VEGETATION

General Aspect of Vegetation

The area from the point of view of vegetation can be conveniently divided into three distinct parts. The northern part of the area (north of river Heran) is more or less plain with few scattered hillocks. The biotic factors are also quite evident in this area. The central part (south of river Heran upto Raisingpura) is more or less plain and mostly under cultivation but for a few low hillocks, which support forest vegetation in degraded condition. In contrast, the southern part is all hilly and is by far the richest as far as natural vegetation is concerned. Biotic activities are also minimum except in such areas as Ambadungar and Manka - Saidivasan. There are evidences to believe that the whole area must have been covered by a typical 'Northern dry mixed deciduous type' belonging to the sub-group 'tropical dry deciduous forests' (Champion and Seth, 1964), and that the present day forests along with their various degraded stages are a result of the extent of biotic factors operating in the various areas. In order to clearly elucidate these general observations, the various aspects of the vegetation have been described separately quite in detail under the following heads :

1. Forest Vegetation,

2. Aquatic vegetation,

3. Waste land and roadside vegetation,

4. Hedge flora and weed flora of cultivated fields.

1. Forest Vegetation

(a) North : As already pointed out earlier, there has been lot of development of agriculture in this area. Even the communication system is relatively better developed, with the obvious result that forests have been pushed to certain inaccessible areas like Fanai and Borgha. Often well-preserved forest patches are observed at Luni along the main road due to the efforts of forest officials, who have prevented illegal felling of trees and have also taken up large scale plantations of Teak.

Fanai :

Fanai, the highest peak in this area, is about 6 kms. north-east of Rangpur. It is 150 meters high and supports a dry deciduous forest with Tectona grandis as the dominant species. On the top of the hill, Tectona grandis, Adina cordifolia, Albizia lebbeck, A. procera, Dalbergia lanceolaria, Terminalia crenulata, T. bellerica, Boswellia serrata and Garuga pinnata were observed. The slopes are occupied by Butea monosperma, Morinda tomentosa, Emblica officinalis,

Holarrhena antidysenterica, Aegle marmelos, Cassine glauca and Cassia fistula are noted in order of their dominance. At the foot of the hill, Holarrhena antidysenterica, Kydia calycina, Holoptelea integrifolia, Oroxylum indicum, Mallotus philippênensis, Wrightia tinctoria, Bauhinia racemosa, Helicteres isora and Maytenus emarginatus are observed.

The woody climbers like Acacia torta, Cissus repanda, Combretum ovalifolium, Milletia auriculata, Tinospora cordifolia, Ventilago denticulata and Celastrus paniculata are observed on tall or medium sized trees. The low shrubs or herbs support Abrus precatorius, Cocculus hirsutus and Rhynchosia minima.

The undergrowth mainly consists of Nauracanthus sphaerostachys, Eranthemum roseum, Hibiscus vitifolius, H. lobatus, Azanza lampas, Desmodium gangeticum, Indigofera astragalina. In open areas, usually the grasses like Eragrostis viscosa, E. tremula, Perotis indica, Themeda quadrivalvis and Desmostachya bipinnata are common. The entry of the roadside weeds like Acanthospermum hispidum, Cassia tora, Digera muricata, Cassia occidentalis along foot-tracks in the forest interiors is a clear indication of the biotic activity in these forests.

The adjoining hillocks have a various stages of degraded forests, where most of the tree species have been felled

either by the local tribals or the foresters for their fuel requirement. In such areas coppiced shoots or very often even saplings of Tectona grandis, Holarrhena antidysenterica and Butea monosperma are noted (Plate 1).

Luni :

The forests at Luni are more or less on the plain or low hillocks. The forests are sparsely vegetated with scattered trees. Madhuca indica is the dominant tree species along with subdominant species like Butea monosperma, Diospyros melanoxylon, Holarrhena antidysenterica, Lagerstroemia microcarpa, Alangium salvifolium and Gmelina arborea. Absence of Tectona is possibly because of felling of these trees. In most of areas Tectona and Butea were observed in various stages of development.

On the open areas, many grasses like Sporobolus diander, Aristida redacta, Cenchrus pennisetiformis, Desmostachya bipinnata, Themeda quadrivalvis, Cymbopogon martinii and Perotis indica. Among these grasses are noted plants like Evolvulus alsinoides, Cleome simplicifolia, Cassia pumila, Indigofera colutea, Iphigenia indica, Urginea indica, Curculigo orchioides and Chlorophytum tuberosum. Weedy annuals or perennials like Cassia tora, Xanthium strumarium, Acanthospermum hispidum, Achyranthes aspera var. porphyristachya and Peristrophe bicalyculata are observed along foot tracks or

PLATE No. 1. Degraded forest of Tectona grandis and Holarrhena antidysenterica near Fanai.

often under the shade of trees.

Along the banks of a perennial stream and in moist places herbaceous plants like Atylosia scarabaeoides, Eleiotis monophylla, Crotalaria pusilla, Canscora diffusa, Hydrolea zeylanica, Lobelia alsinoides, Cyathocline purpurea, Cyperus pseudokyllingoides, C. difformis are observed.

Madhuca indica trees support epiphytic orchids like Aerides crispum, Vanda tessellata and terrestrial orchid Peristylus goodyeroides was observed on rocky ground under the shade.

(b) Central : The central part (south of river Heran upto Raisingpura) has more or less an undulating topography. The plains and the mounds are mostly brought under cultivation by the tribals, who inhibit areas closer to the lines of communication, especially the highway leading to the township at Kadipani or perpetual source of water. The incidence of biotic factors is, therefore, fairly high resulting in the degradation of the depleted forests (Plate 2).

Mohangadh :

The forests at Mohangadh, which are selected here as representative of the central region have sparsely spaced trees of Lagerstroemia microcarpa, Diospyros melanoxylon,

PLATE No. 2. Biotic interferences resulting in depleted forests along the roads.

Dalbergia latifolia, Butea monosperma, Alangium salvifolium, Morinda tomentosa, Acacia chundra, and Miliusa tomentosa. Teak is also present but is usually felled for domestic use by the tribals (Plate 3).

The undergrowth is also poor. In monsoon, many grasses like Desmostachya bipinnata, Eragrostis unioloides, E. viscosa, Paspalidium flavidum, Cymbopogon martinii are observed. Among the grasses, a few herbaceous plants like Enicostema hyssopifolium, Boerhavia diffusa, Goniogyna hirta, Evolvulus alsinoides, Amischophacelus axillaris, Iphigenia indica and Chlorophytum tuberosum are observed. Echinops echinatus, Acanthospermum hispidum, Crotalaria medicaginea, Xanthium strumarium and Cassia tora are noted along roadsides.

On a high mound is situated a fort 'Mohangadh' from which the whole area derives its name. The fort is in a dilapidated condition and supports a number of woody species like Boswellia serrata and Alangium salvifolium, herbaceous species like Lindenbergia muraria and Kickxia incana on its walls. Marsdenia tenacissima, a heavy climber, is also noted here.

The area within the four walls of the fort support luxuriant growth of Annona squamosa, Morinda tomentosa, Tectona grandis and Butea monosperma in different stages of

PLATE No. 3. Mohangadh - Lagerstroemia microcarpa along with Diospyros melanoxylon and Dalbergia latifolia.

development. The natural regeneration of these species in a protected area is a clear proof of the existence of a dry deciduous forest in the past (Plate 4).

(c) South : In comparision to the central part, the southern part in general, is having more hilly areas and is richer so far as the density of vegetation is concerned. Except near the periphery bordering the central part of the area, the forests in general are undisturbed, and belong to the 'tropical dry deciduous type'. These forests are dominated by Tectona grandis. The tropical forests in the extreme south, are of mixed deciduous type and not Teak dominated. These forests have developed along the streams or along the banks of river Narmada. The presence of a few evergreen tree species becomes conspicuous in these forests.

To present a clearer picture of the existing forest cover, a few localities like Manka - Saidivasan, Bunjer, Ambadungar, Handevdungar, Mahudabari and Hampheshwar have been selected for detailed descriptions.

Manka and Saidivasan :

These forests are situated at distance about 10 Kms. from Kawant. The biotic interference are maximum, because of development of Mines, Industries and urbanization. The tribals have settled on the plains near the hillocks by

PLATE No. 4. Natural regeneration of Teak along with other species at Mohangadh.

destroying forest for their convenience. The remnants of few forest species are observed. Mostly the plains and mounds are brought under cultivation in monsoon. The forest, therefore, shows a degraded stage.

The mounds support scattered tree species like Tectona grandis, Butea monosperma, Diospyros melanoxylon, Lagerstroemia microcarpa, Acacia chundra, Bombax ceiba, Holarrhena antidysenterica, Morinda tomentosa, Helicteres isora and Dendrocalamus strictus in order of their dominance (Plate 5).

Along the banks of the perennial stream, the herbaceous plants like Bacopa monnieri, Agaratum conyzoides, Anischophacelus cucullata, Lindernia oppositifolia, Cyathocline purpurea, Canscora diffusa, Vicoa indica, Saccharum spontaneum and Argemone mexicana are observed.

During post-monsoon and summer the undergrowth is very poor or all together absent. In monsoon, the open areas in the forest show the presence of Amischophacellus axillaris, Murdannia nudiflorum, Commelina paludosa, Neuracanthus sphaerostachys, Asparagus racemosus var. javanica, Pupalia lappacea, Curculigo orchioides, Crotalaria hirsuta, Tephrosia strigosa, Borreria stricta and many other grasses like Sporobolus diander, Themeda quadrivalvis, Perotis indica,

PLATE No. 5. Saidivasan - Biotic interference and the resulting degraded forests of scattered trees of Tectona, Butea and Diospyros. Saccharum spontaneum is conspicuous along the stream.

Aristida redacta, Setaria pallide-fusca as an undergrowth. Forest fringes and forest roads show the presence of weedy annuals or perennials like Cassia tora, Achyranthes aspera var. porphyristachya, Xanthium strumarium and Triumfetta rhomboidea.

Bunjer :

The area is mostly plain with few mounds around. Most of the area is brought under cultivation by the local tribes removing the forest cover. The presence of the tree species like Tectona grandis, Butea monosperma, Diospyros melanoxylon and Lagerstroemia microcarpa gives an evidence of the existence of tropical dry deciduous forest in the past, which is now on way to extinction.

Near habitation Borassus flabellifer, Madhuca indica, and Delonix regia are commonly observed. The plain areas and the barren mounds are brought under cultivation and inferior cereals like Jowar, Bajra, Maize, Millet are grown. The yield is poor because of poor soil condition and lack of fertilizer. (Plate 6).

During monsoon the open barren areas show the presence of Enicostemma hyssopifolium, Eranthemum roseum, Boerhavia diffusa, Borreria articularis, B. stricta, Tridax procumbens, Leucas stricta, Indigofera tinctorea, Lepidagathis cristata,

PLATE No. 6. Bunjer - Degraded forests, cultivated plains and the Toddy trees indicating human habitation.

Peristrophe bicalyculata and few grasses like Themeda quadrivalvis, Perotis indica, Heteropogon contortus, Setaria pallide-fusca.

A perennial stream passing through this area supports along the banks, tree species like Syzygium heyneanum, Derris indica, Tectona grandis, Butea monosperma and Borassus flabellifer. The herbaceous plants like Rotala serpyllifolia, Hoppea dichotoma, Lindernia parviflora, L. multiflora, Hygrophila auriculata, Caesulia axillaris, Cyperus compressus, C. eleusinoides, C. difformis, Fimbristylis ferruginea and F. bisumbellata are noted near water along the banks.

Ambadungar :

Ambadungar is about 12 Kms. away from Kawant in southward direction. The area consists of an intermittent chain of hillocks ranging from 200 to 300 meters in height. The forests are well preserved as felling of tree is strictly prohibited. The tree species are healthier as far as the pole size and girth are concerned. The density of tree population varies from place to place but in general the pattern is same as can be seen from plant species growing at various spots. The forest cover is, by far the richest as far as the natural vegetation is concerned.

The hillocks are rich in fluorite mineralization. Of late since 1963 the mining activity has begun. It is necessary

to compile the data regarding the vegetation of this area, which may not exist in the same state after some years. (Plate 7).

The forests on hillocks exhibit marked zonation. The top layer consists of tree species like Adina cordifolia, Albizia lebbeck, Lannea coromandelica, Boswellia serrata, Bridelia squamosa, Garuga pinnata, Terminalia crenulata, T. bellirica and Bombax ceiba. The middle layer consists of Tectona grandis, Diospyros melanoxylon, Lagerstroemia microcarpa, Butea monosperma, Anogeissus latifolia, Cassine glauca, Cassia fistula, Kydia calycina and Rhadermachera xylocarpa. The lower storey consists of Holarrhena antidysenterica, Wrightia tomentosa, Helicteres isora and Dendrocalamus strictus. A patch of forest is cleared by the inhabitants and brought under cultivation. This clearly indicates how biotic interference has reached some of the undisturbed forests. (Plate 8).

On these tree species are observed a large number of climbers or twiners like Hemidesmus indicus, Canavalia gladiata, Pueraria tuberosa, Merremia aegyptia, Abrus precatorius, Ampelocissus latifolia, Cayratia auriculata, Ventilago denticulata and Ipomoea sps.

The valley inbetween the hillocks support trees like Tectona grandis, Terminalia crenulata, T. bellerica,

PLATE No. 7. Ambadungar - Mining operations and the clearing of forests. In the background, forests of Adina, Tectona and Anogeissus may be noted.

PLATE No. 8. Ambadungar - A patch of forest cleared for cultivation showing Mangifera in the centre. On the sides are Tectona, Diospyros, Terminalia and Lagerstroemia.

Diospyros melanoxylon, Adina cordifolia, Cassine glauca, Butea monosperma, Holarrhena antidysenterica, Morinda tomentosa, Wrightia tinctorea, and Dendrocalamus strictus. (Plate 9).

The forest has a rich undergrowth during monsoon and post-monsoon periods mainly consisting of Neuracanthus sphaerostachys, Triumfetta annua, T. pentandra, Eranthemum roseum, Leea macrophylla, L. edgeworthii, Barleria cristata, B. prattensis, Pimpinella heyneana, Hibiscus lobatus, H. vitifolius, Plumbago zeylanica, Azanza lampas, Anisomelos ovata, Sida glutinosa, Centratherum phyllolaenum, Carvia callosa, Dyerophytum indicum, Lepidagathis cuspidata, Celosia argentea and a few grasses like Perotis indica, Paspalidium flavidum, Panicum antidotale, Themeda quadrivalvis, Heteropogon contortus, Setaria pallide-fusca, Eragrostis ciliaris and Saccharum spontaneum. (Plate 10).

Handevdungar :

It is situated near Ambadungar and represents the highest peak of the hillock range. The forest is rich as far as the vegetation is concerned. The biotic interference is very less. The general pattern is more or less same as that of Ambadungar forest. (Plate 11).

PLATE No. 9. Ambadungar - Valleys support Tectona along with Terminalia, Cassine and Adina. Depleted forests on plains in the background.

PLATE No. 10.

Ambadungar - Holarrhena antidysenterica and Morinda tomentosa with Carvia callosa, few grasses as an undergrowth.

PLATE No. 11.

Highest peak of Handevdungar with Boswellia serrata in the foreground.

The vegetation exhibits marked zonation. In addition to the usual associates, Mitragyna parvifolia, Diospyros melanoxylon, Morinda tomentosa, Acacia chundra, Tectona grandis, Cochlospermum religiosum, Dendrocalamus strictus, Sterculia urens, Albizia lebbeck and Balanites aegyptiaca are met with . (Plate 12).

Along roadside at the foot of hillock, the patch of forest shows Boswellia serrata and Adina cordifolia as dominant species alongwith Tectona grandis, Diospyros melanoxylon and Butea monosperma. (Plate 13).

In addition to the usual climbers and twiners noted at Ambadungar, the presence of Marsdenia tenacissima, Dioscorea hispida, D. pentaphylla, Rhynchosia rothii, Cryptolepis buchanani and Tinospora cordifolia is worth mentioning.

The conspicuous elements of the undergrowth of this forest are Carvia callosa, Lepidagathis cuspidata, Neuracanthus sphaerostachys, Costus speciosus, Tylophora rotundifolia, T. fasciculata, Celastrus paniculata, Desmodium neo-mexicanum, D. velutinum, Kirganelia reticulata, Sida alba and few grasses like Spodiopogon rhizophorus, Rottboellia exaltata and Panicum antidotale. During summer most of the annuals are dried up, but sturdy plants like

PLATE No. 13.

Adina cordifolia, the dominant tree species at Handevdungar.

PLATE No. 12.

Handevdungar - Diospyros melanoxylon, Morinda tomentosa, Acacia chundra, Tectona grandis, Dendrocalamus strictus and depleted forest in the background (a summer aspect).

Carvia callosa, Lepidagathis cuspidata, Neuracanthus sphaerostachys and dried grasses survive. (Plate 14).

Mahudabari :

The forest of Mahudabari is situated 3 Kms. away from Kadipani in southward direction. The area is more or less plain with undulating topography represented by few mounds. A perennial stream 'Banganga' traverses the area and travel from north to south draining its water into river Narmada. As the inhabitants are very few and scattered all over the area, the biotic interference is at its minimum.

The forests are of mixed deciduous type showing dominant species like Schleichera oleosa, Morinda tomentosa, Oroxylum indicum, Schrebera swietenioides, Hymenodictyon excelsum, Ficus virens, Acacia chundra, Alangium salvifolium, Stereospermum suaveolens, Dendrocalamus strictus, Helicteres isora and Spermadictyon suaveolens. Tectona grandis is less conspicuous as compared to the previously described forests. The trees and shrubs support usual climbers and twiners, but mention of Combretum ovalifolium, Butea parvifolia and Cissampelos pareira var. hirsuta is necessary. (Plate 15).

During monsoon rich undergrowth is seen below the tree species and on open areas inbetween them.

The elevated banks and rocky crevices along the stream

PLATE No. 14.

Handevdungar - Cassia fistula, Morinda tomentosa and Tectona grandis association. Carvia callosa, Helicteres isora, Dendrocalamus strictus as an undergrowth.

PLATE No. 15. Mahudabari - On the slopes Tectona grandis, Helicteres isora, Morinda tomentosa and Dendrocalamus strictus are noted.

of Banganga support Blumea fistulosa, B. malcolmii, Aerva sanguinolenta, Nepeta bombaiensis, N. hindostana, Waltheria indica, Leucas stricta, Eriophorum comosum, Woodfordia fruticosa, Kickxia romosissima, K. incana, Cynoctonum mitreola, Campanula dimorphantha and Lindenbergia muraria. (Plate 17).

Hampheshwar :

The forest of Hampheshwar is situated 6 Kms. south of Mahudabari. The topography and general configuration of the ground is more or less similar to that of Mahudabari. The river Narmada forms the southern boundary of the area and flows in east-west direction. The forest is of the mixed deciduous type showing the usual components like the one described above. In addition to this tree species like Dolichandrone falcata var. lawii, Soymida febrifuga and Hardwickia binata are observed at this locality only. (Plate 16).

2. Aquatic Vegetation

Various diverse habitats such as rivers, puddles, roadside ditches and marshes were studied. All these habitats exhibit a characteristic zonation of vegetation which is controlled mainly by the change in the water level during the year.

PLATE No. 16. Dominance of Hardwickia binata along Narmada banks at Hampheshwar.

Vegetation along river banks :

The area is traversed by three rivers and their tributaries. Of these Narmada is the biggest and forms the southern boundary of the area under investigation. It flows in east-west direction. River Heran situated in the northern region flows in east-west direction and drains its water in river Orsang. River Kara which is situated in the central region flows south-north and empties its water into Heran. All these rivers are perennial. River Dhaman and Sapan are semi-perennial type. A stream 'Banganga' flows in serpantine manner in most of the areas in southern part and joins river Narmada at Hampheshwar.

All these rivers and their tributaries show considerable fluctuations in water level during different seasons. The vegetation along the banks of the rivers has permanent and seasonal aspects in addition to an ephemeral aspect. In monsoon, the rivers are flooded and their water inundate large areas of the tributaries and low lying tracts. In these months only the permanent vegetation on the elevated banks exists and is dominated by trees or woody perennials and a few herbaceous annuals, especially during monsoon. This permanent vegetation is mostly edaphically controlled and water fluctuations do not seem to have any effect whatsoever as it is beyond the reach of water except during very heavy

floods. This vegetation which comprises of trees and shrubs forms the 'upper storey'.

The 'middle storey' which corresponds to the sloping or steep banks exhibits a permanent vegetation consisting of various shrubs, undershrubs and a few perennial herbs during summer and a number of annuals during the monsoon. The vegetation of this storey also does not show any great change, as to a large extent it is also edaphically controlled.

In contrast to the permanent vegetation, there is an ephemeral vegetation during dry months, on the banks near the water current. This aspect of vegetation is controlled by the water current. This forms the 'lower storey'. The ephemeral vegetation consists of submerged or emerged aquatics near the water and other water-loving annuals and perennials herbs on the wet, muddy or sandy banks. This ephemeral vegetation is completely destroyed when the water level rises during the monsoon.

The vegetation along these rivers exhibit clear vertical zonation, which is affected by biotic factors like plant cutting, grazing, widening of the rivers, removal of clay and sand for construction of embankments. In general, the vegetation of the river banks in the area under investigation is thin and sparse exhibiting a perponderance of perennial plant species.

River Narmada

Narmada is the largest among all and has a vast rocky and sandy beds throughout. It is a perennial type of river. It is usually flooded during the rainy season inundating large areas of low lying lands along its course. The water gradually recedes exposing almost completely the sandy or gravelly rocky banks during dry months. The fluctuations in water level influence the vegetation and demarcates various zones occupying the elevated banks, slopes and beds.

The permanent vegetation of elevated banks support a number of wild and cultivated tree species like Hardwickia binata, Dolichandrone falcata var. lawii, Anogeissus latifolia, Terminalia crenulata, Tectona grandis, Derris indica, Acacia nilotica ssp. indica, Ficus religiosa and F. benghalensis. (Plate 17).

The middle storey consists of woody perennials like Kirganelia reticulata, Vitex negundo, Nyctanthes arbor-tristis, Ficus hispida, Tamarix ericoides, Calotropis procera, Zizyphus nummularia, Urena lobata, Abutilon indicum, Pavonia zeylanica, Cassia occidentalis, Capparis sepiaria. These permanent components have a large number of associates consisting of climbing herbs or shrubs like Hemidesmus indicus, Canavalia gladiata, Rhynchosia minima, Merremia aegyptia,

PLATE No. 17. Hardwickia binata, Bombax ceiba and Tectona grandis on the banks of Narmada.

Ipomoea nil, I. pes-tigridis, Abrus precatorius, Coccinia grandis, Luffa acutangula var. amara, Cayratia carnosa and Asparagus racemosus var. javanica. With the begining of monsoon, a number of annual or perennial herbs appear on the hitherto open areas between the permanent vegetation and the whole area assumes a fresh green look. Most common early monsoon herbs are Enicostema hyssopifolium, Convolvulus microphyllus, Borreria articularis, B. stricta, Alternanthera pungens, Hybanthes enneaspermus, Cyperus rotundus and a large number of tall and low grasses. These grasses in the later half of monsoon become fairly tall. Of which the noteworthy ones are Apluda mutica, Sorghum halepense, Heteropogon contortus, Saccharum spontaneum, Themeda quadrivalvis and Cymbopogon martinii. The silvery white, shining inflorescence of Saccharum spontaneum above the dense foliage adds to the beauty of land scape at certain places. Other common low grasses are Cenchrus ciliaris, Chloris virgata, Digitaria adscendens and Cenchrus pennisetiformis.

The ephemeral vegetation of lowermost storey is controlled by the water current. At the advent of dry months, the water level recedes, exposing the sandy and rocky banks. The dry, sandy beds away from water current look barren but are sparsely vegetated with Xanthium strumarium, Cleome gynandra, Borreria articularis, Solanum surattense, Indigofera linifolia,

and Aristolochia brachiolata. In the escarpment and crevices along the rocky banks are found plants like Canscora diffusa, Rotula aquatica, Rungia pectinata, Rotala serpyllifolia, Lindenbergia muraria and Tridax procumbens. The wet sandy beds near water, support a large number of sedges and herbs like Cyperus laevigatus, C. pumilus, Eleocharis atropurpurea, Fimbristylis miliacea, Gnaphalium luteo-album, G. pulvinatum, Cochlearia cochlearioides, Rumex dentatus, Centipeda minima, Alternanthera paronychioides, Ranunculus sceleratus, Sutera dissecta, Potentilla supina, Mazus pumilus, Bacopa procumbens, B. monnieri, Veronica anagallis-aquatica, Salvia plebeia, Wahlenbergia marginata, Exacum pedunculatum, Ammannia multiflora and host of others. Amphibious plants like Cyperus difformis, Scirpus strobilinus, [illegible], Typha angustata, Sagittaria sagittiformis, Polygonum glabrum and Eclipta prostrata were observed along the banks at several places. In the slowly running water are found submerged communities of Potamogeton pectinatus, Najas minor, Hydrilla verticillata, Vallisneria spiralis and other algal species.

Kara and Sapan

River Kara flows through the central part of the area. River Sapan which is semi-perennial meets Kara at Kawant.

The permanent vegetation of elevated banks, in addition

to the usual tree species, consists of Lagerstroemia microcarpa, Ficus asperrima, Cassine glauca and Bridelia squamosa.

The middle storey consists of woody perennials. The rocky slopes show Achyranthes aspera var. porphyristachya, Plumbago zeylanica, Woodfordia fruticosa along with saplings of Alangium salvifolium and Derris indica. The lower sandy banks show the dominance of Tamarix ericoides, Vitex negundo and Homonia riparia.

Wherever the banks are muddy, they support a carpet vegetation consisting of Cynodon dactylon, Goniogyna hirta, Zornia gibbosa, Hedyotis corymbosa, Lindernia oppositifolia, L. crustacea and Indigofera cordifolia. The wet sandy beds near water support a number of sedges and herbs like Bulbostylis barbata, Cyperus squarrosus, Gnaphalium indicum, Ammannia baccifera and a few hygrophilous species like Alternanthera sessilis, Phyla nodiflora, Bacopa monnieri, Cyathocline purpurea and Conscora diffusa. Cyperus exaltatus, Aeschynomene indica, Caesulia axillaris, Hygrophila auriculata, Cyperus compressus, Fimbristylis miliacea, F. littoralis, Scirpus squarrosus are noted as amphibious hydrophytes.

Heran and Dhaman

The vegetation along the banks of Heran was studied at

Rangpur and Juna Kimarva and that of Dhaman at Panvad.

The permanent vegetation along the elevated banks consisting of tree species like Prosopis cineraria, Madhuca indica, Acacia nilotica ssp. indica, Mangifera indica, Derris indica and Borassus flabellifer. (Plate 18).

The middle storey consists of Vitex negundo, Tamarix ericoides mixed with Derris indica and Butea monosperma in various developmental stages. Also present here are Salvadora persica, Abutilon indicum, Urena lobata, Solanum incanum and a few seasonals like Phyllanthus asperulatus, Physalis minima, Solanum roxburghii and Vicoa indica.

The ephemeral vegetation appears on or near water after the water level recedes considerably. On the fringes of water surface and on water logged substrate a number of hydrophytes like Cyperus exaltatus, Polygonum barbatum var. gracile, Ludwigia perennis, Ammannia baccifera and a few hygrophilous species like Alternanthera sessilis, Phyla nodiflora and Bacopa monnieri are frequently observed. At few places Coix lacryma-jobi, Sorghum halepense and Saccharum spontaneum form dense clumps.

Banganga

Banganga is a small stream which flows in north-south

PLATE No. 18. River beds show Cyperus. Elevated banks support Borassus flabellifer, Mangifera indica and Madhuca indica. Fanai hill in the background.

direction, mostly through the forest areas ultimately draining its water into river Narmada at Hampheshwar. It remains dry in all seasons except monsoon. The vegetation along the banks was studied at Mahudabari, Rajghat and Hampheshwar.

The permanent vegetation of elevated banks in addition to usual tree species consists of Ailanthes excelsa, Moringa oleifera, Hymenodictyon excelsum, Diospyros melanoxylon, Bombax ceiba, Stereospermum suaveolens, Lannea coromandelica and Albizia lebbeck. These permanent components have a large number of associates consisting of climbing herbs or shrubs like Tinospora cordifolia, Combretum ovalifolium, Argyreia sericea, Butea parviflora and Ampelossisus auriculata in addition to the usual climbers and twiners.

On steep escarpments and slopes the woody perennials like Spermadictyon suaveolens, Helicteres isora, Holarrhena antidysenterica, Dendrocalamus strictus, Morinda tomentosa, Woodfordia fruticosa, Barleria prionitis and herbaceous annuals like Kickxia incana, K. ramosissima, Lindenbergia muraria, Eriophorum comosum, Nepeta bombaiensis, N. hindostana, Lavendula bipinnata, Leonotis nepetaefolia, Leucas aspera, Blumea fistulosa, B. malcolmii and Campanula dimorphantha. The pteridophytes like Actiniopteris dichotoma, Adiantum

lunulatum, Cheilanthes sp. and Selaginella sp. were observed. (Plate 19).

The muddy banks and moist places nearby show the presence of Alternanthera sessilis, Phyla nodiflora, Ammannia baccifera, Ludwigia perrenis, Bacopa monnieri, Rotala serpyllifolia, Canscora diffusa, Cyathocline purpurea, Agaratum conyzoides and Cyperus exaltatus.

The sandy and gravelly beds at places support pure strands of Vitex negundo.

Vegetation of roadside ditches and puddles

The roadside ditches and puddles are filled with water during the rainy season supporting free floating species like Spirodela polyrhiza, Azolla pinnata, submerged rooted species like Utricularia inflexa var. stellaris and rooted submerged plant with floating leaves such as Ipomoea aquatica, Marsilea quadrifolia.

The sloping banks have plants like Hemiadelphus polyspermus, Hygrophila auriculata, Caesulia axillaris, Eclipta prostrata, Alternanthera sessilis, Bacopa monnieri and Amischophacelus cucullata. In addition slightly away from water is a carpet vegetation chiefly consisting of Dentella repens, Enicostema hyssopifolium, Gnaphalium indicum,

PLATE No. 19.

Stream beds support Vitex negundo. On the escarpments Morinda, Lannea, Bombax, Woodfordia and Eriophorum are noted.

and G. pulvinatum.

In summer, when the upper banks have dried, Argemone mexicana, Xanthium strumarium, Hygrophila auriculata and Ammannia baccifera persist in a fruiting stage with whatever little moisture available. The dry beds support plants like Chrozophora rottleri, Coldenia procumbens, Heliotropium supinum, Cressa cretica, Polygonum plebeium, Solanum surattense, Grangea maderaspatana and Glinus lotoides.

3. Waste land and Roadside Vegetation

The waste lands near habitations are common all over. They are a result of grazing, as well as other human activities. The usual components of such vegetation are Withania somnifera, Martynia annua, Datura metel, Physalis minima, Amaranthus spinosus and Xanthium strumarium which occupy garbage heaps near about the villages. The waste lands due to over grazing usually support Tephrosia hamiltonii, Acanthospermum hispidum, Phyllanthes asperulatus, Cleome gynandra, Abutilon indicum and Alhagi pseudoalhagi. Certain tree species like Borassus flabellifer, Phoenix sylvestris, Mangifera indica, Tamarindus indicus, Azadirachta indica, Dalbergia sissoo, Pithecellobium dulce, Bauhinia purpurea, Acacia nilotica ssp. indica and Moringa oleifera are commonly

planted near habitation.

Along the roadsides - small roads, forest roads, cart tracks, foot tracks - various plant associations have been recognised.

(i) Xanthium strumarium - Cassia tora association

This is the commonest and most dominant association. The co-dominants are Crotalaria medicaginea, Cassia occidentalis, Tephrosia hamiltonii and Acanthospermum hispidum. During monsoon, a few spreading herbaceous plants capable of withstanding trampling are usually noticed. They are Goniogyna hirta, Alysicarpus monilifer, Boerhavia diffusa and a few spreading grasses. The sturdy perennials in dry, fruiting stage are the only survivals during summer.

(ii) Tephrosia hamiltonii - Cassia tora association

The common associates of this association are Sida alba, Tridax procumbens, Peristrophe bicalyculata, Setaria glauca, Dinebra retroflexa, Eragrostis unioloides and E. viscosa. The monsoon aspect is more or less similar to the previous association.

(iii) Xanthium strumarium - Acanthospermum hispidum association

This association consists of sturdy plant species,

avoided by human being and cattle because of certain defence mechanisms. The usual associates of this are Triumfetta rhomboidea, Achyranthes aspera var. porphyristachya, Anisomeles indica, Sclerocarpus africanus, Corchorus aestuans and Calotropis gigantea.

(iv) Tephrosia hamiltonii - Triumfetta rhomboidea association

The usual associates of this are Eragrostis viscosa, E. ciliaris along with Cassia tora, C. occidentalis, Solanum surattense and Sida alba.

(v) Xanthium strumarium - Crotalaria medicaginea association

The other plants noted here are Acanthospermum hispidum, Cassia tora, Tephrosia hamiltonii, T. hirta along with small herbaceous plants like Commelina nodiflora, Enicostema hyssopifolium, Digera muricata, Goniogyna hirta, Convolvulus microphyllus, Evolvulus alsinoides etc. After the monsoon, this seasonal vegetation dwindles and only the perennials persist in a dry, fruiting stage during the summer.

4. Hedge flora and weed flora of cultivated fields

Hedge flora :

To demarcate the boundaries of agricultural lands and residential areas, number of shrubs and trees are grown as hedges. These hedges support quite a large number of climbers and twiners. Number of herbs are also found under the shade of these hedge species. The hedge flora, thus consists of perennial shrubs, small trees, a number of climbing plants, supported on them and herbs.

Euphorbia neriifolia, E. tirucalli, Opuntia elatior and Lawsonia inermis are the only shrubs which are very commonly grown as hedge plants throughout the area. Other commoner shrubs met with in hedges are Cadaba fruticosa, Annona squamosa, Clerodendrum multiflorum, Zizyphus mauritiana, Z. oenoplia, Kirganelia reticulata, Abutilon indicum, Alangium salvifolium and Bougainvillea spectabilis. A number of trees like Acacia nilotica ssp. indica, Mangifera indica, Moringa oleifera, Derris indica, Bauhinia purpurea, Salvadora persica and Streblus asper are observed.

During monsoon, these hedges support a number of woody climbers such as Canavalia gladiata, Abrus precatorius, Mucuna pruriens, Maerua oblongifolia, Clitorea ternatea,

Pergularia daemia, Merremia aegyptia, Dregea volubilis, Marsdenia tenacissima, Leptadenia reticulata, Rivea hypocrateriformis and herbaceous climbers such as Coccinia grandis, Ipomoea obscura, Rhynchosia minima, Cissampelos pareira var. hirsuta, Mukia maderaspatana, Momordica balsamina, Ipomoea nil and Cocculus hirsutus. The herbaceous climbers disappear completely during the dry season.

Under the shade of these hedges many straggling or erect herbs like Blepharis maderaspatensis, Hybanthus enneaspermus, Peristrophe bicalyculata, Borreria articularis, Dipteracanthus prostratus, Pupalia lappacea, Leucas cephalotes, L. urticaefolia, Sclerocarpus africanus, Polygala erioptera, Launaea fallax and Rungia repens are commonly found.

Weed flora :

A large portion of the available land is under cultivation. Agriculture has almost reached to the foot of the hill. The crop plants and their weed flora, therefore, form an important part of the vegetation of the area under investigation.

Crops which are sown in monsoon and harvested in winter are called Kharif crops. Second crop season begins in the winter. This is a rainless period and the crops mature either

in the presence of artificial irrigation or by the moisture left in the soil on account of monsoon rains, or the heavy dew of the winter. The crop is harvested in dry months of February and March and is known as the winter crop or Rabi crop. In some areas after the Kharif crops, fields remain fallow. All these crops and the fallow fields support a variety of annual and perennial weeds.

Important Kharif crops are Oryza sativa (Rice), Pennisetum typhoideum (Bajra), Arachis hypogaea (Ground-nut), and Zea mays (Maize).

Most prominent Kharif weeds found in such fields are Ammannia baccifera, Aeschynomene indica, Alternanthera sessilis, Caesulia axillaris, Cyperus iria, C. difformis, Eclipta prostrata, Ludwigia perennis, Sesbania bispinosa, Cyperus rotundus, C. esculentus and Melochia corchorifolia.

Weeds of the fields other than paddy are Corchorus olitorius, Cleome gynandra, Euphorbia hirta, Hedyotis corymbosa, Abelmoschus manihot, Hibiscus panduraeformis, Cenchrus biflorus, Commelina diffusa, Eragrostis tenella, Phyllanthus maderaspatensis, P. urinaria, Trichodesma indicum and Sopubia delphinifolia.

The important Rabi crops are Cajanus cajan (Cajan pea),

Triticum aestivum (Wheat), Gossypium herbaceum (Cotton), Medicago sativa (Lucerne), Nicotiana tabacum (Tobacco) and Cicer arietinum (Gram). Most common Rabi weeds are Amaranthus spinosus, Anagallis arvensis var. coerulea, Asphodelus tenuifolius, Vicoa indica, Digera muricata, Chenopodium album, Cenchrus biflorus, E. microphylla, Eragrostis ciliaris, Melilotus indica, Vaccaria pyramidata, Linum usitatissimum, Tridax procumbens and a host of other herbs and grasses.

During winter and summer, the fallow fields exhibit a luxuriant growth of sturdy plants like Argemone mexicana, Dactyloctenium aegyptium, Dichanthium annulatum, Desmostachya bipinnata, Echinops echinatus, Grangea maderaspatana, Heliotropium supinum, Stemodia viscosa, Verbascum chinense and Trichodesma zeylanicum.