishment and Management

The State level committee was constituted under the Chairmanship of Development Commissioner for policy, planning and monitoring of the project. At Tehsil level a watershed team was constituted under the Chairmanship of the Assistant Conservator of forest with participation of the local officers concerned with agriculture, animal husbandry, industry, rural development and fisheries. The members of the multi-disciplinary team constituted for WSI, WSII and WSIII are shown in Table 19.

Various soil conservation work, field survey and cartographic work were taken up by the staff of Department of Agriculture and other associated work of forest, animal husbandry etc. under the technical expertise of the concerned department. Execution of soil and water conservation, crop production activities and official work under WSI is shown in Fig. 15.

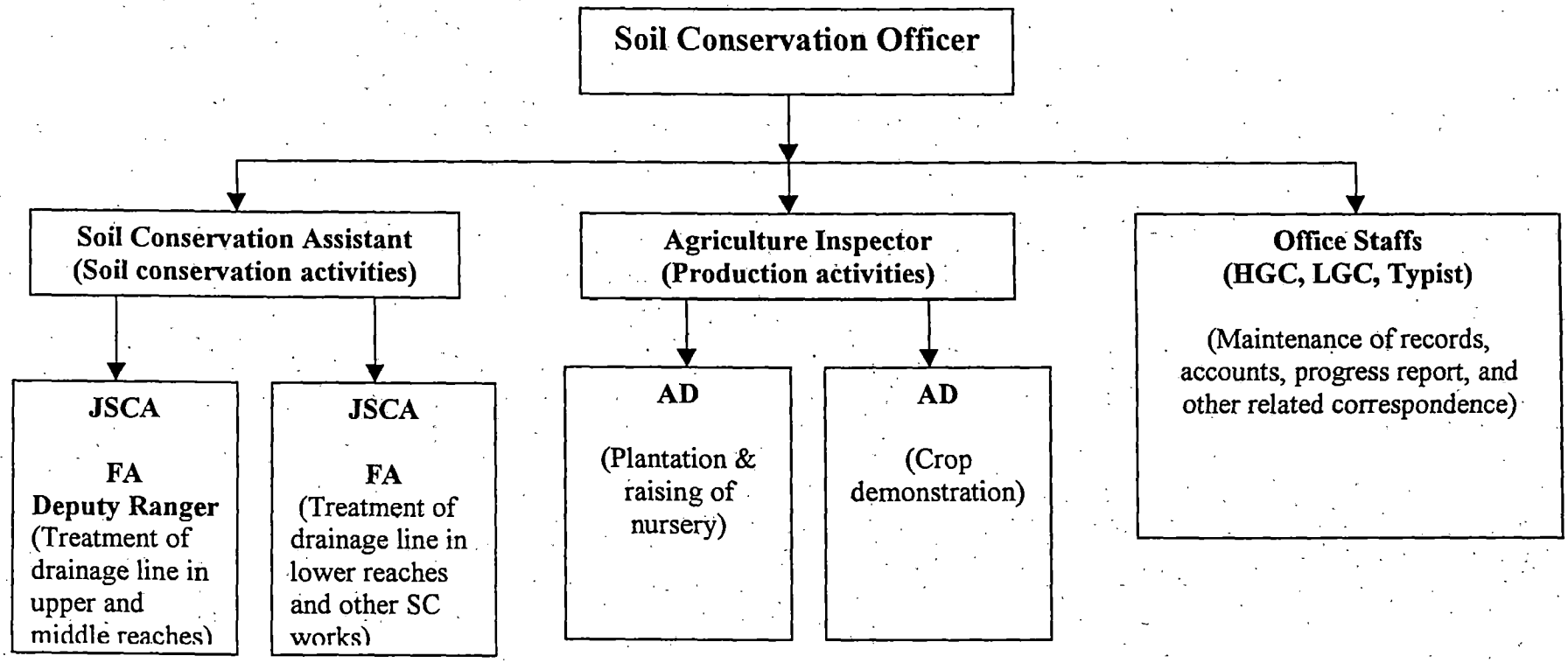
Due to remoteness of the islands of project site from the capital and as well as the remoteness of the islands from the mainland, the project work got up to a slow start in the beginning and later on picked up with the coordinated efforts of the inter-alia departments like Animal Husbandry, Forest, Fisheries, Agriculture and other administration units of this UT who worked hand in hand for proper implementation of the project.

Table 19 : Multi-Disciplinary Team for Implementation of NWDPRA Scheme

S. No.	Watershed	Details of Members	Position
(I)	Mannarghat Watershed	1. Assistant Conservator of Forest Wimberleygunj	Chairman
		2. Veterinary Assistant Surgeon, Wimberleygunj	Member
		3. Tehsildar, Ferrargunj	Member
		4. Block Development Officer, South Andaman	Member
		5. Assistant Director of Fisheries, South Andaman	Member
		6. Industries Promotion Officer, South Andaman	Member
		7. Soil Conservation Officer, Agriculture Department Port Blair	Member-Secretary
(II)	Uttara Watershed	1. Assistant Conservator of Forest, Rangat	Chairman
		2. Veterinary Assistant Surgeon, Rangat	Member
		3. Block Development Officer, Rangat	Member
		4. Assistant Director of Fisheries, Rangat	Member
		5. Industries Promotion Officer, Rangat	Member
		6. Tehsildar, Rangat	Member
		7. Assistant Engineer (MI) Agriculture Department	Member-Secretary
(III)	Rampur Watershed	1. Assistant Conservator of Forest, Mayabunder	Chairman
		2. Veterinary Assistant Surgeon, Webi	Member
		3. Block Development Officer, Rangat	Member
		4. Assistant Director of Fisheries, Rangat	Member
		5. Industries Promotion Officer, Rangat	Member
		6. Tehsildar, Mayabunder	Member
		7. Agriculture Officer, Mayabunder	Member-Secretary

(Source : Directorate of Agriculture, Port Blair)

Figure 15 : Structure of Staff on Various Activities of Watershed Mannarghat



Benefits to Agriculture

The absence of irrigation facilities has made the farmers of the watershed area in general the entire islands to take up only one crop of paddy during Kharif season. But with the implementation of NWDPRA, the soil and water conservation measures adopted with moisture conservation structures and ponds has enabled few farmers along the Mannarghat Nallah in Mannarghat Project (WS-I) Rampur Nallah in Rampur Project (WS-III), Ramnagar Nallah in Ramnagar project (WS-IV) to take up cultivation of pulses, oil seeds and vegetables in a small area.

The agricultural labourers were engaged for farm activities in their respective watershed area and did not had to venture out for seeking employment.

The artisen families residing inside the watershed area were supplied tools, kits and accessories for improvement of their production system along with livestock component. 130 beneficiaries in WS-I, 56 beneficiaries in WS-II, 9 beneficiaries in WS-III, 87 beneficiaries in WS-IV were benefitted.

The impact of the conservation measures towards soil and water conservation has improved with the maximum moisture being conserved in the forest and catchment area which has been observed by the recharge of the wells.

The incidences of flash floods during the months of monsoon has been minimized. The construction of vegetative and dugout structures in the streams and nallahs have arrested the flow of heavy load of gravels/stone etc. into the agricultural land.

The current cropping intensity is in the range of 110-130 % in the watershed area which would be enhanced further when the hilly areas taken up for plantation start bearing fruit in a period of 5-10 years; which otherwise lay vacant before the project implementation.

The epidemic of pest attack was a common phenomenon before the

implementation of project, with the benefit of integrated pest management under the watershed management scheme reaching to the farmers of these 4 project there is a timely control of their pest problem.

The top soil erosion, removal of rocks and gravels threatening land slides have by and large been eliminated after implementation of the project in the 4 project area.

The excavation of ponds under the schemes in the 4 project area has improved the ground water recharge which supplement the drinking water, irrigation needs of farmers in the driest spells.

Benefits from Livestock Development

The intensive house to house contact programme under the scheme has showed tangible production resulting in improvement of livestock development and in production of milk and meat.

Benefits from Employment Generation

On an average various watershed management activities generated gainful employment and about 80% of the total expenditure under the scheme was labour component, which directly benefitted the local unemployed and under employed rural community.

The erstwhile neglected weaker section of the villages were deployed by Watershed Development Team at different stages of the project for its successful implementation.

Benefits from Soil and Water Conservation/Protective Measures

The protective benefits from watersheds were reduction in runoff volume, peak discharge, increase in lean period flow with time and recharge of ground water. The farmers who were at a stage of risk/uncertainty have changed to the stage of certainty by developing the farm plan for their betterment and prosperity to the nation as a

The socio-economic survey conducted in the area for taking up the details of no. of families and livestock resources is given in Table 20 and 21.

Table 20

S. No.	Details	Watershed Mannarghat	Watershed Uttara	Watershed Rampur	Watershed Ramnagar
1	No. of families in (nos)	289	303	71	154
	Population in (nos)				
	(a) Males	596	552	175	691
	(b) Female	563	511	108	663
	(c) Children	661	639	80	

(Source : Directorate of Agriculture, Port Blair)

Table 21

S. No.	Details	Watershed Mannarghat	Watershed Uttara	Watershed Rampur	Watershed Ramnagar
1	Livestock resources	I	II	III	IV
	Population in (nos)				
	(a) Cattle	241	383	105	363
	(b) Buffalo	110	133	155	409
	(c) Goat	214	279	194	517
	(d) Poultry	2923	3704	855	3135

(Source : Directorate of Agriculture, Port Blair)

The general trend of distribution of farmers in the Andamans district as per the Agriculture Census 1990-91 is shown in Table 22 and its percentage is depicted in Fig. 16.

Table 22

Size Class	No. of Holdings	Area of Holdings (Ha)	Average Size (Ha)
Marginal	2434	917.0	0.37
Small	2424	3433.0	1.41
Semi Medium	3359	8266.0	2.46
Medium	1831	7733.0	4.22
Large	55	3517.0	63.94
Total	10103	23866.0	2.36

(Source : Directorate of Economics & Statistics, Port Blair)

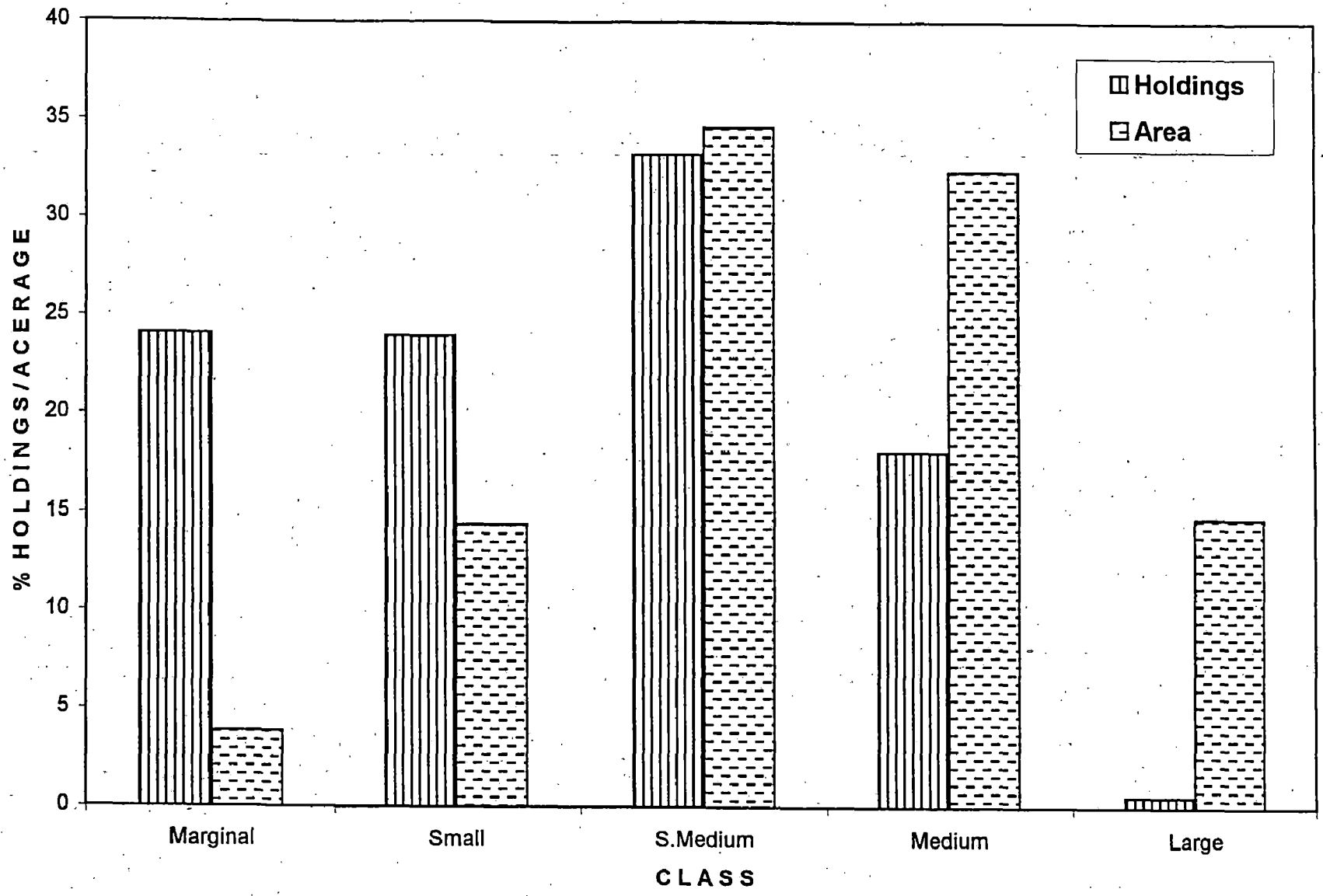


FIG:16 PERCENTAGE DISTRIBUTION OF FARM HOLDINGS & ACERAGE
(Andaman Dist.)

The living standard of medium, semi-medium and large farmers of the watershed area were well established in terms of economy and social aspects. The marginal and small beneficiaries in the watershed who were predominantly engaged in watershed activities and selected under household production system etc. are trying to enhance their living standards by taking-up poultry, goatry, fishing and agriculture.

The health care facilities for the population in the watershed area was sufficient as all the villages were about 7-15 km away from a Primary Health Centre (PHC) of that locality apart from a dispensary in the respective village.

The distribution pattern of the age group engaged in farming activities was found to be in the range of 51 years and above followed by middle age group in the range of 31 to 50 years.

The literacy level amongst the residents of the watershed showed that the majority of the farming community had an education upto primary level followed by the middle school education and rest of the few illiterate. The majority of second generation who are engaged in farming are educated upto high school level, followed by middle school and few senior level education and above.

The average annual income per family from agriculture ranged from 1500/- to Rs. 35,000 in the watershed area. The income generated in these islands is largely through plantation. Sources of income are fishing, small scale industries, namely furniture industry, cane and bamboo processing industry, poultry and piggery. Apart from this a major mass is engaged in government services. The medium, semi-medium and large farmers have adapted plantations and orchard crops and marginal and small farmers cultivate cereals, lagumes and vegetable crops.

The lower income group identified in the project area were involved in various activities to uplift these groups towards sound economy.

The field crop which is grown predominantly in the watershed areas in low lying

area was paddy with a production of about 2 t/ha. However the farmers so far have not adopted paddy in Rabi season since the water is insufficient to meet the requirement for its cultivation.

The period between January and April is the driest when the number of rainy days in each month is the lowest, thus agriculture often suffers badly during this period due to draught.

The Table 23, 24 and 25 shows the rainfall for the period from 1967-91 at Port Blair, Andaman, Nicobar Districts; No. of rainy days recorded at Port Blair from 1961-1990 and the monthly climatic parameters in these islands. The Fig. 17 depicts the monthly rainfall (average of 48 years data).

The Table 26 shows the data of water balance in these islands average of 6 years for the period from 1985-90 and the Fig. 18 shows relation between rainfall and evaporation as recorded at CARI, Agricultural Meterology Station, Garacharma, Port Blair.

Table 23 : Yearwise Rainfall of Andaman & Nicobar District and of Port Blair (For Last 25 Years)

Year	Port Blair (mm)	Andaman District (mm)	Nicobar Dist. (mm)
1967	3604.60	3117.80	2833.60
1968	2620.00	2911.50	2499.30
1969	2689.50	2727.10	2701.00
1970	3663.20	3468.10	2829.00
1971	2894.50	2947.20	3000.60
1972	3747.50	3651.10	2084.30
1973	2912.00	2868.30	3130.50
1974	3088.50	2965.10	2955.70
1975	2764.70	3234.00	3923.80
1976	3495.70	3357.20	2912.40

1977	2331.80	2529.60	2363.40
1978	2663.30	2851.30	2444.40
1979	1541.40	1774.30	2184.90
1980	3756.60	3491.90	2993.30
1981	3204.00	3078.80	2379.00
1982	2445.60	2620.50	1335.80
1983	2975.00	2945.90	2301.20
1984	3421.10	2338.10	2697.90
1985	2828.20	2836.40	2060.40
1986	2197.90	2176.80	2177.50
1987	2635.40	2344.80	2188.40
1988	3364.90	2939.40	2879.80
1989	2541.70	2390.80	2630.30
1990	2593.70	2223.70	2320.20
1991	3096.90	2484.40	2720.10
Average rainfall	2923.11	2810.96	2581.87

(Source : Directorate of Economics & Statistics, Port Blair)

Table 24 : Number of Rainydays Recorded at Port Blair From 1961 to 1990

Year	Total No. of Rainydays	Year	Total No. of Rainydays	Year	Total No. of Rainydays
1961	197	1971	132	1981	127
1962	194	1972	138	1982	119
1963	185	1973	138	1983	137
1964	142	1974	138	1984	124
1965	145	1975	140	1985	189
1966	120	1976	138	1986	174
1967	149	1977	124	1987	181
1968	121	1978	136	1988	199
1969	118	1979	117	1989	184
1970	157	1980	127	1990	163

(Source : Directorate of Economics & Statistics, Port Blair)

Table 25 : Climatic Parameters of Andaman and Nicobar Islands

Month	Rainfall (mm)	Temperature		Relative humidity		Wind Speed (Km/hr)	Rainy days Nos.	Sunshine (hrs/day)	Evaporation mm/day
		Min °C	Max °C	8.30 a.m.	5.30 p.m.				
1	2	3		4		5	6	7	8
January	41.73	22.08	29.65	71	75	6.55	Nil	9.20	5.50
February	20.21	21.77	30.44	71	72	5.54	01	8.60	5.30
March	13.47	22.68	31.50	69	72	4.96	06	6.80	4.90
April	66.98	23.92	32.52	68	73	5.84	01	8.90	5.60
May	377.95	23.88	31.11	78	82	10.19	17	5.50	6.10
June	489.88	23.88	29.51	83	84	11.47	14	5.30	2.80
July	435.67	23.52	29.10	84	85	15.08	19	3.50	2.60
August	450.91	23.54	29.03	84	86	17.01	25	3.40	3.70
September	474.15	23.53	29.00	84	85	11.34	20	3.40	3.80
October	303.44	23.20	29.54	81	86	7.46	15	5.30	3.70
November	237.08	23.04	29.70	78	81	6.94	08	7.20	4.20
December	137.97	23.47	29.28	73	77	7.80	01	7.50	4.70
Monthly Average/ Total	254.12	23.21	30.03	77	79.83	9.68	127	6.20	4.4

Column 2 : Average of 48 years, i.e., from 1949 to 1996

Column 3 : Average of 48 years, i.e. from 1949 to 1996

Column 4 : Average of 31 years, i.e. from 1966 to 1996

Column 5 : Average of 22 years, i.e. from 1975 to 1996

(Source : Directorate of Economics & Statistics, Port Blair)

Column 6 to 8 : Average of 1993-94

(Source : CARI Port Blair)

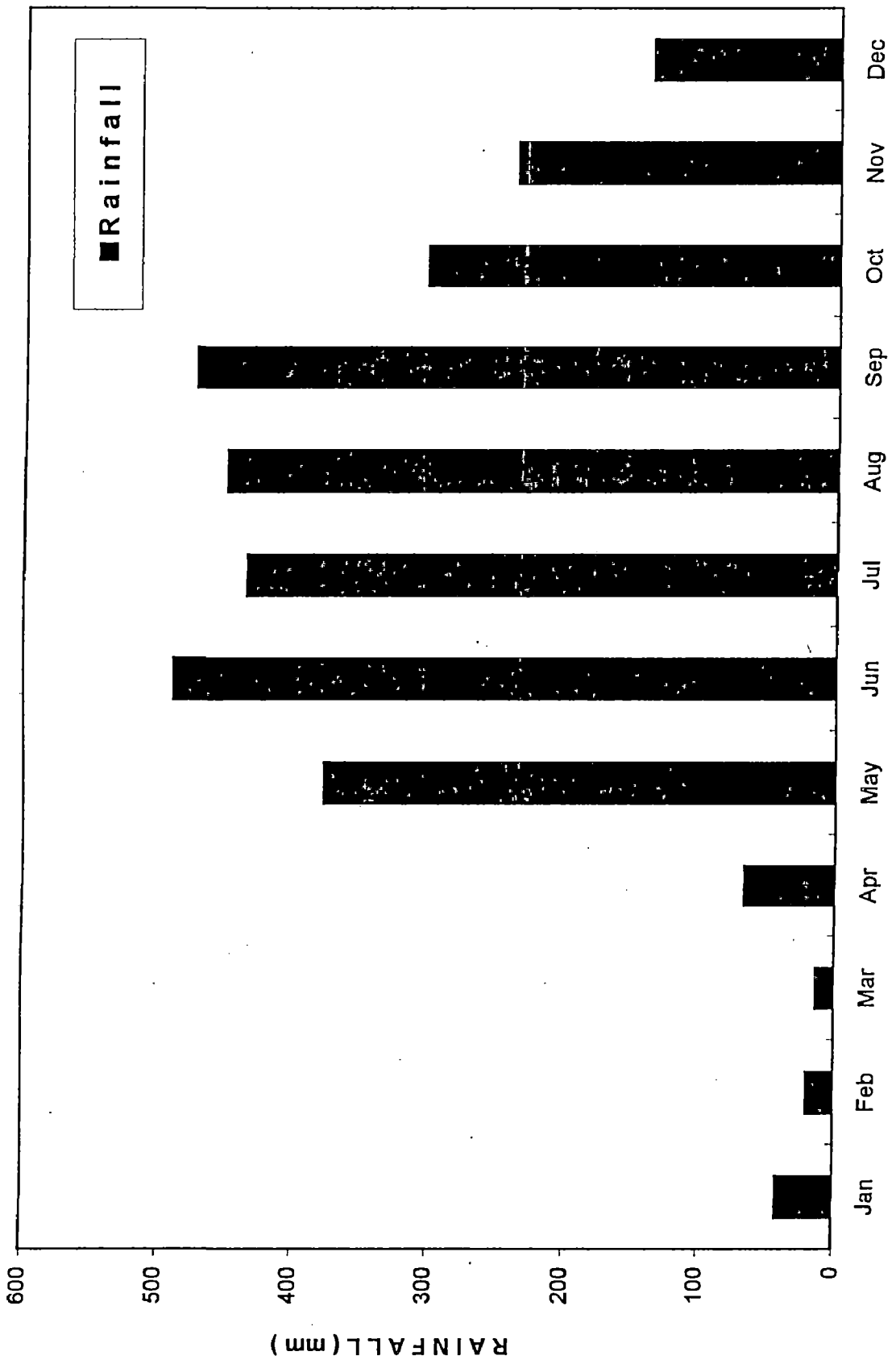


FIG:17 NORMAL RAINFALL (Average of 48 years) AT PORT BLAIR

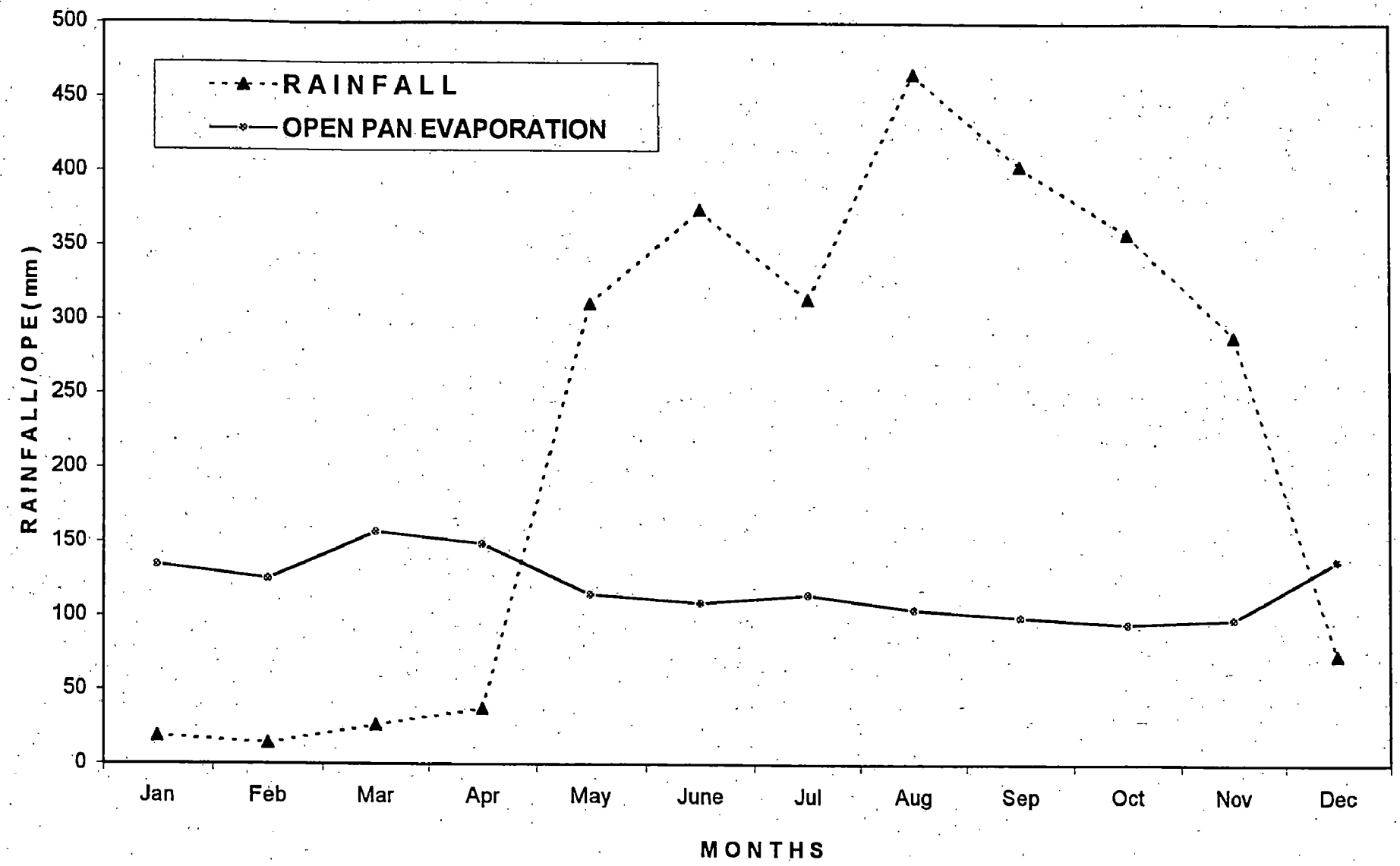


FIG : 18 MONTHLY OPEN PAN EVAPORATION AND RAINFALL (Average of Six Years) AT PORT BLAIR

Table 26 : Water balance of Bay islands in relation to rainfall and open pan evaporation (Average of 6 years 1985-90)

Months	Rainfall	Evaporation	Water Balance (mm) + Surplus - Deficit
Jan	18.7	134.0	-115.3
Feb	14.1	124.9	-110.8
Mar	26.3	156.5	-130.2
Apr	37.4	148.5	-111.1
May	310.6	114.4	+196.2
Jun	374.5	108.7	+265.8
Jul	313.9	114.8	+199.1
Aug	465.8	104.3	+361.5
Sep	403.9	99.1	+304.8
Oct	358.3	94.6	+263.7
Nov	289.0	98.2	+190.8
Dec	74.0	137.5	+63.5
Yearly	2686.5	1435.5	+1251.0

(Source : Annual Report CARI, 1990-91)

The cultivation pattern in the watershed area is the flat/low lying lands was paddy/vegetables/pulses, some crop mixture of green manuring plant was also seen alongwith paddy. In hilly land the pattern was coconut/arecanut/pepper with banana/tapioca/turmeric/ginger in Manarghat watershed area. Arecanut in combination with betelvine, citrus plant and banana; coconut/arecanut/mango/ sapota/spices with banana/turmeric/ginger in Uttara, Rampur and Ramnagar areas.

The production of paddy with respect to area in these group of islands from 1990-95 is shown in Table 27 and also in Fig. 19.

Table 27

Year	Area (Ha)	Production (MT)
1990-91	12,159	30,555
1991-92	12,000	31,000
1992-93	12,025	31,574
1993-94	12,156	32,139
1994-95	12,104	30,600
1995-96	12,570	33,000

(Source : Directorate of Economics & Statistics, Port Blair)

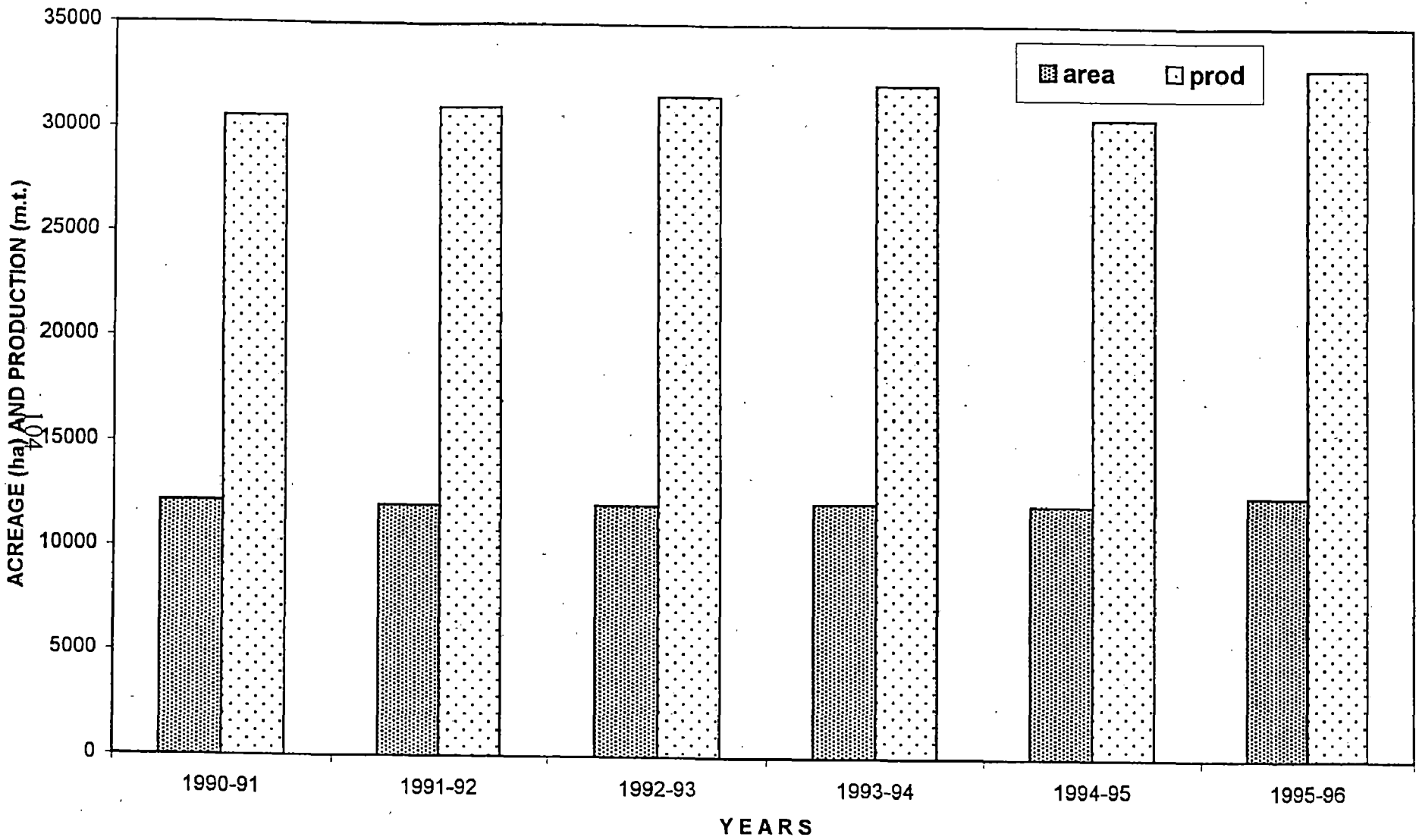


FIG: 20 ACRE AGE AND PRODUCTI ON OF PADDY IN A&N ISLANDS FROM 1990-95

The area and overall production of vegetables in the year 1998-99 in the four zones namely South Andaman, Rangat, Mayabunder & Diglipur in which watershed area is also located is shown in Table 28, 29. Area of vegetables in South Andaman, Rangat, Diglipur and Mayabunder (in Ha) 1998-99.

Table 28 : Area of Vegetables in South Andaman, Rangat, Mayabunder, Diglipur (in Hectares) 1998-99

Item	South Andaman Ex-Neil & Havelock	Rangat	Maya bunder	Diglipur	Total of Andaman District	Total of A & N Islands
Brinjal	90.92	56.00	40.00	96.00	481.02	524.40
Lobia	93.30	40.00	50.00	89.00	343.00	439.62
Bhindi	100.30	76.00	45.00	145.00	454.70	498.00
Radish	38.13	30.00	30.00	63.00	214.77	267.77
Chilli	18.12	30.00	10.00	82.00	163.32	175.32
Tomato	22.60	50.00	20.00	20.00	220.50	225.40
Cucumber						
Bottle Gourd						
Bitter Gourd						
Ridge Gourd	65.44	100.00	80.00	183.00	613.34	723.54
Ash Gourd						
Pumpkin						
Kundru						
Beans	10.00	20.00	2.00	3.00	63.90	77.90
Harsa/Aharanth	32.00	15.00	8.00	18.00	84.00	112.60
Poi	7.09	15.00	8.00	18.00	67.44	91.35
Palak	6.56	15.00	5.00	8.00	55.36	68.59
Cabbage		10.00	5.00	73.00	88.00	88.00
Cauliflower		10.00	5.00	86.00	101.00	101.00
Kholkhol				38.00	38.00	38.00
Colocasia & EF	69.90	73.00	15.00	20.00	228.82	264.68
Beet Root	2.43				2.83	2.83
Sweet Potato					4.00	4.00
Coriander					1.00	1.00
Onion					0.50	0.50
Others (Tapioca,pointed gourd, etc.)	60.00	10.00	5.00	10.00	115.50	127.50
Total	616.79	550.00	328.00	952.00	3278.00	3832.00

(Source : Directorate of Agriculture, Port Blair)

Table 29 : Production of Vegetables in South Andaman, Rangat, Mayabunder, Diglipur (in Tonnes) 1998-99

Item	South Andaman Ex-Neil & Havelock	Rangat	Maya bunder	Diglipur	Total of Andaman District	Total of A & N Islands
Brinjal	460.03	308.00	100.00	500.00	2233.00	2548.00
Lobia	648.30	240.00	150.00	489.00	1833.00	2127.00
Bhindi	773.20	494.00	270.00	870.00	2974.00	3089.00
Radish	386.10	165.00	135.00	378.00	1364.00	1539.00
Chilli	28.66	100.00	30.00	492.00	724.46	758.00
Tomato	96.10	250.00	80.00	112.00	1265.00	1275.00
Cucumber						
Bottle Gourd						
Bitter Gourd						
Ridge Gourd	620.00	500.00	300.00	849.00	3321.55	3618.55
Ash Gourd						
Pumpkin						
Kundru						
Beans	40.00	110.00	9.00	15.00	294.00	340.00
Harsa/Aharanth	132.90	40.00	24.00	126.00	370.00	465.00
Poi	17.80	50.00	25.00	138.00	313.00	379.00
Palak	36.10	65.00	15.00	32.00	215.00	242.00
Cabbage		85.00	35.00	465.00	585.00	585.00
Cauliflower		55.00	15.00	367.00	437.00	437.00
Kholkhol				190.00	190.00	190.00
Colocasia & EF	360.54	268.00	39.00	193.00	1064.69	1302.69
Beet Root	10.10				12.10	12.10
Sweet Potato					13.60	13.60
Coriander					0.10	0.10
Onion					2.50	2.50
Others (Tapioca,pointed gourd, etc.)	228.00	20.00	10.00	20.00	374.00	396.00
Total	3837.83	2750.00	1237.00	5236.00	17586.00	19320.00

(Source : Directorate of Agriculture, Port Blair)

The agricultural inputs like fertilizer, pesticides, seed and new variety and crop in the watershed area was obtained from the Department of Agriculture. Apart from the department medium and large farmer purchased it from local suppliers at Port Blair. There is an increase in supply of fertilizers made available to farmers by Department during years 1994 to 1999 as shown in Table 30, which may be due to the adoption of high yielding varieties.

Table 30 : Fertilizer Consumption for the Last Five Years

S. No.	Name of Item	Unit	Consumption				
			94-95	95-96	96-97	97-98	98-99
1	Urea	Mt	355.75	394.95	321.58	434.36	418.41
2	DAP	Mt	78.30	236.87	163.29	148.11	318.34
3	MOP	Mt	126.51	103.45	62.71	97.47	129.30
4	MP/Rock Phosphate	Mt	19.90	12.00	137.86	194.37	49.19
5	SSP	Mt	-	-	-	-	-
	Total		580.46	747.27	685.54	874.31	915.24

(Source : Directorate of Agriculture, Port Blair)

The supply of PP chemicals made by Department of Agriculture in the years 1994 to 99 is shown in Table 31.

Table 31 : Plant Protection Chemical Consumption for Period 1994-99.

S. No.	Particulars	Units	94-95	95-96	96-97	97-98	98-99
1	Liquid form	Mt in tech	1.615	1.789	1.86	1.274	1.873
2	Powder & granular	grade	6.275	5.201	7.57	1.556	2.804

(Source : Directorate of Agriculture, Port Blair)

The land utilization level varied from low to moderate in all watershed area and trend for productivity of plantation crop is anticipated to increase in 5-10 years

when the plantation crop start bearing fruit.

The overall reaction of the farmers towards the rainfed watershed management scheme in all the watershed area was that it is beneficial for agricultural productivity and that to on a sustainable basis. The use of groundwater potential is still untapped in these islands.

No major problem was noticed with respect to the environment, drainage, pollution in the watershed area. However some low lying areas of watershed namely Rampur, Ramnagar and Manarghat and Uttara areas near to the sea where the extent of saline water affecting the groundwater strata needs to be studied further through periodical detail assessments.

The *nallahs* in the middle and lower reaches of Manarghat, Rampur, Uttara and Ramnagar have stabilised due to the vegetative and conservation measures adopted along the drainage line. However in some areas where the soil erosion has occurred due to the breach in conservation structure needs to be replaced by semi-mechanical structures to stabilise these zones to greater extent. These areas have to be taken up under the maintenance work by Panchayat in the locality in association with the Mitra Krishak Mandals to avoid further deterioration of soil strata.

The financial and physical target and achievement under each project is shown in 32 to 34. The various field activities carried out under each watershed is tabulated in 35 to 37.

Table 32 : Consolidated List of Target and Achievement of Physical and Financial Aspects

S. No.	Name of Project	Code of the watershed project	Date/month of commence ment	Physical (in ha)		Financial (in Rs.)	
				Target	Achieve ment	Target	Achievement
1	Mannarghat	WS I	June'94	704	675	3407600	3426226
2	Uttara	WS II	August'94	498	440	2490000	2051250
3	Rampur	WS III	August'94	278	278	1390000	1387529
4	Ramnagar	WS IV	Sept.'93	1189	1045	5297300	4919795
	Total			2669	2438	12584900	11784800

(Source : Directorate of Agriculture, Port Blair)

Table 33 : Yearwise Position of Area Treated Under the Project

Year	WS I		WS II		WS III		WS IV	
	Target (in ha)	Achievement (in ha)	Target (in ha)	Achievement (in ha)	Target (in ha)	Achievement (in ha)	Target (in ha)	Achieven (in ha
1993-94	-	-	-	-	-	-	100	80
1994-95	170	161	100	63	70	58	270	218
1995-96	180	143	135	115	70	72	270	266
1996-97	180	161	135	99	70	91	275	208
1997-98	174	153	128	121	68	53	274	186
1998-99	-	57	-	42	-	4	-	87

(Source : Directorate of Agriculture, Port Blair)

Table 34 : Physical and Financial Achievement of Various Projects under NWDPRA

Year	WS I Mannarghat Project		WS II Uttara Project		WS III Rampur Project		WS IV Ramnagar Project	
	Physical Achievement (in ha)	Financial Achievement (in Rs)	Physical Achievement (in ha)	Financial Achievement (in Rs)	Physical Achievement (in ha)	Financial Achievement (in Rs)	Physical Achievement (in ha)	Financial Achievement (in Rs)
1993-94	-	-	-	-	-	-	80	392232
1994-95	161	774684	63	300733	58	280875	218	1045785
1995-96	143	688843	115	553883	72	345369	266	1277228
1996-97	161	775318	99	476234	91	438795	208	1002095
1997-98	153	721575	121	567163	53	267990	186	882382
1998-99	57	452306	42	153237	4	54500	87	320073
Total	675	3412726	440	2051250	278	1387529	1045	4919795

Watershed	Remark
Mannarghat Project	Work in WSI under nursery carried out for Rs. 13,500 in 1999-2000
Uttara Project	Under WSII also work under Nursery carried out in 1999-2000
Rampur Project	Under WSIII work in all respect completed
Ramnagar Project	Under WSIV work in all respect completed
	The handing over of the project to the concerned panchayats are under process.

(Source : Directorate of Agriculture, Port Blair)

Table 35 : Field Activities under Conservation Measures

S. No.	Description of conservation measures	Unit	WS-I	WS-II	WS-III	WS-IV
1	Vegetative filter strip (m)	@ Rs. 15 per m.	7000 m	2000 m	700 m	20641 m
2	Contour vegetative hedge (ha)	@ Rs. 300/- ha	112 ha	170 ha	132 ha	23 ha
3	Contour vegetative hedges over contour trenches (ha)	@ Rs. 400 ha	93 ha	157.63 ha	20 ha	217 ha
4	Repairing of existing soil conservation	@ Rs. 500/- ha	205 ha	160 ha	154.50 ha	100 ha
5	Live fencing (m)	@ Rs. 10/- mt	-	5403 m	2000 m	4995 m
6	Contour hedges with furrows (ha)	@ Rs. 400/- to @ Rs. 500/- ha	100 ha	-	83 ha	399.6 ha
7	Gully plugging (each)	@ Rs. 750/- each or as per need	270 Nos	1316 Nos	8 Nos	36 Nos
8	Overseeding of grains and legmes (ha)	@ Rs. 200/- per ha for 2 years	50 ha	30 ha	60 ha	243.88 ha
9	Planting of trees on drainage line (each)	@ Rs. 7.50 to Rs. 15/- per tree	2500Nos	1847 Nos	1891 Nos	11674Nos

(Source : Directorate of Agriculture, Port Blair)

Table 36 : Different Components of Watershed Project

S. No.	Description of conservation measures	Unit	WS-I	WS-II	WS-III	WS-IV
1	Crop demonstration on cultivator land					
	(a) Single crop	@ Rs. 325/- each	40 Nos	39 Nos	45 Nos	96 Nos
	(b) Double crop	@ Rs. 525/- each	35 nos	15 Nos	17 Nos	155 Nos
	(c) Inter crop	@ Rs. 400/- each	25 nos	13 Nos	16 Nos	30 Nos
2	Dry land horticulture Planting of fruit trees	@Rs.15/- per tree	2325Nos	2650 Nos	550 Nos	11809Nos
3	Organic farming system Incentives on compost pits and bio fertilizers	@ Upto Rs. 100/- per family	150 Nos	195 Nos	81 Nos	151 Nos
4	Homestead gardens, kitchen gardens, backyard horticulture	@ Rs 1000/- per family	150 Nos	200 Nos	-	154 Nos
5	Small live stock system, Agro processing	@ Rs. 1000/- each	100 Nos	50 Nos	-	77 Nos
6	Small Dugout taken ponds	Rs. 1500/- to Rs.2000/-per unit	40 Nos	32 Nos	20 Nos	102Nos
7	Runoff management dugout ponds	@Rs. 2500/- to Rs. 3000/- per unit	40 Nos	11 Nos	5 Nos	20 Nos
8	Runoff management dugout pond with vegetative inlet and outlet	@ Rs 25000/- per unit	8 Nos	8 Nos	2 Nos	5 Nos

(Source : Directorate of Agriculture, Port Blair)

Table 37

S. No.	Treatment of drainage line	Unit	WS-I	WS-II	WS-III	WS-IV
1	Bank stabilization with vegetative method	@ Rs. 10/- Rmt	5000	3912	1973	10226
2	Live check dam	@Rs.100/-per unit	150	90	50	196
3	Brush wood dam	@Rs.150/-per unit	100	101	50	195
4	Loose boulder check dam with vegetative support(upper reaches)	@ Rs. 500/- to Rs. 750/- per unit	100	95	35	111
5	Loose boulder check dam with vegetative support (middle reaches)	@ Rs. 2000 to Rs. 3000/- per unit	40	18	15	173
6	Earthen structure with vegetative support pitching with local materials	@ Rs.1000/- to Rs.1250/- per unit	50	71	20	179

(Source : Directorate of Agriculture, Port Blair)

SUMMARY AND CONCLUSION

The evaluation of the watershed projects namely under the NWDPRA scheme was studied and major findings are summarised as follows :

(1) The project area of Ramnagar watershed was the largest followed by Manarghat, Uttara and Rampur watersheds.

(2) The execution of soil and water conservation and crop production level work was carried out in the project area from 1993 to 1999.

(3) In all the four watersheds no specific arrangement is made for the maintenance of the assets created under watershed. People need more motivation to respond positively and willingly especially in Ramnagar, Uttara, Rampur watershed. However, in case of Manarghat, the responsibilities towards community based watershed management was predominantly observed.

(4) The live barriers, vegetative barriers and green cover methods are showing positive impact in all the four watershed.

(5) With the soil conservation and vegetative measures adopted along the drainage line, the gradual process in control of soil erosion in the catchment areas was visible. The process of enhancement of storage/water harvesting structures is also gradually found to be effective in supplementing water during dry spells. The method of lining the storage structure with plastics could be tried to enhance the storing capacity.

(6) The response from the farmers to adopt and choose plantation crop under multitier cropping pattern was predominant amongst the cultivators in all the four watershed area.

(7) The execution of water management activities through *Mitra Krishak Mandals* and Self-Help Groups was effective.

(8) The continuance of the activities already executed now rest with the people of the catchment area and the respective Panchayats who are yet to take over the project completed.

(9) The Department of Forest widely coordinated in the forestry activities as major part of the catchment areas under forest apart from other line departments.

(10) The distribution of planting materials was widely done under the scheme by Department of Agriculture apart from raising of grasses, shrubs etc. in the nurseries. The proportionate survival rate was not consistent with the distribution.

(11) The employment status improved in the project area with the implementation of watershed approach, namely in the employment generated through land development work and agriculture activity.

(12) Participation of farmers towards the watershed programmes have been received well in all the four watershed, however for active and continuous rapport amongst the users the various department extension agency needs to play greater role for future sustainablity of project activity as the beneficiaries often tend to become mere passive recepients rather than active participants.

(13) The strengthening of the extension agency, involving soil conservation team, crop production team for dessemination of policy, implementation and execution of watershed development work should be done on priority basis to take up schemes in more areas of the island.

In conclusion to the study done on the performance evaluation of watershed programme for future scope of study the work which can be carried out in detail are :

(1) The assessment of runoff volumes and peak rate runoff rate based on complete previous and latest data is required for the purpose in each watershed.

(2) To determine the increase in groundwater table and also the salt water intrusion into the catchment areas by introducton of watershed project.

(3) The assessment and conservation of soil and water losses in each of the watershed.

(4) With the trend shifting towards people's participation in development of land and water resources, a study on effective community-based watershed management taking location specific conditions into consideration in each of the watershed.

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ANNEXURE – I

MODEL TRIPARTITE MEMORANDUM OF UNDERSTANDING (MoU

1. INSTITUTION : The institution involved in Memorandum of Understanding (MoU) include :

(a) Watershed Community represented by its President or Secretary, Mitra Krishak Mandal (MKM)

The Watershed Community would consist of a group of Mitra Kisans, five from each village of the micro-watershed. The five Mitra Kisans from each village shall consist of two women farmers, two landless agricultural labourers, one of whom will be trained as Gopal and the other representing the artisans, and one enlightened farmer, open to innovative ideas. The Mitra Kisans will be selected by consensus in the general assembly of each village, once every year, for a period of one year. The watershed community would elect a President and Secretary from amongst the Mitra Kisans by consensus for a periof of one year, the Secretary of this year becoming President of the Community the folowing year by convention to lend continuity. In the absence of a voluntary agency in any area, the watershed community would have to shoulder the responsibilities of the NGO. Organizing the watershed community will be the joint responsibilities of the NGO and local government officer responsible for the project.

(b) NGO or voluntary agency will be represented by the managing trustee.

(c) Government represented by a Class II level officer of the development department or an officer of a higher level, as the case may be.

2. OBJECTIVES

(i) To work out modalities of interactions and cooperation between NGOs, Government functionaries and the micro-watershed community by defining their respective roles specially in greening rainfed areas by maximizing rainwater conservation and eco-restoration in fragile eco-system where local production systems have ceased to be sustainable. Such areas could lie in the catchments of River Valley Projects (RVP) and Flood Prone Rivers (FPR) and micro-watersheds taken up for development under National Watershed Development Project for Rainfed Areas (NWDPRA) or other similar development schemes. A Government functionary of adequate standing and experience shall function as watershed development team leader.

(ii) To enhance and strenghten the appropriate form of working together, between villagers, NGO and the GOs. NGO to help the Mitra Krishak Mandal in farmers' training, project preparation, evaluation and programme implementation by organizing hamlet-wise self help thrift groups to manage composite nurseries and

take up greening of degraded lands and other welfare activities.

(iii) To design and determine development programmes that can respond to the basic needs of villagers in a micro-watershed of area ranging between 500 to 1000 hectares.

(iv) To enhance and strengthen the role of women particularly their leadership in decision making for watershed development.

(v) To enhance and strengthen local organization like Mitra Krishak Mandal to implement developmental activities aiming to achieve self-reliance by using resources available locally and become a prime mover for sustainable development.

(vi) To organize hamletwise self-help thrift groups in the micro-watershed comunities so as to enable their participation in devleopment activities and sharing of benefits therefrom, as well as inculcating self-reliance in them by encouraging them to open a saving bank account in a local bank which will benefit from NABARD scheme meant to encourage thrift groups.

3. STRATEGY AND APPROACH

(i) Adoption of a project approach to treatment of micro-watershed in rainwater catchment areas in consultation with the village community, the programme measures being for meeting their needs and resolving their problems.

(ii) Studying local farm practices based on experience of villagers, finding local resource persons (Mitra Kisans and Gopals) and developing these people to become potential organizers in sharing experiences with other target groups. Landless persons could be trained as "Gopals" to look after common property resources as well as improving breed of local cattle.

(iii) Initiating new appropriate technologies that may enhance the villager's and women's work efficiency, generation of awareness through study tours, training sessions and meetings and discussions about the scheme, questioning, encouraging demonstrations, advising and counselling to innovate and experiment.

(iv) Responding to the need for support to agricultural developments and rain-water conservation by exploring appropriate agricultural and water resources technologies that are suitable in the local context.

(v) Taking stock of fodder requirement in the micro-watershed with development of sustainable fodder production mechanism and promotion of stall feeding of cattle as well as controlled grazing to preserve common lands. A model of controlled grazing may consist of closing by common consent one third area of common lands for one year by rotation leaving two-third area for free grazing every year. In this manner, the spots in the common lands where growth of grass is most luxuriant may be

identified and marked out as most suitable for making protected enclosures to develop village woodlots and for cutting grass for stall feeding. Thus, in the first few years fodder, fuel, fruit and timber trees would only be planted on homesteads and farmers' field boundaries where protection of planted trees would be the responsibility of the individual farmers or householder. Thereafter, when social fencing has been established by common consent, trees and plants of desired species could be planted by the villagers in the protected enclosures on common lands in a phased manner, the area of protected enclosures could gradually grow at the convenience of the village community.

(vi) Treatment planning of the micro-watershed to be initiated by the community for comprehensive development and maintenance in an integrated fashion. Management of the village commons by the community would be evolved by common consent in order to become fully operational during the project period.

(vii) Integrating treatment efforts through projectisation approach and proper choice of work areas to maximize rainwater storage. This would help in recharge of groundwater and natural water springs.

(viii) Promoting measures for sustaining the benefits of treatment through institutional mechanism.

(ix) Giving high priority to vegetative conservation measures like afforestation, growing shrubs and grasses, agroforestry, horticulture and planting fuel, fodder, timber and fruit trees according to soil depth and moisture. Bio-diversity would be the guiding principle in the greening programme and local conservation of flora would be explored and promoted. Fencing would be only through live hedges in general and stone walls in the hills supplemented by vegetative measures. Vegetative contour barriers with furrows and ridges, earthen dugout sunken ponds across drainage lines from top downwards to maximize in situ moisture conservation, plantation along field boundaries as per the need of the site after discussions with the beneficiaries during farmers' training, are to be adopted. Land shaping, terracing and levelling should be avoided as they are costly measures and also cause soil erosion in the first few years.

(x) Organising leadership training and promotion of cooperation among micro-watershed community and evolving an equitable method of distributing the usufruct generated by the development programme amongst the villagers at the beginning of the project implementation. Such a usufruct sharing formula should keep aside a portion of the proceeds for reinvestment in watershed development.

(xi) Minimizing the involvement of government machinery in actual implementation in order to encourage peoples' involvement in their own development.

(xii) Institutionalising resource generation for implementation of programmes with community as 'donor' by organizing hamletwise self-help thrift groups and the state as initiator. In projects funded by Government the per hectare cost would not exceed Rs. 3500 in the plains and Rs. 5000 in the hills. Projects taken up only with peoples' contribution would cost even less.

4. OPERATION OF ACCOUNTS

(i) Hamletwise self-help thrift groups may be assigned the task of implementing specific development activities according to their skills and interests. Funds could be placed in the bank account of the self-help thrift group implementing a specific programme as its wages, to be jointly operated by the President of the group and the NGO representative or GO representative. Funds could also be placed in the bank account of the MKM as wages for its activities to be jointly operated by its President and the Watershed Development Team Leader.

(ii) An audited annual account of income and expenditure of the project would be placed before five representatives other than Mitra Kisans of each village of the project every year, nominated by the general assembly of the concerned village. Within each village the audited annual account would be placed before the general assembly for their information by their five representatives along with their own comments.

(iii) In case of complaints, five persons of integrity, nominated by the general assembly, would investigate and express their opinion before the general assembly at the earliest, say within a month.

(iv) The general assembly may commission a group of persons of integrity (3 or 5) to assess the quality of work done after the project has been in operation for; say five years. An expression of satisfaction by the community would be the final test of a project's success.

(v) In the event of defalcation of funds, the administrative system would proceed according to rules and regulations.

5. INITIATING THE PROCESS OF PEOPLES' PARTICIPATION

(i) The concerned government department or a voluntary agency or a watershed community may initiate the idea of implementing a project of this nature by mutual consultation regarding the choice of the project area.

(ii) The specific points of the MoU that need to be deliberated upon, decided in the light of the model MoU, will be discussed and finalised within a month without reference to an authority above the district level.

(iii) Upon receiving a letter of intent from an officer of the development, the NGO and the watershed community shall initiate the process of organizing various activities and self-help thrift groups by organizing village level meetings with the field level functionaries of the concerned development department.

(iv) The project activities and their financial outlays on a yearly/six monthly/quarterly basis will be worked out and entrusted upon specific self-help thrift groups of actual workers for each activity within three months and intimation to this effect will be sent to the concerned officer of the development department, whereupon the final draft of the MoU will be sent to all concerned.

(v) On signing of the MoU, the Project Committee will release funds on a quarterly basis into the bank account of each self-help thrift group activity-wise and the bank account of the MKM for its activities to be replenished every quarter to ensure proper utilization.

6. PROJECT COMMITTEE

This will be a joint management arrangement between NGO and governmental system to be negotiated.

ANNEXURE – II

LEDGER FOLIO : _____ **DIARY NO. :** _____

NAME OF FARMER : _____

SIGNATURE OF FARMER

NATIONAL WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS (NWDPRA)

SUMANGAL DIARY

(A FARMER'S PASS BOOK)

NAME OF MICRO-WATERSHED : _____

VILLAGE/PO/BLOCK/TALUKA : _____

_____ DISTRICT

_____ STATE

1. This Sumangal Diary (Farmers' Pass Book) is both an identity card and a bench-mark record. It will also serve as a blue-print of micro-watershed plan for a farmer.
2. It is mandatory that all farmers, in a given NWDPRA micro-watershed, be issued this Diary.
3. This diary should be updated annually/tri-annually, as the case may be, and as indicated in the form.
4. Basic data on farmer should be filled in at the time of issue of this diary by project personnel.
5. Basic data on Forms I and II should be filled in by project team after a visit to and discussion with the farmers which should be repeated tri-annually.
6. Proposed work should be filled in by project staff after completion of survey of the farmland.
7. Actual work progress should be filled in by the executing staff.
8. Input/credit should be supplied to farmers only on production of this Diary and after making proper entries.
9. All inspecting officials should ask for the Diary, and verify and record their observation when they visit the farmers.
10. Project staff should discuss the details, as entered into in the Diary, with farmers.

BASIC DATA

(Page 3)

Name of Watershed Development Team Leader

District : _____ State : _____

1. (i) Name of the farmer _____
   (ii) Father's/Husband's Name _____
   (iii) Hamlet/Village/Post Office _____
   (iv) VLM Circle _____
   (v) Block _____
   (vi) Name of nearby Coop. Society/Bank _____
2. Social Group : SC/ST/BC/OC _____ Age _____ Years
3. Type of farmer : Marginal/Small/Big _____
4. Whether a Mitra Kisan of NWDPRA Yes/No
5. Whether a member of any Coop. or self-help group _____
6. Assets Position : As on _____ Date
   (i) Land (Acre/ha) Irrigated _____
   Unirrigated _____
   (ii) Livestock : Milch cows _____
   Milch buffaloes _____
   (NO) Calves _____ Goats _____
   Sheep _____ Bullocks _____
   Others _____
   (iii) Implements : Specify _____

   1. 4.
   2. 5.
   3. 6.

(Page 4)

7. Family details as on _____ (Date)
   (i) Size of family (Same kitchen)
   (a) Adult Male _____ (b) Adult Female _____
   (c) Earning _____ (d) Earning _____
   (e) Children _____ (f) No. of children immunised _____

(ii) No. of literate Members — Farmers _____
Other males _____
Other females _____
Children _____

(iii) No. of houses — Concrete _____
Tiled _____
Thatched _____

(iv) Consumer (durable) : Two-wheelers _____
(major items only) Radio _____ TV _____ Others_____

8. Estimated Family Income (per annum)

Agriculture	Rs._____
Livestock	Rs._____
Wages	Rs._____
Others (specify)	Rs._____
Total	Rs._____

9. Access to Common Property Resources

	Type of Common Property	Extent of Right	Whether Used(Yes/No)
(i)			
(ii)			
(iii)			
(iv)			

Signature of Officer
Incharge

Note : *This may be updated by project staff at the end of project.*

BASIC DATA ON FORM – I

(Pages 5-6)

As on _____

S. No.	Name of Parcel/ Survey No.	Source & Mode of Irrigation	Irrigated/U nirrigated	Area (ha)	Class of land	Crops generally grown	Soil fertility status; indicate only NPK deficiency	Applied fertiliser in terms of NPK or biofertiliser	Yield levels Kg/ha

BASIC DATA ON FORM – II

(Pages 7-8)

FOR THE BASIC YEAR _____

A. PRODUCTION DETAILS

Item	Variety	Total Production	Quantity			
			Retained for		Marketed	Value marketed
			Home	Seed		
a. crop i. ii. iii. iv. v. vi. b. Fodder 2. Livestock	 i. Milk ii. Calves iii. Eggs iv. Birds v. Animals vi. Others					

B. SAVINGS AND INDEBTEDNESS

(a) Savings

(i) Banks etc. Rs. _____
(ii) Jewels etc. Rs. _____
(iii) Money lent out Rs. _____
(iv) Others Rs. _____

(b) Indebtedness

Outstanding loans	Source	Year	Purpose	Amount	Interest Rate

Note : Not to be repeated every three years

PROPOSED PROJECT WORKS AS PER SURVEY PLAN

(Pages 9-10)

Year	Parcel Name/ Survey No.	Area	Nature of Work	Extent of work	Estimated expenditure	Subsidy

Note : *To be filled by project after survey and planning has been completed.*

DETAILS OF ACTUAL WORK DONE

Year	Parcel Name/ Survey No.	Area	Nature & Extent of Work	Employment (mandays)	Actual expenditure	Subsidy	Reason for deviation, if any

CULTIVATION PROGRAMME BY FARMERS

(Pages 13-15)

Year and season	Parcel name/ Survey No.	Crops/ variety	Season	Area	Irrigated/ Unirrigated	Certified seed fertilizer Bio-fertilizer (Qty)	PP Measures with details of hired labour	Production Kgs/ha	Remarks whether recommended programmes/ package adopted etc.

FOOD BUDGET

(Page 16(a))

Qty of food required for th family Kgs/annum		Produced on farm	Production retained		Qty marketed	Qty purchased	Balance surplus/ sufficient/ deficient
Type	Qty	Qty	Home consumption	Seed			Kgs

Cereals

Oilseeds/

Pulses

Milk

FODDER BUDGET

(Page 16(b))

Year	Type of Fodder	Cropping season proportion as %				Balance surplus/ Sufficient Deficient (Qty)	Non-cropping season proportion as %				Balance surplus/ sufficient/ deficient (Qty)
		Grazing	Own farm	Sold	Purchased		Grazing	Own farm	Sold	Purchased	
	Green Dry Green Dry										

WATER BUDGET

(Page 16(c))

Year	Purpose	Monsoon Season (Kharif				Balance surplus/ sufficient/ deficient	Dry season (Rabi)				Balance surplus/ sufficient/ deficient
		Source of water	Distance to water source	Adequacy of water			Source of water	Distance to water source	Adequacy of water		
				Own	Purchased				Own	Purchased	
	Crops (Area										
	Human Cattle Crops										
	Human										

LABOUR BUDGET

(Page 16(d))

Year and season kharif/ Rabi/ Other	Purpose (cropping operation etc.)	Manday of labour		Hired Labour		Extent of shortage (mandays)
		Family	Hired	Adequate Yes/No	From Same/ Next village	

CULTIVATION PROGRAMME BY FARMERS

(Page 17)

Year	Parcel name	Crops/ variety	Season	Area	Irrigated/ Unirrigated	Fertiliser/ Bio-fertiliser (Qty)	PP Measures	Production Kgs/ha	Remarks whether recommended practicxes adopted, etc.

PACKAGE OF ASSISTANCE AVAILABLE TO FARMERS IN THE MICRO-WATERSHED

(Page 18)

Sl. No.	Source	Types of Assistance (specify quantity, loan, subsidy, concessional interest, etc.)
	A. Micro-watershed project	
	B. Other Agri. development project	
	C. Any other IRDP, etc.	

AGRICULTURAL INPUT SUPPLIED UNDER PROJECT _____

(Pages 19-22)

1. Whether a beneficiary under IRDP – Yes/No
2. If yes, give details.

Sl. No.	Date	Type of Input	Qty/ Units supplied	Free / subsidised/ full cash	Name and signature of supply agency

Note : Input through project Govt. agencies should be supplied only on production of this book. The staff in-charge should fill-up these details.

REMARKS AND SUGGESTION OF INSPECTING/SUPERVISING OFFICERS

(Pages 23-28)

Date/Time	Name and Designation of Officer	Brief Note by the Visiting Officer	Signature of inspecting Officer

INSTITUTIONAL LOAN TO FARMERS

(Pages 29-31)

Date	Name and Address of Institution	Purpose & Period of Loan	Amount of Subsidy, if any	Repayment Performance

Note : Institutions should provide assistance only on production of this book. Entries should be made by the institution concerned.

OTHER SPECIAL DETAILS

(Farmer's Fair, Training, Demonstration, Meeting of farmers' Sangha, etc. attended)

(Pages 31-35)

Date	Details

BENEFICIARY INDEX CARD

Village Ledger Folio No. _____

1. Name of Beneficiary_____
2. Year of record_____
3. Whether a Gopal. Yes/No
4. Major occupation. Agri. Labour/ Non-farm labour/ Livestock _____
5. No. of dairy animals _____ other livestock _____ other
6. Average no. of days of wage labour (mandays) :

Year	Kharif		Rabi		Others	
	Same Village	Outside Village	Same Village	Outside Village	Same Village	Outside Village

7. Access to Common Property Resources (CPR) :

Year	Type of CPR	Type of Access	Remarks on Rights

8. Involvement in NWDPRA Activities :

Month/Year	Activity	Employment (mandays)	Wages paid	Other benefits	Remarks

9. Milk Production :

Year	Production (Litres)	Sold (Litres)	Consumed (Litres)	Fodder available good/fair/poor	Remarks

ANNEXURE – III

PHYSICAL AND FINANCIAL ACHIEVEMENT MADE UNDER NWDPRA DURING 1999-2000 IN _____ STATE/UT

(Rs in lakhs)

Sl. No.	Activity	Unit	Target of 1999-2000		Achievement made during 1999-2000 (upto 12/99)	
			Physical	Financial	Physical	Financial
1	2	3	4	5	6	7
	BASIC ACTIVITIES					
1	Survey and Projectisation	Rs				
2	Training	No				
3	Establishment of Nurseries					
	I. Composite	No				
	II. Others	No				
4	Estt. & Management Cost	Rs				
5	Research					
	I. By ICAR/SAU	Rs				
	II. Field functionaries	Rs				
6	Estt. of Barauni Cahetna Kendras	No				
7	Innovative support/activities	Rs				
8	Formation of MKMs	No				
	Total for basic activities					
	ARABLE LANDS					
	(I) Conservation Measures					
1	Contour vegetative hedges	Ha				
2	Repairing of old soil conservation works	No				
3	Gully control measures	No				
4	Dead furrows contour cultivation	No				
5	Other activity	No				
	Total of conservation measures					
	(II) Production Systems					
1	Crop demonstrations					
	(a) Rabi	No				
	(b) Kharif	No				
2	Agro-forestry	No				
3	Dry land horticulture	No				
4	Organic farming system/No. of compost pits	No				
5	Homestead gardens	No				
6	Household production systems (No. of families)	No				
	Total of production systems					
	NON-ARABLE LANDS					
	(I) Conservation Measures					
1	Live fencing	Rmt				
2	Vegetative filter strips in place of diversion drains	Rmt				
3	Vegetative contour hedges	Ha				
4	Gully control measures	No				
5	Gabian structures	No				
	Total of conservation measures					

Sl. No.	Activity	Unit	Target of 1999-2000		Achievement made during 1999-2000 (upto 12/99)	
			Physical	Financial	Physical	Financial
1	2	3	4	5	6	7
	(II) Production Systems					
1	Overseeding of grasses for pastures development	Ha				
2	Planting of shrubs	No				
3	Silvi pastural and Past Dev.	No				
	Planting of trees	No				
	Total of production systems					
	DRAINAGE LINE TREATMENT					
	Bank stabilisation	Rmt				
	Upper reaches					
1	Live check dams	No				
2	Brushwood check dams	No				
3	Loose boulder check dams	No				
4	Small dugout sunken ponds	No				
	Total of upper reaches					
	Middle Reaches					
1	Loose boulder structures	No				
2	Earther structures	No				
3	Runoff management dugout ponds (WHT)	No				
	Total of middle reaches					
	Lower Reaches					
1	Limited nos of dugout structures (WHT)	No				
2	Gabian structures	No				
3	Removal of nala congestion and others	No				
	Total of lower reaches					
	Total for drainage lines					
	LIVESTOCK MANAGEMENT					
1	Castration of scrub bulls	No				
2	Natural breeding and other means of population control	No				
3	Cultivated fodder production	No				
	Total of livestock management					
	EMPLOYMENT GENERATION	Man days				
	GRAND TOTAL					

Note : Area targetted during 1999-2000 ha

Area treated during 1999-2000 ha

ANNEXURE – IV

DAC – AGRINDIA – NWDPRA

SCHEDULE FOR QUARTERLY REPORT BY POST-GRADUATE (AGR) APPRENTICE OR WDT LEADER FOR EACH MICRO-WATER SHED

I. IDENTIFICATION PARTICULARS :

1. State : ☐☐
2. District : ☐☐
3. Block : ☐☐
4. Micro watershed project : ☐☐
5. Year : ☐☐
6. Quarter : ☐
7. Date of reporting : ☐☐☐☐☐
8. Due date of reporting : ☐☐☐☐☐
9. P.G. (Agri) Apprentice or WDT Leader : ☐
10. Name of the P.G. (Agri.) Apprentice or WDI Leader :

II. (A) ACTIVITY-WISE EMPLOYMENT DETAILS :

Activity	Acty Code	Unit Cost Fixed by State Govt. for the Project Area (Rs.)	Labour Directly Employed under the Project			
			No. of Mandays		Wages	
			Men	Women	Men	Women
(1)	(2)	(3)	(4)	(5)	(6)	(7)

II. (B) ACTIVITY-WISE ACHIEVEMENT DETAILS :

Activity	Acty Code	Financial (Rs. 000)	Physical						Activity Code of other Acty If Any, in the Same Area
			Prod. (Mts.)	Area (ha)	Length (kms)	Nos.	Weight (Mts)	Value (Rs. 000)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

III. ACTIVITY-WISE IMPACT ON EMPLOYMENT

Activity	Acty Code	Labour Got Employment as Impact of The Project			
		No. of Mandays		Wages	
		Men	Women	Men	Women
(1)	(2)	(3)	(4)	(5)	(6)

IV. MIGRATION TO OTHER AREAS DURING THE QUARTER :

No. of Mandays		Wages	
Men	Women	Men	Women
(1)	(2)	(3)	(4)

V. INCIDENCE OF PESTS AND DISEASES :

	Crops Affected	Crop-Code	Area-Affected (ha)
	(1)	(2)	(3)
1.			
2.			
3.			
4.			

VI. FOOD GRAIN BALANCE :

		Self-sufficient – 1 Deficient – 2 Surplus – 3	If surplus, or deficient Specify how much
1.	Paddy		Mts.
2.	Coarse Cereals		Mts.
3.	Pulses		Mts.
4.	Oil Seeds		Mts.

VII. OTHER BALANCES :

1.	Fodder Balance		Mts.
2.	Milk		Mts.
3.	Fuel		Mts.

VIII. RAINFALL Cms.

IX. TRAINING AND FEEDBACK FROM FARMERS :

1. No. of Mitra Kisans attending 3-day training/ One day feed back session
2. (a) No. of one day village level training camps held
   (b) No. of farmers attending one day village level training

3. No. of Gopals trained in animal husbandry and management of Common Property Resources ☐☐☐☐

4. No. of meetings of Block level committee to supervise the project ☐☐

5. No. of meetings of farmers groups/village Panchayat to discuss the project ☐☐☐☐

6. No. of visits made by WDT

(a) Team as a whole ☐☐☐☐

(b) Individual members ☐☐☐☐

7. General Comments : (Very Good – 1; Good – 2; Poor – 3)

Training : ☐

Feed Back : ☐

Progress : ☐

X. PROJECT STATUS :

1. Financial Status : (Rounded to Rs.)

Opening balance of funds	Funds released by District	Funds utilised	Closing balance

2. Problems (Codes)

Financial : 1 ☐☐☐☐

Departmental coordination : 2

Supply of planting material : 3

Others (specify) : 4

Date :

Signature of
P.G. Apprentice / WDT Leader

XI. COMMENTS FROM NODAL OFFICER AT DISTRICT LEVEL ON THE PERFORMANCE

Very Good - 1 ☐

Good - 2

Poor - 3

Date :

Signature of
District Nodal Officer

DAC – AGRINDIA – NWDPRA

SCHEDULE FOR QUARTERLY REPORT BY DISTRICT NODAL OFFICER

I. IDENTIFICATION PARTICULARS :

1. State : ☐☐ 3. Year : ☐☐
2. District : ☐☐ 4. Quarter : ☐

II. FINANCIAL STATUS DURING THE QUARTER : (In Rs.)

Opening balance of funds	Funds released by District	Funds utilised	Closing balance

III. INSPECTION :

1. Watersheds inspected by the district level SMS

Block Code										
Micro Watershed Code										

2. Watersheds inspected by higher level officers (Dist. and State Levels)

Block Code										
Micro Watershed Code										

3. Watersheds inspected by scientists of State Agricultural University Extension Directorate

Block Code										
Micro Watershed Code										

IV. Number of Mitra-Kisans trainings conducted or attended by District Level SMS ☐☐

V. PROBLEMS (Codes) ☐☐☐☐

Financial : 1
Departmental coordination : 2
Supply of planting material : 3
Others (specify) : 4

Date :

Signature of
District Level Nodal Officer

DAC – AGRINDIA – NWDPRA

SCHEDULE FOR QUARTERLY REPORT BY STATE LEVEL OFFICER

I. IDENTIFICATION PARTICULARS :

1. State : ☐☐ 2. Year : ☐☐ 3. Quarter : ☐☐

II. FINANCIAL STATUS DURING THE QUARTER : (In Rs.)

Opening balance	Funds received from GOI	Total funds released to districts	Closing balance

District-wise release of funds and performance :

District Code	Funds Released	Performance Very Good – 1 Good – 2 Poor – 3

III. INSPECTION :

1. Micro Watersheds inspected by State level officers

District Code										
Block Code										
Micro Watershed Code										

IV. TRAINING AND COORDINATION :

1. Number of District level SMSs trained at State level ☐☐☐☐
2. No. of training programmes held for SMSs ☐☐☐☐
3. Number of Non-Governmental Organizations involved in organising farmers training and project evaluation ☐☐☐☐

4. Whether meeting of state level policy and implementation committee held during the quarter (Y/N) ☐

V. PROBLEMS (Codes)

Financial	:	1
Departmental coordination	:	2
Supply of planting material	:	3
Others (specify)	:	4

☐☐☐☐

Date :

Signature of
State Nodal Officer

DAC – AGRINDIA – NWDPRA

SCHEDULE FOR ANNUAL REPORT BY POST-GRADUATE (AGR) APPRENTICE OR WDT LEADER FOR EACH MICRO-WATERSHED

1. State :
2. District :
3. Block :
4. Micro watershed project :
5. Number of villages covered :
6. Agro-climatic region (ICAR) :
7. Year :
8. Rainfall : (a) Average per annum : cm
   (b) Current year : cm
9. Major soil class :
10. Population
    (a) Male :
    (b) Female :
    (c) Children :
    (d) No. of Families :
11. Number of
    (a) Agricultural Labourers :
    (b) Landless Labourers :
    (c) S. C. Families :
    (d) S. T. Families :
12. Total (a) Geographical area : ha
    (b) Area under agriculture : ha
    (c) Area under assured irrigation : ha

13. Land Holding

    Number of Families Holding

    (a) Less than 1 hectare
    (b) 1-2 hectare
    (c) 2-4 hectare
    (d) 4 & above hectare

14. Cropping Pattern
Area Under

	Crop	Crop Code	Area
(1)			ha
(2)			ha
(3)			ha
(4)			ha
(5)			ha

15. Cattle Population

(a) Milch Cattle

(b) Working Cattle

16. Number of Families Engaged in Other Economic Activities in Addition to Agriculture

(a) Dairy

(b) Poultry

(c) Fishing

(d) Piggery

(e) Others

17. Other Information

(a) No. of Co-op. Societies

(b) Total no. of members of Co-op societies

(c) No. of seed distribution centres

(d) No. of pesticide depots

(e) No. of grain godown

(f) No. of Mandies

(g) No. of implements repairing centres

(h) No. of pumpsets

(i) No. of tractors

(j) No. of tillers

18. Income Generation (Annual)	No. of families	Amount (Rs. 000)
(a) Surplus – Food grains		
(b) Horticulture		
(c) Milk and Milk Products		
(d) Wages		
(e) Remittances		

Date :

Signature of
P. G. Apprentice / WDT Leader

ANNEXURE - V

NATIONAL WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS

(PROFORMA TO BE MAINTAINED BY SELF-HELP GROUP PERFORMING THE CASTRATION)

Sl. No.	Name & Address of Livestock owner	No. of Bulls/calves castrated	Signature of Livestock owner	Amount payable to Self-Help Group	Remarks

ANNEXURE - VI

NATIONAL WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS

(Application form for availing financial assistance for purchase of breeding bulls and undertaking to maintain the same)

Name of the Watershed
District/State

Name of
W.D.T. Leader

Sir,

I/We the members of Self-Help Group, R/o the Village/Villages _____ _____ understand that financial assistance is available for purchase of breeding males of the breed of _____ cows/buffaloes.

I/We hereby apply for availing of the facilities and give an undertaking that I/We will charge the fee from the beneficiaries at the rate fixed by the WDT/MKM. We also give an undertaking that I/We would keep the animal in good health and would not sell it or gift it away. I/We may be provided the breeding bull of _____ breed in accordance with financial assistance of Rs. _____ for purchase of the animal.

Thanking you,

Yours faithfully

Name of the beneficiary/President/Secretary of Self-Help Group :

Recommendation of the Livestock Member of the WDT :

Recommendation of Mitra Krishak Mandal :

Rs. _____ provided and the bull of _____ breed procured and handed over to the beneficiary.

Signature of the recipient

Description of the animal

Age :

Colour :

Shape and Size alongwith identification mark to be recorded overleaf

ANNEXURE - VII

NATIONAL WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS

(Proforma to be maintained by the Self-Help Group performing the natural service for breeding)

Sl. No.	Name & Address of Livestock owner	No. of Animals serviced	Signature of Cow/Buffalo owner	Service charges payable to Self-Help Group	Remarks
1	2	3	4	5	6

ANNEXURE - VIII

NATIONAL WATERSHED DEVELOPMENT PROJECT FOR RAINFED AREAS

(Proforma for Register to be maintained at Watershed level regarding animals conceived and successful deliveries)

Sl. No.	Name of Beneficiary	No. of Animals Conceived		No. of animals in which deliveries were successful		Remarks
		Cow	Buffalo	Cow	Buffalo	
1	2	3	4	5		6

ANNEXURE – IX

Format for Socio-Economic and Health Status Survey

Date of Survey : Watershed :

1. Name of the head of family .....
2. No. of residents in the house : Male ..... Female.....
   Children below 5 yrs..... Total .....
3. No. of illeterates : Male..... Female..... Total.....
   (5 – 40 age group)
4. Type of house (a) Roof ☐ A. Straw/leaf B. Sheet C. Tiles D. Concrete E. Others
   (b) Walls ☐ A. Straw/leaf B. Sheet C. Wood panel D. Mud E. Brick/stone
   (c) Floor ☐ A. Mud/sand B. Cowdung C. Wood panel D. Cement E. Mosaile F. Tiles
   (d) Kitchen ☐ A. Indoor B. Outdoor C. With chimney D. No chimney
   (e) Latrine ☐ A. Indoor B. Outdoor C. Community D. No facility
   (f) No. of rooms..... (exclude kitchen, bathroom and toilet)
   (g) Electrification ☐ A. Yes B. No
   (h) Ownership ☐ A. Self-owned B. Rented C. Undivided family property
5. Fuel Used (a) Lighting ☐ A. Kerosene B. Firewood C. Candle D. Electricity
   (a) Cooking ☐ A. Firewood B. Biowaste C. Biogas D. Petroleum gas E. Kerosene F. Electricity
6. Type of stove ☐ A. Open hearth B. Closed hearth C. Kero. stove D. Efficient Choola E. Electric stove F. Gas stove
7. Inventory on family members

Name	Age	Sex	Marital status	Education	Employment status	Place of employment	Place of residence	No. of days residing in GP/year
1	2	3	4	5	6	7	8	9

iv. M. Married U. Unmarried

v. A. Illiterate B. Literate without school going C. Class 1-4 D. Class 5-7
E. Class 8-10 F. Class 10+2 G. ITI H. Diploma
I. Degree in Arts J. Degree in Science K. Computer L. Degree in Commerce
M. Masters Degree N. Ph.D. O. Degree in Engineering
P. Degree in Medicine

vi. A. Employed B. Self-employed C. Unemployed D. Registered unemployed

vii. Within the A. GP B. Block C. District D. Others

Viii Within the A. GP B. Block C. District D. Others

8. Assets of the family

Area of landholding (acres)		Area cultivated (acres)		Building on rent	Vehicles and type	Other assets
Inside GP	Outside GP	Inside GP	Outside GP	Total No.	Total No.	Total No.

9. Details on animal husbandry (number and income)

Cows	Buffaloes	Bullocks	Goats	Pigs	Chicken	Duck	Others	Annual Income

10. Employment and income of family members

Name of the employed family members	Primary employment/secondary employment						Income from other assets (Rs)	Total income (Rs.)
	Employment code	No. of days employed	Income (Rs)	Employment Code	No. of days employed	Income (Rs)		
i	ii	iii	iv	v	vi	vii	viii	ix

Employment codes :

A. Farmer B. Farmer and agri labour C. Agri labour D. Skilled labour

E. Unskilled labour F. Factory owner G. Fact. employee H. Govt. Servant

I. Trader J. Student K. Others

11. For children below five years

Name	Age	Sex	BCG0/1	Polio 0-5	Measles 0-5	DPT 0-5	Diarrhoea Y/N	Worms Y/N

If no vaccine is given, write 0, 1, 2 or 3 to indicate number of times the vaccine is given.

12. Any child born in last one year Yes/No Number.....

13. Any death in last two years Yes/No Number.....

Male Age.....yrs.....months

Female Age.....yrs.....months

14. Cause of death..... A. Pregnancy associated

B. Others (specify name)

15. Does anybody in the family suffer or suffered from the following illness in the last two years

Name	Illness

A. Prolonged fever (over two weeks) B. Goitre

C. Diarrhoea D. TB

E. Jaundice F. Typhoid

G. Encephalitis H. Fluorosis

I. Malaria J. Others

16. No. of handicapped persons, if any, in the family.

Assessment of Agricultural Production, Under the Watershed

Watershed :				
Village :				
I.	Crop	Area	Production	
			Before the project implementation	After the project implementation
a.	Paddy Kharif-P1			
b.	Paddy winter-P2			
c.	Paddy Rabi-P3			
d.	P1 + P2 + P3			
e.	P1 + P2			
f.	Wheat			
g.	Vegetables			
h.	Pulses			
i.	Oilseeds			
j.	Cereals			
k.	Sugarcane			
l.	Fodder			
m.	Banana			
n.	Mixed crops			
o.	Coconut			
p.	Arecanut			
q.	Cashew			
r.	Mango			
s.	Guava			
t.	Rubber			
u.	Fuelwood			
II.	***Problems in Agricultural Production***			
a.	Lack of irrigation water			
b.	Lack of improved seed			
c.	Lack of fertilizer			
d.	Lack of plant production			
e.	Lack of finance			
f.	Lack of land development			
g.	Lack of extension service			
h.	Lack of marketing facility			

III.	**Agricultural Inputs** **Place Item and Availability**			
a.	Fertilizer			
b.	Pesticides			
c.	Seed			
d.	New variety and crop			
IV.	**Credit Service** **Available in the locality**			
a.	Agricultural/commercial bank			
b.	Cooperative bank			
c.	Government departments			

Irrigation Land Utilization and Productivity

Watershed :		
Village :		
Details		**Area**
	Irrigated Land **Land Utilization Level**	
a.	Low	
b.	Moderate	
c.	High	
	Productivity	
a.	Increasing	
b.	Decreasing	
c.	Steady	
	Water Related Details	
	Dug wells (seasonal/perennial/pumping)	
	Tube wells (seasons/perennial/pumping)	
	Minor irrigation pond	

Farmer Reactions to the Scheme

I.	a.	Agriculture productivity	Beneficial	Harmful	Indifferent
II.	a.	Conjuncture use of surface and ground water			
	b.	Potential utilization			
	c.	Percentage of area irrigated in the command			
III.	a.	Productivity of crops/season/ unit of water			
	b.	On farm employment			
	c.	Net income from farm operations			
IV.	a.	Environmental problems			
	b.	Drainage related			
	c.	Erosion			
	d.	Pollution			
	e.	Salinity			
V.	a.	Farmers participation in training programme			
VI.	a.	Non-cooperation from department officials			
	b.	Any other problem			