

## Ecological Assessment and Planning report

Jatdewala

April 2006

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### 1. Introduction

Watershed development is developing physical and biological elements for sustainable and self-reliant interdependence. Present watershed development projects are more focused on production approach and soil and water conservation are the core of activities. However for sustainable development, ecological perspective and long term planning of resources is essential.

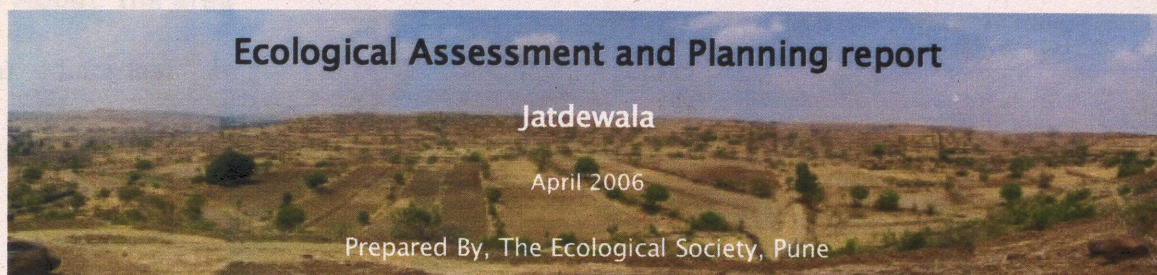
It is well known that during last many decades there has been drastic change in land use pattern and agricultural practices, which has resulted in depletion of natural resources and natural processes. To safeguard our future, ecologically appropriate land use must be planned, along with the ways to enhance productivity and self-sufficiency of the land in terms of water, energy and food.

As a methodology it was decided to carry out ecological survey on selected watershed and then decide upon the ecological interventions in the particular watershed which should be 'site specific.' Present report is the outcome of this three day survey, for ecological assessment, done by Ecological society during 15<sup>th</sup> to 17<sup>th</sup> March 2006. Ecological assessment is a screening tool to know the present situation and potential of the land. It is necessary to identify the status of existing biological diversity, natural resources and natural processes. In this assessment detailed analysis of soil, water, flora & fauna and natural processes is done. Based on the survey results, ecologically appropriate land use can be decided, along with the ways to enhance productivity and self-sufficiency of the land in terms of water, energy and food.

Components of Ecological Assessment:

- Natural resources.
- Bio-diversity.
- Ecologically important / sensitive sites. (includes difficult areas)
- Ecological Processes.

Report covers the information about the watershed area, its landscape analysis and treatment to the identified sites along with other supportive activities.



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## 2. About the area

### 2 a) Location:

The watershed is about 25 km towards South of Pathardi. (Longitude-75° 10' E, Latitude-19° 05' N) District Ahmadnagar and consists of Grampanchayat including villages and settlements Jatdeola, Shindewadi, Nakadewadi, Shekucha Tanda, and Aatharwadi.

### 2 b) Topography & Geology:

The villages are located in the near-circular watershed of the nala (fourth order stream), which flows towards West, and the watershed forms a part of the Sina river basin. The total area of the watershed bounded by the small hills from North, East and West sides is about 1442 ha. The Ridge tops exhibit flat undulating topography, with highest elevations of about 760m to 740m. The slopes of the hills are gradual, leading to the broader stream basins exhibiting elevation about 660m to 640m. Thus, in general, moderately flat ridges, moderately gradual slopes and the stream basins demarcate the topography of the watershed.

The watershed forms a part of the elevated plateau region towards the East of the Sahyadri Ranges, dissected by the drainage. This area falls in the rain shadow area of Sahyadri, characterized by semi-arid climate.

On broader basis, the volcanic basaltic rocks exposed in the watershed indicate different characteristics, which can be observed at different elevations with respect to the basalt flows. At the higher elevations, is exposed highly fractured Compact Basalt, which is highly weathered and is covered with varying soil cover at different hill tops. The middle elevations are characterized by the well-jointed Compact Basalt, which after weathering has formed the bouldery topography. Big boulders scattered in this region make it difficult for conventional land use by human beings. After this, separated by a small brecciated grayish red flow, in the lowest elevations in the watersheds, exposed at many places in the stream bottoms, is the Compact Basalt with fragmentary top.

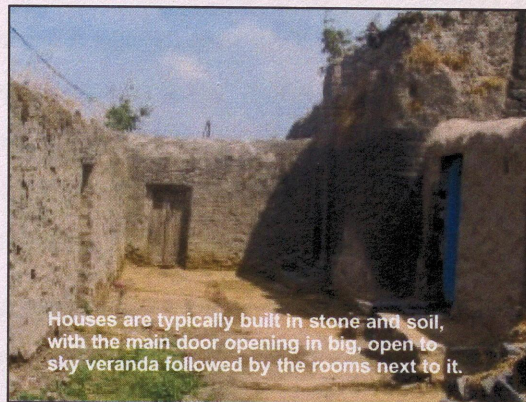
### 2 c) Rainfall and climate :

The average rainfall in the region recorded from 1993 to 2002 is 660mm. However, the rainfall varies a lot year to year as from 354mm in 1994 to 1152mm in 1998.

### 3. Socio economic picture of the village and its ecological implications

Total population is 2071 and it consists of 275 households and 334 families. There are 926 females and 1145 males. The literacy rate is average where 74 persons have completed matriculation and 39 individuals have passed out as graduates.

The village has an old story of 'Jats' inhabiting the village a few centuries ago. These Jats, originally of North India, were defeated by Rajasthanis (Kshatriya Badgujars) a couple of centuries ago and had to leave. Now there are people of various casts who stay in the village viz. Maratha, Gujar, Sutar, Marwadi Chambhar, Kumbhar, Nhavi, Kasar,



Mang, Mahar and Laman. A few Muslim families also stay in the village. There was substantial forest cover surrounding the village around half a century ago. There used to be many peafowl, wild boars, barking deer. The tirman community used to visit and hunt barking deer in the monsoon months of Ashadh and Shravan. This was stopped nearly 20 years ago.

People belonging to the same community/caste stay together in groups called *wadi* or *vasti*. Nakade vasti consists of vanzaris whereas tanda vasti is of banjaras. Daryavasti, Shembadevasti and Shindevasti are dominated by Marathas. Earlier this village used to be a marketplace where most of the shops were owned by marwadis. Now, as the market has moved to Pathardi, all the marwadis, except one, are moved out.

The main **occupation** of the villagers is agriculture. The Kharip crops include bajra, groundnut, onion, vegetables, warai and a few pulses like black gram (urid), matki, tur, moong, chawli, sesame, kulith etc. The rabbi crops include bengal gram (harabhara), wheat and jawar. The cash crops of the region are groundnut, cotton and onion which cover an area of 80 hectares. The agricultural practices have been influenced by modern farming. The farmers use chemical fertilisers like urea and sufala. Only one farmer (Bhanudas Pawar) is producing vermicompost.

But the revenue generated through this is not sufficient. Hence most of the people go for sugarcane harvesting on contract basis. Carpentry and smithy is done by a single family. Few families are engaged in brick making. The lamaan community used to produce charcoal by cutting trees from jungle. Now as the jungle has thinned, most of them have moved away. The new alternatives include transport providers, decorators.

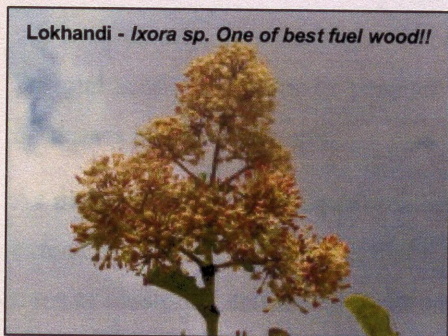
**Market system:** Most of the agricultural produce is sold at Pathardi by villagers. But it is not affordable to them as everybody takes his own produce to the market which is very low. So transport cost increases. There is no defined market linkages and fixed period for sale. Everybody takes his produce to the market whenever he needs money. This system needs to be refined to make livelihood better along with creating linkages for forest produce which is in very much neglected state right now. Interesting thing seen in the market was barter between marwadi and the villagers. Villagers exchange grains, cereals etc. for oil, mirch, spices etc. He is the only source of all the needful things including clothes, provisional goods and other accessories needed in the house. Marwadi takes the bartered good to the market place at Pathardi or Nagar for sale.

**Land use :** About 60% area of the watershed is under agriculture. Currently out of 696.5 hectares of cultivable land 36% land is irrigated and the rest is rainfed. Earlier agriculture used to be mainly rainfed. After the watershed development programme started water level in wells started rising and most of those have become perennial in last two years. As a result people have started taking crops in rabbi season also. There are 85 wells and 12 bore wells in the village.

**Land Owning :** 11% of the population is landless while 18% of families hold land less than 1 hectare. 48 % of families have an average land holding of about 1-4 hectare while rest 22% of population has more than 4 hectares. Average gross land holding per house is 4.25 hectares. 16 acres of land that belonged to the diety Durga has been given to harijans.

**Livestock :** The total livestock of village includes 1355 animals of which 25.6% are working animals, 14.6% are buffaloes , 2.5% are cross-bred cows, 16.2% indigenious cows and goats are 22.7%. The livestock is mainly fed with agricultural residue and grass. The village has a reserved grazing land (gairaan) of about 15 hectares which is used as a common pasture. But uncontrolled grazing is very much disturbing the area. Trampling causes compaction of the soil. Also regenerating flora is consumed by the cattle obstructing the development of cover types on the ground which is very necessary in these semi arid areas, leading to soil erosion. Stall feeding can be promoted here to save these ecological benefits along with improvement of grasslands and

Lokhandi - *Ixora* sp. One of best fuel wood!!



plantation of fodder species. This would also ensure the health of the cattle and milking capacity.

**Fuel :** Wood from trees like Neem, Babhul, Tantani, Wad, Lokhandi, Umbar, Henkal, Amoni-kamoni is used as fuel; of these Lokhandi is the most preferred. Dung cakes and kerosene are also used as fuel. Though, dried wood is preferred as fuel wood, even trees are cut for the same.

There is no sustainable practice for consumption of fuel wood. Energy plantations along the edges of the fields could be the best option.

**Medicinal Plants :** Neem, Bibba, Medshing, Arjun sadada, Apamari, Hadsandhi, Bel.

**Forest Food :** Consumption of forest food species is very low throughout the year because of unavailability of those species due to loss of their habitats. But some monsoon herbs like Tandulja, Kunjir, Pathari and Tarata are used as vegetable. During summer many forest fruits are available like Bibba, Bor, Kawath, Amba, Chinch.



Bibba – Forest food

**Village Deities :** There are old temples of lord mahadev, khandoba, hanuman and goddess durga. They celebrate a festival of goddess durga (Jatra, Utsav) on chaitra suddha teras (13th). Land around the Khandoba temple is reserved as God's land (Dewachi Jamin) and it is not used for cultivation.

There is no sanitation system in the village. Waste water is collected and let into the stream as it is which needs to be treated. Some villagers do composting of the waste in *Ukhanda*, a ditch just outside the house. The roof water is also let into it. This system needs to be promoted in the whole village.

#### 4. Landscape analysis

There are four well defined land classes which can be demarcated by the slope characteristics, land-use pattern, along with other ecological factors like the vegetation types, habitats and the weathering profiles and Geological characters. Landscape structure is revealed in these four land classes with potential landscape elements like vegetation clusters, streams, corridors and old growth trees. Each land element has certain ecological value. Many a times these land elements are not seen clearly. In such cases 'habitats' play an important role along with 'surrounding buffer'. So total ecological value or productivity of any land can be judged according to its land elements or classes and habitat units.

As discussed in the ecological history, the area is constantly under change and degraded to a great extent. But landscape still retains a set of natural patches and 'stepping stones' (i.e. old growth trees or clusters), connected by stream and riparian vegetation corridors. Also old abandoned

A habitat is the place where a population lives. The habitat must supply the needs of organisms, such as food, water, temperature, oxygen, and minerals. If the population's needs are not met, it will move to a better habitat.



Pandan, with grass clumps, serving as good habitat for birds like Bush quails. These can be the basis of a conservation pattern with links across the whole region.

#### 4 a) Plateaus

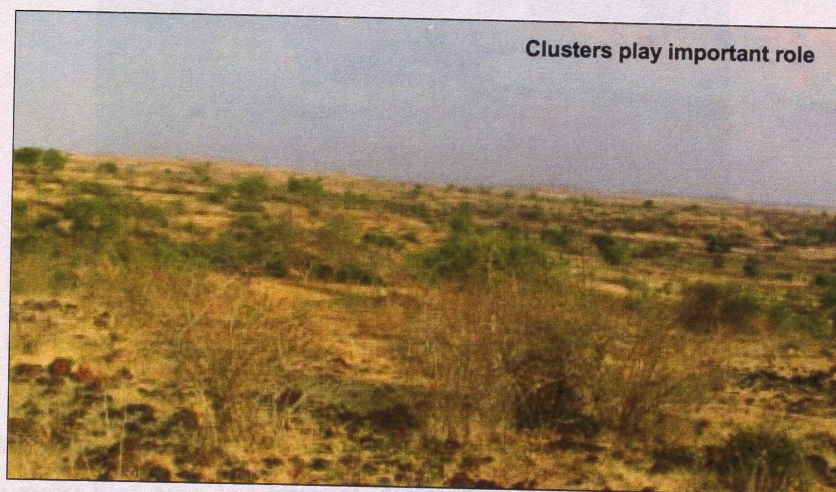
- Plateaus are mostly with rocky outcrops and with very less soil cover. Grasses is the



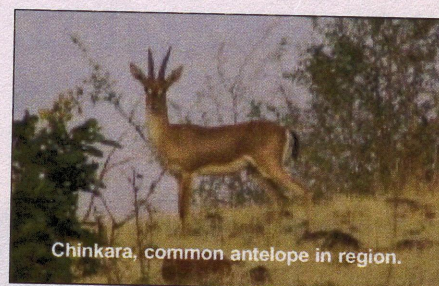
only dominant cover type community. Dusty racks on the plateaus are indication of biotic interference like human as well as cattle.

- Clusters play important role in this area. They have special functions like, maintaining and increasing diversity as they serve best as anchoring places for seeds, providing habitats for many insects, Soil and water conservation and aeration of soil, Pollination, Dispersal, Reproduction, Gene bank.
- Clusters are typically composed of Amoni kamoni (*Rhus mysorensis*), Karwand (*Carissa congesta*), Lokahndi (*Ixora*) along with Tanatni (*Lantata camara*), which is non-native shrub species invading the areas very fast.

- In semi-protected areas clusters hold relatively better diversity like Apmari (*Gymnema sylvestre*), *Sarcostemma*, Bartondi (*Morinda pubescens*), along with better regeneration of species like Ixora, Neem, Palas and Dhawada.
- At certain locations soil cover is good. It is seen being helped by the CCTs, WATs, and constructions of the bouldery walls. These can be very good sites for the development of the soil and then plantation of some ecologically important trees which can also serve as source of fuel wood or some forest food/product.
- Ecologically important sites (EIS): Clusters, heaps of boulders, stone walls, old growth trees – stepping stones and the good soil pockets.



- Fauna mainly comprises of many insects, arthropods, reptiles, birds and mammals like Chinkara. Chinkara herds are often seen here; even this antelope belongs to the mixed type of forest. Thus indicating the presence of forest ecosystem than a scrub or grassland ecosystem, which is usually assumed in drought areas.

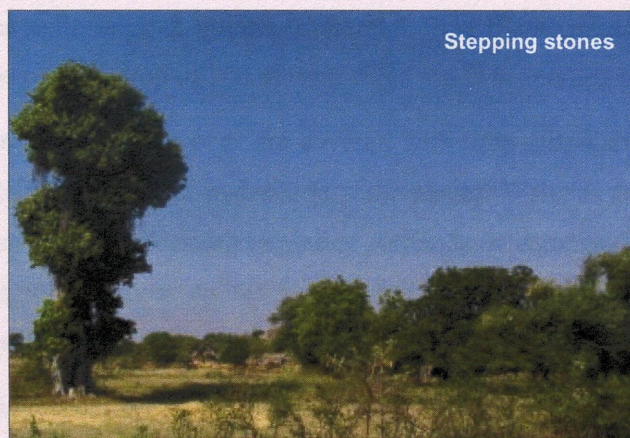


#### 4 b) Slopes

- Many slopes are terraced for agriculture, so they are either fallow or under cultivation. Settlements are at the bottoms of the slopes. The slopes in general are very steep towards valleys and gradual towards the spurs. But quality of soil is much degraded

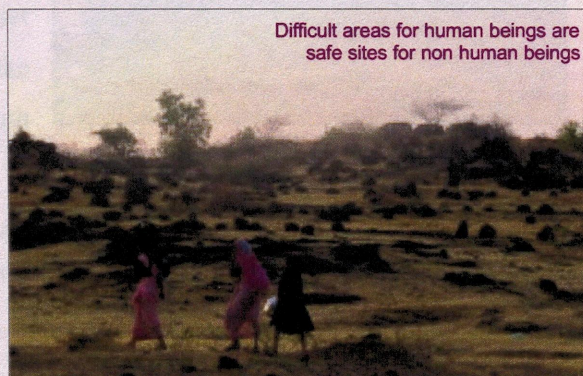
with very less humus content. These terraced fields are under rainfed cultivation of Harbhara, Corn and Cereals. Slopes which are steep or not suitable for agriculture are left barren. This serve as 'safe sites' for wild life. Such slopes are mostly covered with grasses along with infrequent bushes of Tantani (*Lantata camara*) and Utkatar (*Echinops spp*).

- Old growth trees play important role in terraced fields. E.g. Amba, Chinch, Wad on the



edges of the fields. Such trees are called 'wolf trees' giving shelter to various flora and fauna at different levels. Many a times they support the huge climber of Piwalyel, *Combretum albidum*. The ground level buttress roots and lower branches support much insect diversity like Ants and termites. Holes in the old boles are used by nocturnal birds like owls. Top canopy serves as roosting places for Bird of prays like Kestrel.

- Fauna ranging from insects, arthropods, reptiles, birds to mammals. Bees and birds are relatively in more number than plateaus; may be due to food and shelter availability. The presence of honey- bees (*Apis sp.*) indicates the availability of flowers all year round.
- Slopes in the middle belt all along the watershed have scattered boulders. This has made the complete zone a difficult terrain and no agriculture or settlement or any other land use is not possible. These boulders provide shelter for wild life; at some places accumulated soil provide good substrate for organisms. This zone of several meters in width is a very important site



from ecological perspective and needs to be protected. In the monsoon survey, detailed assessment is planned to see if any medicinal or rare species or wild life inhabit this particular zone.

#### 4 c) Streams

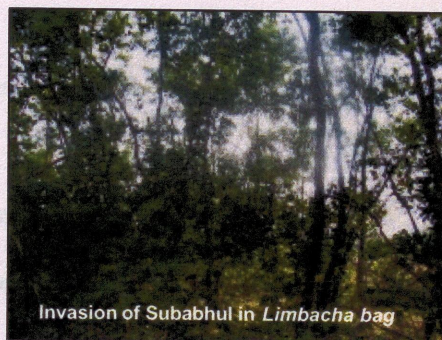
- Most of the streams have raised fields on either sides of it, which increases the apparent depth of the stream. The stream has moderate amount of vegetation along its bank. The inflows of matter both biotic & abiotic (minerals) from the surrounding area is high. The main streams cover a drop of 100 m from ridge top to watershed boundary.
- Most of the stretches of stream beds are covered with transported soil, clay, and sand along with the dead, fallen plant material at some places. Water is accumulated in the stream at frequent locations forming miniature wetlands or lagoons. Water is stagnated in these puddles which boost up the insect activity; also it is used as wallow by domestic animals like buffalo.
- Vegetation along these wet courses is mainly *Cyperus*, *Polygonum*, etc. with invasive species like Besharam. Dense grass patches are also providing good habitat for smaller wild life. Few islands are formed in streams which are comprised of *Lantana* clusters along with some regenerating trees like Jambhul and Umbar. Old growth trees growing across the stream or dead wooden logs serve as insect galleries.
- Presence of moisture boosts a different set of fauna. Birds like Waterhen, insects like Water skaters which are associated with water body are present here.
- Main stream is the most potential element in the whole landscape. It is a multi order stream receiving waters from many 1<sup>st</sup> orders, 2<sup>nd</sup> order and 3<sup>rd</sup> order streams like *Adhalwadicha odha*, *Uphalicha odha* and *Mohashetacha*. Instream habitats like boulders, root wads, animal wallows, provide food and shelter to innumerable life forms right from aquatic to terrestrial.



Dense canopy over the stream maintain moisture and create good habitats.

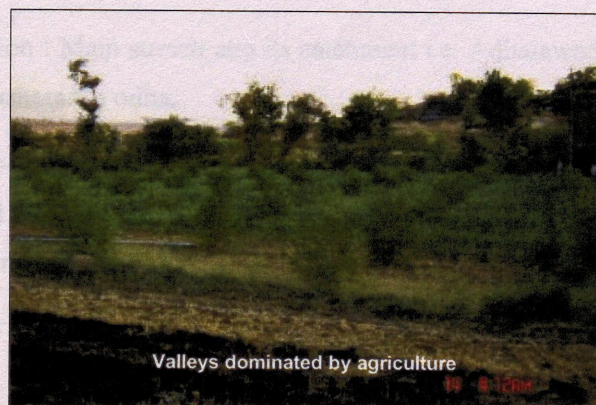
#### 4 d) Streamside or riparian zone

- Vegetated corridors along the stream allow species movement and a wide range of ecological benefits not otherwise obtained such as erosion control, nutrients, and fish habitat, insect galleries etc. Most of the streams, though infrequently vegetated, exhibit better functionality.
- Old growth trees along the streamside are providing shelter to birds like Paradise flycatcher.
- Streamside vegetation typically comprises of riparian flora like Arjun, Karanj, Jambhul, Umbar etc. Interesting thing is that the tree species Ramphal, Sitaphal, which are not a component of natural vegetation, are seen regenerating here, though there is no intense horticulture of those species anywhere else in the watershed. This may be due to transportation of seed to the stream sides some years back.
- Invasion of Lantana and Subabhul is threatening the original vegetation in some patches. It was told by locals that one patch of Neem trees which was known as *Limbolyancha bag* is completely taken over by Subabhul.



#### 4 e) Valley bottom

Agriculture is dominant in the valley bottoms. Alluvial pans which are ideal for agriculture are very few along the streams. Most of the agriculture terraces in the bottom are comprised of pediment. Edges of the fields are mostly open except for few old growth trees like Mango, which are serving as stepping stones in the landscape. Hedges are lacking. At some places Niwdung hedge is planted specially for protection.



## 5. Ecological Planning and Management

After assessing the area ecologically, potential of the watershed is concluded so as to start the ecological activities at the watershed. It can be done in two ways,

- By changing the approach and procedures of current standardized activities,
- By treating some areas in watershed ecologically.

In first case, concrete changes can be suggested after the second survey or year round survey and more interaction with the watershed committee. Right now it can be started with the native plantations. List of appropriate species is given in the next section.

From the assessment it is understood that the treatment can be given as per the land classes as the status of degradation, strata, quality of soil, availability of moisture changes as per the land class. So those areas are identified during the survey which are suitable for this kind of work. These are called as Ecologically Important Sites (EIS)

### 5 a) Ecologically Important Sites (EIS) and its treatment

#### 5 a) i - Common property land

- Area and location : Common grazing land (Gairan) Survey no. \_\_\_\_\_ 5-6 acres
- Objective : Grassland improvement for better quality fodder, superior grasses. Increasing microbial activity.
- Treatment : For first year -
  - a. Protection i.e. fencing with thorns or stone wall.
  - b. Addition of biomass to the piece of land i.e. crop residue, grass mulch, etc.
  - c. Spreading dung and cow urine
  - d. Introducing superior quality grass seeds

#### 5 a) ii - Streams

- Area and location : Main stream and its catchment i.e. Adhalawadicha odha, Uphalicha odha and Mohashetacha odha.
- Objective : To increase moisture spread along the riparian patch, which will boost plantations and regeneration along the stream, create canopy along the stream which can act as a corridor.
- Treatment : For first year -

- a. Continuous protection to the streamside buffers for the suggested areas (Survey no.s \_\_\_\_\_) i.e. fencing with thorns or stone wall.
- b. Creating obstacles i.e. fencing on the cattle paths across the stream.
- c. Dispersal of native seeds
- d. Plantation of native trees
- e. Creating loose boulder dams near root wads.

**5 a) iii - Difficult areas for microbial reserve**

- Area and location : Bouldery areas in the upper catchment. Actual location will be decided after discussion with the individual land owners.
- Objective : To increase microbial activity in the soil so as to promote natural succession.
- Treatment : For first year -
  - a. Protection i.e. fencing with thorns or stone wall.
  - b. Addition of biomass to the piece of land i.e. crop residue, grass mulch, etc.
  - c. Spreading dung and cow urine

**5 a) iv - Area around the Khandoba temple**

- Area and location : Survey no. 112 A and 112 B.
- Objective : To develop a Sacred grove.
- Treatment :
  - a. Protection i.e. fencing with thorns or stone wall.
  - b. Addition of biomass to the piece of land i.e. crop residue, grass mulch, etc.
  - c. Plantation of common and uncommon, rare species.

**5 a) v - Vegetated patch - WAT area in survey no. 405**

This area already has better canopy of dense clusters and regenerating trees of various heights. So it is easy to accelerate the process of canopy formation. Some locally uncommon species are being conserved here. So this patch can be converted into good gene bank or mother plants required for nursery.

- Area and location : Survey no. 405, 3-5 acres
- Objective : To develop canopy to conserve uncommon species found in this area.
- Treatment :
  - a. Protection i.e. fencing with thorns or stone wall.

**5 b) Management of vegetation as per land classes (Plantation of native species, Protection and habitat creation)**

Plantation of species could become supportive to the livelihood if it is planned properly along with the development of market links for various products generating from plants. This system can be evolved through training of the villagers for the same. So, ecological benefits of management of vegetation are given below along with plant lists which can be used commercially.

**5 b) i Ridge top**

Objective: To convert ridge top into a dry deciduous forest cover

Treatment :

- Creating "Sponge effect" - Together with well stocked grassland, soil and ground cover improvements
- Fencing - Dry and Live hedge List1
- Plantation - Native and Economic List2
- Protection to special habitats

**5 b) ii Slopes and plains**

Objective: To develop an alternative non agricultural tree based production system and bio diversity enhancement *together with*

Treatment :

- Protection
- Plantation of non timber tree crops (forest food) List3
- Plantation of shrubs and grasses for fodder List4
- Seed dispersal
- Protection to difficult areas, rare plants

**5 b) iii Streams**

Objective: Restoration of streams to increase infiltration, slow down run off and create habitats.

Treatment :

- Bank protection by maintaining a buffer zone
- Plantation of aquatic and water tolerant species List5

- Habitat creation through instream overflow obstructions to increase instream vegetation
- Protection to riparian vegetation

#### 5 c) Nursery of native plants

Nursery of native and rare or special plant species which needs to be created at the watershed as these saplings are not readily available at the nurseries. In this nursery, common species for mass plantation, commercially valued species and medicinal species can be grown along with the special species which needs to be conserved.

#### 5 d) Education and training programmes for villagers

Capacity building of locals is important for effective implementation and future maintenance. The perspective building as well as skills development training will be required for the local community, community organisations and the project implementing agency. Hence orientation training for project staff is suggested.

In a dry area is it proper to place so much emphasis on plantation? What about water availability to sustain it? If it is to be rain fed, it will result in drying up soil moisture. Stress on natural regeneration, plantation only at strategic places will be a better strategy.

## 6. Annexure I

## 6 a) Flora list

| Sr. No. | Scientific Name               | Common Name    | Remarks                                   |
|---------|-------------------------------|----------------|---|
| 1.      | <i>Acacia nilotica</i>        | Babhul         | Timber for agricultural equipment.        |
| 2.      | <i>Acacia leucophloea</i>     | Hivar          |   |
| 3.      | <i>Acacia catechu</i>         | Khair          | Timber and Tannin value                   |
| 4.      | <i>Albizia lebbbeck</i>       | Shirish        |   |
| 5.      | <i>Albizia procera</i>        | Kinai          |   |
| 6.      | <i>Alianthus exelsa</i>       | Maharukh       | Soft wood tree                            |
| 7.      | <i>Aegle marmalos</i>         | Bel            | Forest food and Medicinal use             |
| 8.      | <i>Anona squamosa</i>         | Sitaphal       | Forest food sp.                           |
| 9.      | <i>Anona reticulata</i>       | Ramphal        | Forest food sp.                           |
| 10.     | <i>Azadirachta indica</i>     | Neem           | Timber and Medicinal IMP sp.              |
| 11.     | <i>Bauhinia racemosa</i>      | Apata          |   |
| 12.     | <i>Boswellia serrata</i>      | Salai          | Medicinal sp.                             |
| 13.     | <i>Bridelia retusa</i>        | Asana          | Forest food and Timber sp.                |
| 14.     | <i>Buchanania lanzan</i>      | Char           | Forest food, Fruit edible .               |
| 15.     | <i>Butea monosperma</i>       | Palas          | Timber                                    |
| 16.     | <i>Citrus medica</i>          | Limbu          | Edible fruit                              |
| 17.     | <i>Cordia macleodii</i>       |                |   |
| 18.     | <i>Cordia myxa</i>            | Bhokar         | Edible fruit                              |
| 19.     | <i>Dalbergia sisoo</i>        | Shisoo         | Timber useful                             |
| 20.     | <i>Diospyros Montana</i>      | Tembru         | Forest food sp. Leaf used for Bidi.       |
| 21.     | <i>Erythrina suberosa</i>     | Pangara        | Fodder valuable                           |
| 22.     | <i>Euphorbia tirucalli</i>    | Sher           | Medicinal use                             |
| 23.     | <i>Emblica officinalis</i>    | Avala          | Forest food, Medicinal                    |
| 24.     | <i>Eucalyptus maculate</i>    | Nilgiri        | Non native species                        |
| 25.     | <i>Feronia limonia</i>        | Kavath         | Forest food, Edible fruit                 |
| 26.     | <i>Ficus bengalensis</i>      | Vad            |   |
| 27.     | <i>Ficus recemosa</i>         | Umbar          | Fruit edible                              |
| 28.     | <i>Ficus cordifolia</i>       | Payar          |   |
| 29.     | <i>Ficus tsiela</i>           | Pimpri         |   |
| 30.     | <i>Gmelina arborea</i>        | Shivan         | Medicinal IMP sp.                         |
| 31.     | <i>Ixora brachlata</i>        | Lokhandi       | Fuel wood sp.                             |
| 32.     | <i>Launnea coromandallica</i> | Moi            |   |
| 33.     | <i>Leucena leucocephala</i>   | Subhabul       | Non native species Leaves used for fodder |
| 34.     | <i>Madhuca indica</i>         | Moha           | Forest food sp. Flowers edible            |
| 35.     | <i>Melia azedarach</i>        | Bakan-Nimb     | Fodder valuable sp.                       |
| 36.     | <i>Mitragyna parviflora</i>   | Kalam          | Timber sp.                                |
| 37.     | <i>Moringa oleifera</i>       | Shewga         | Edible sp.                                |
| 38.     | <i>Morinda tinctoria</i>      | Bartondi       |   |
| 39.     | <i>Mangifera indica</i>       | Amba           | Timber and edible fruit                   |
| 40.     | <i>Phoenix sylvestris</i>     | Shindi         | Fruit edible                              |
| 41.     | <i>Pithecolobium dulce</i>    | Vilayatichinch | Non native species Fruit edible           |

|                 |                               |               |  |
|-----------------|-------------------------------|---------------|--|
| 42.             | <i>Pongamia glabra</i>        | Karanj        | Seed useful for Bio- diesel              |
| 43.             | <i>Psidium guavaja</i>        | Peru          | Fruit edible                             |
| 44.             | <i>Santalum album</i>         | Chandan       | Useful for oil                           |
| 45.             | <i>Semicarpus anacardium</i>  | Bibba         | Forest food and Medicinally Valuable sp. |
| 46.             | <i>Soymida febrifugu</i>      | Ruhin         |  |
| 47.             | <i>Syzygium cuminii</i>       | Jambhul       | Fruit edible and Timber sp.              |
| 48.             | <i>Schrebera swietenoides</i> | Mokha         |  |
| 49.             | <i>Tamarindus indica</i>      | Chinch        | Fruit edible                             |
| 50.             | <i>Terminalia arjuna</i>      | Arjun         | Medicinally useful sp.                   |
| 51.             | <i>Terminalia bellerica</i>   | Behada        | Medicinally useful sp.                   |
| 52.             | <i>Terminalia elliptica</i>   | Ain           | Timber sp.                               |
| <b>Shrubs</b>   |                               |               |  |
| 53.             | <i>Zizyphus jujube</i>        | Bor           | Fruit edible                             |
| 54.             | <i>Abrus precatorius</i>      | Gunj          | Leaf edible                              |
| 55.             | <i>Ehretia aspera</i>         | Dhatrang      |  |
| 56.             | <i>Carissa congesta</i>       | Karvand       | Forest food, Fruit edible                |
| 57.             | <i>Cassia auriculata</i>      | Tarwad        | Useful for fuel wood                     |
| 58.             | <i>Caesalpinia bonducella</i> | Sagargota     | Useful for fencing                       |
| 59.             | <i>Flacourtia montana</i>     | Tambat        |  |
| 60.             | <i>Gymnosporia montana</i>    | Henkel        | Fuel wood, Medicinal                     |
| 61.             | <i>Ipomea carnea</i>          | Besharam      | Non native species                       |
| 62.             | <i>Jatropha curcas</i>        | Mogali-eranda |  |
| 63.             | <i>Lantana camara</i>         | Tantani       | Non native species                       |
| <b>Climbers</b> |                               |               |  |
| 64.             | <i>Tragia involucrata</i>     | Khajkoyri     |  |
| 65.             | <i>Combretum extensum</i>     | Piluk         |  |
| <b>Grasses</b>  |                               |               |  |
| 66.             | <i>Andropogon annulatus</i>   | Marvel        | Fodder value                             |
| 67.             | <i>Apluda mutica</i>          | Ral           | Fodder value                             |
| 68.             | <i>Sehima sulucatum</i>       | Pavana        | Fodder value                             |
| 69.             | <i>Heteropogon insigini</i>   | Kusali        | Fodder value                             |
| 70.             | <i>Heteropogon</i>            | Kusali        | Fodder value                             |

The list will be updated after year round survey.

## 6 b) Fauna list

### 6 b) i Plateau

#### A} Insects+ Arthropods

1. Apis indica
2. Apis dorsata
3. termites
4. ants
5. dung beetle
6. Lepisma sp.
7. sun scorpion

8. Funnel-webbed spider

9. *Locusta locusta*

The presence of honey-bees (*Apis* sp.) indicates the availability of flowers all year round. Thus hinting towards good vegetal conditions, a more moist deciduous forest character.

B} Herpetofauna

1. *Sitana ponticeriana*

2. *Calotes versicolor*

3. *Hemidactylus brookii*

C} Avifauna

1. Montague's Harrier

2. Pallid Harrier

3. Hen Harrier

4. Shikra

5. Kesrel

6. Peafowl

7. Rock Bush Quail

8. Little Brown Dove

9. Common Myna

10. Rufous Tailed Lark

11. Sykes Crested Lark

12. Scaly Breasted Munia

13. Black Bulbul

D} Mammals

1. Chinkara

2. Rodents- 3/4sp.

6 b) ii *Slope*

A} Insects+ Arthropods

1. *Locusta locusta*

2. *Scolopandra* sp.

3. *Forficula* sp.

4. *Dysdercus indicus*

B} Herpetofauna

*Calotes versicolor*

C} Birds

1. Red Vented Bulbuls

2. Black Drongo
3. Grey Partridge
4. Koel
5. Laughing Dove
6. Black Shouldered Kite
7. Rufous Tailed Lark
8. Syke's Crested Lark
9. Ashy Crowned Sparrow Lark
10. Red Winged Bush Lark
11. Paradise Flycatcher
12. Coppersmith Barbet
13. Silverbills
14. Scaly Breasted Munia
15. House Sparrow

On an old growth Mango Tree, we saw Paradise Flycatcher. It indicates Moist character of the vegetation.

#### D} Mammals

1. Blacknaped Hare
2. Chinkara
3. Indian Jackal

Chinkara herds are often seen here; even this antelope belongs to the mixed type of forest. Thus even this indicates the presence of forest ecosystem than a scrub or grassland ecosystem, which is usually assumed in drought areas.

#### *6 b) iii Valley Bottom*

##### A} Insects+ Arthropods

1. Ants
2. *Apis indica*
3. *Apis dorsata*
4. *Gryllus* sp.
5. *Xylocopa fenestra*
6. *Chelifer* sp.

##### B} Herpetofauna

*Calotes versicolor*

*Bufo bufo*

##### C} Birds

1. Baya Weaver Bird

2. Silverbills
3. Grey Partridge
4. Black Drongo
5. Rose ringed Parakeet
6. White Breasted Kingfisher
7. Jungle Myna
8. Bank Myna

D} Mammals

1. Blacknaped Hare
2. Field Mice

6 b) iv Stream :

A} Insects+ Arthropods

1. Waterskators
2. Diplocodes trivialis
3. Common Tiger Butterfly
4. Common Crow Butterfly
5. Bradinopyga geminata
6. Apis indica
7. Apis dorsata
8. Drosophila sp.
9. Land Crabs

B} Herpetofauna

Bufo bufo

C} Birds

1. Tailor Bird
2. Ashy Wren Warbler
3. Rufous Backed Shrike
4. India Robin
5. Pond Heron
6. Rose Ringed Parakeet

D} Mammals

1. Indian Jackal
2. Common Mongoose
3. Blacknaped Hare

## 7. Annexure II

## Recommended plant list

## List 1

## Hedges

| Sr.No. | Scientific Name                | Common Name |
|--------|--------------------------------|-------------|
| 1      | <i>Adathoda vasica</i>         | Adulasa     |
| 2      | <i>Crotolaria pallida</i>      | Jangli tag  |
| 3      | <i>Lowsonia alba</i>           | Mendi       |
| 4      | <i>Phyllanthus reticulatus</i> |             |
| 5      | <i>Vitex nigundo</i>           | Nirgudi     |
| 6      | <i>Caesalpinia sepiaria</i>    | Chilar      |
| 7      | <i>Caesalpinia bonducella</i>  | Sagargota   |

## List 2

## Economic trees

## Hard wood timbers On ridge tops

| Sr.No. | Scientific Name                 | Common Name |
|--------|---------------------------------|-------------|
| 1.     | <i>Acacia nilotica</i>          | Babhul      |
| 2.     | <i>Albizia lebbek</i>           | Shirish     |
| 3.     | <i>Anogeissus latifolia</i>     | Dhawda      |
| 4.     | <i>Bauhinia variegata</i>       | Kanchan     |
| 5.     | <i>Chloroxylon swietenia</i>    |             |
| 6.     | <i>Dalbergia sisoo</i>          | Shisoo      |
| 7.     | <i>Dalbergia paniculata</i>     | Phanashi    |
| 8.     | <i>Gmelina arborea</i>          | Shivan      |
| 9.     | <i>Grewia tiliifolia</i>        | Dhaman      |
| 10.    | <i>Hardwickia binata</i>        | Anjan       |
| 11.    | <i>Lagerstroemia parviflora</i> |             |
| 12.    | <i>Milusa tomentosa</i>         | Umb         |

|     |                               |            |
|-----|-------------------------------|------------|
| 13. | <i>Ougeinia ooijeinensis</i>  | Kala Palas |
| 14. | <i>Pterocarpous marsupium</i> | Bija       |
| 15. | <i>Mitragyna parviflora</i>   | Kalam      |
| 16. | <i>Terminalia elliptica</i>   | Ain        |
| 17. | <i>Ixora</i>                  | Lokhandi   |

## Soft wood timber On slopes

| Sr.No. | Scientific Name                | Common Name |
|--------|--------------------------------|-------------|
| 1.     | <i>Ailanthus exelsa</i>        | Maharukh    |
| 2.     | <i>Boswellia serrata</i>       | Salai       |
| 3.     | <i>Erythrina spp.</i>          | Pangara     |
| 4.     | <i>Haldina cordifolia</i>      | Hedu        |
| 5.     | <i>Holoptelia integrifolia</i> | Wawal       |
| 6.     | <i>Mangifera indica</i>        | Amba        |
| 7.     | <i>Mitragyna parviflora</i>    | Kalam       |

## Agricultural implements

| Sr.No. | Scientific Name              | Common Name |
|--------|------------------------------|-------------|
| 1.     | <i>Acacia leucophloea</i>    | Hivar       |
| 2.     | <i>Albizzia amara</i>        | Lalai       |
| 3.     | <i>Bauhinia purpurea</i>     | Kanchan     |
| 4.     | <i>Emblica officinalis</i>   | Awala       |
| 5.     | <i>Flacourtia indica</i>     | Tambat      |
| 6.     | <i>Ougeinia ooijeinensis</i> | Kala Palas  |
| 7.     | <i>Tamarindus indica</i>     | Chinch      |
| 8.     | <i>Citrus medica</i>         | Limbu       |

## List 3

## Forest Food Species and Minor timber species

| Sr.No. | Scientific Name                  | Common Name |
|--------|----------------------------------|-------------|
| 1.     | <i>Acacia leucophloea</i>        | Hivar       |
| 2.     | <i>Aegle marmalos</i>            | Bel         |
| 3.     | <i>Artocarpus heterophyllous</i> | Phanas      |
| 4.     | <i>Bauhinia racemosa</i>         | Apta        |

|     |                               |                      |
|-----|-------------------------------|----------------------|
| 5.  | <i>Bridelia retusa</i>        | Asana                |
| 6.  | <i>Buchanania lanzan</i>      | Charoli              |
| 7.  | <i>Cassia fistula</i>         | Bahava               |
| 8.  | <i>Cordia myxa</i>            | Bhokar               |
| 9.  | <i>Craetava adansonii</i>     | Waywama              |
| 10. | <i>Diospyros melanaxylon</i>  | Tendu / Tembru       |
| 11. | <i>Emblica officinalis</i>    | Awala                |
| 12. | <i>Feronia limonia</i>        | Kavath               |
| 13. | <i>Garuga pinnata</i>         | Kakad                |
| 14. | <i>Gerwia asiatica</i>        | Phalsa               |
| 15. | <i>Launnea coromandallica</i> | Moi                  |
| 16. | <i>Madhuca indica</i>         | Moha                 |
| 17. | <i>Mangifera indica</i>       | Amba                 |
| 18. | <i>Moringa oleifera</i>       | Shewga               |
| 19. | <i>Phoenix sylvestris</i>     | Shindi               |
| 20. | <i>Santalum album</i>         | Chandan              |
| 21. | <i>Sesbania sesban</i>        | Hatga                |
| 22. | <i>Spondias pinnata</i>       | Ambada               |
| 23. | <i>Sygygium cumini</i>        | Jambhul              |
| 24. | <i>Tamarindus indica</i>      | Chinch               |
| 25. | <i>Wrightia tinctoria</i>     | Kala kuda / Dahikudi |
| 26. | <i>Zizyphus jujuba</i>        | Bor                  |

#### Shrubs

| Sr.No. | Scientific Name              | Common Name |
|--------|------------------------------|-------------|
| 1.     | <i>Carrisa congesta</i>      | Karwanda    |
| 2.     | <i>Cassia tora</i>           | Takla       |
| 3.     | <i>Clerodendrum serratum</i> | Bharangi    |
| 4.     | <i>Holarrhena pubescens</i>  | Kuda        |
| 5.     | <i>Murraya koenigii</i>      | Kadhipatta  |
| 6.     | <i>Solanum indicum</i>       | Chichardi   |

#### List 4

### Shrubs and grasses for slope stabilization

#### Shrubs

| Sr.No. | Scientific Name              | Common Name  |
|--------|------------------------------|--------------|
| 1.     | <i>Barleria cuspidata</i>    | Kate koranti |
| 2.     | <i>Bauhinia tomentosa</i>    | Kanchan      |
| 3.     | <i>Capparis divaricata</i>   | Pachunda     |
| 4.     | <i>Capparis decidua</i>      |              |
| 5.     | <i>Carissa congesta</i>      | Karawand     |
| 6.     | <i>Cassia auriculata</i>     | Tarwad       |
| 7.     | <i>Dichrostachys cinerea</i> | Sigam kati   |
| 8.     | <i>Ehretia aspera</i>        | Dhatarang    |
| 9.     | <i>Gymnosporia montana</i>   | Henkel       |
| 10.    | <i>Helicteres isora</i>      | Murud sheng  |
| 11.    | <i>Mimosa hamata</i>         |              |
| 12.    | <i>Woodfordia fruticosa</i>  | Dhayati      |

#### Fodder plants

##### Grasses

| Sr.No. | Scientific Name                 | Common Name  |
|--------|---------------------------------|--------------|
| 1.     | <i>Andropogon annulatus</i>     | Marwel       |
| 2.     | <i>Apluda mutica</i>            | Ral          |
| 3.     | <i>Bambusa arundinacea</i>      | Kateri kalak |
| 4.     | <i>Cenchrus</i>                 |              |
| 5.     | <i>Coix lacryma jobi</i>        | Kashed       |
| 6.     | <i>Dichanthemum</i>             |              |
| 7.     | <i>Echinochloa colonum</i>      | Pakad        |
| 8.     | <i>Ischaemum spp</i>            |              |
| 9.     | <i>Oxytenanthera monostigma</i> | Udha bamboo  |
| 10.    | <i>Panicum</i>                  |              |
| 11.    | <i>Sehima sulcatum</i>          | Pavana       |
| 12.    | <i>Sporobolus</i>               |              |
| 13.    | <i>Themeda quadrivalvis</i>     | Bondwel      |
| 14.    | <i>Zoysia matrella</i>          |              |

## Herbs

| Sr.No. | Scientific Name                | Common Name |
|--------|--------------------------------|-------------|
| 1.     | <i>Boerhaavia diffusa</i>      | Punarnava   |
| 2.     | <i>Desmodium dichotomum</i>    |             |
| 3.     | <i>Elephantopus scaber</i>     | Hastipad    |
| 4.     | <i>Indigophera astragalina</i> |             |
| 5.     | <i>Indigophera glandulosa</i>  |             |
| 6.     | <i>Scoparia dulcis</i>         |             |
| 7.     | <i>Sida acuta</i>              | Bala        |
| 8.     | <i>Sida cordifolia</i>         | Bala        |
| 9.     | <i>Tribulus terrestris</i>     | Gokhru      |
| 10.    | <i>Stylosanthes fruticosa</i>  |             |

## Trees used as fodder plants

| Sr. no. | Scientific Name             | Local name  | Season                            | Part eaten      |
|---------|-----------------------------|-------------|-----------------------------------|-----------------|
| 1.      | <i>Bauhinia racemosa</i>    | Apta        | All                               | Foliage         |
| 2.      | <i>Bridelia retusa</i>      | Asana       | All                               | Foliage         |
| 3.      | <i>Ficus racemosa</i>       | Umbar       | Fruits in summer,<br>Lvs- sep-May | Foliage, fruits |
| 4.      | <i>Grewia tiliifolia</i>    | Dhaman      | All                               | Foliage         |
| 5.      | <i>Helicteres isora</i>     | Murud sheng | All                               | Tender Foliage  |
| 6.      | <i>Moringa oleifera</i>     | Shewga      | All                               | Foliage         |
| 7.      | <i>Syzygium cuminii</i>     | Jambhul     | All                               | Foliage         |
| 8.      | <i>Terminalia belerica</i>  | Behada      | May-Dec                           | Foliage         |
| 9.      | <i>Terminalia elliptica</i> | Ain         | May-Dec                           | Foliage         |

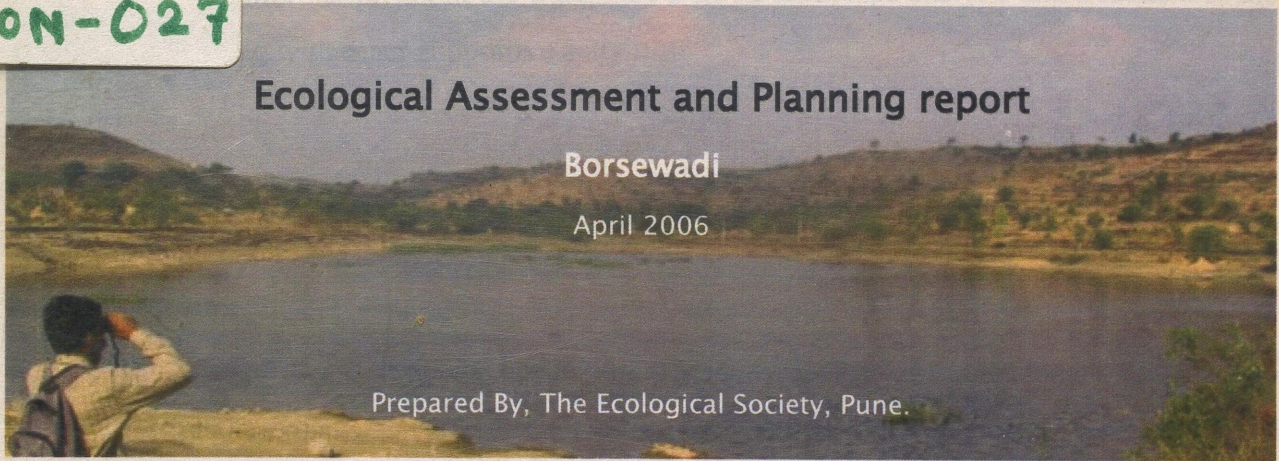
## List 5

## Aquatic Plants And Water tolerant plants

| Sr.No. | Scientific Name         | Common Name  | Type                |
|--------|-------------------------|--------------|---------------------|
| 1.     | <i>Bauhinia semla</i>   | Kanchan      | Tree High elevation |
| 2.     | <i>Pongamia glabra</i>  | Karanj       | Tree                |
| 3.     | <i>Terminlia arjuna</i> | Arjun sadada | Tree                |

|     |                              |             |                              |
|-----|------------------------------|-------------|------------------------------|
| 4.  | <i>Scleichera oleosa</i>     | Koshimb     | Tree                         |
| 5.  | <i>Syzygium cuminii</i>      | Jambhul     | Tree                         |
| 6.  | <i>Ficus glomerata</i>       | Umbar       | Tree                         |
| 7.  | <i>Trapa bispinosus</i>      | Shingada    | Shrub                        |
| 8.  | <i>Polygonum glabra</i>      |             | Tall herb                    |
| 9.  | <i>Ascelpias curassavica</i> | Halad kumku | Tall herb                    |
| 10. | <i>Ludwigia octovalvis</i>   | Pan lavang  | Shrub                        |
| 11. | <i>Tamarix dioica</i>        | Kad sherani | Shrub                        |
| 12. | <i>Homoinea riparia</i>      | Sherani     | Shrub                        |
| 13. | <i>Cyperus rotundus</i>      | Nagarmotha  | Grass                        |
| 14. | <i>Cyperus spp</i>           |             | Grass                        |
| 15. | <i>Commelina spp</i>         |             | Streamside and Instream herb |
| 16. | <i>Cyanotis spp</i>          |             | Instream herb                |
| 17. | <i>Mollugo spp</i>           |             | Instream herb                |
| 18. | <i>Rhabdia spp</i>           |             | Instream herb                |





## 1. Introduction

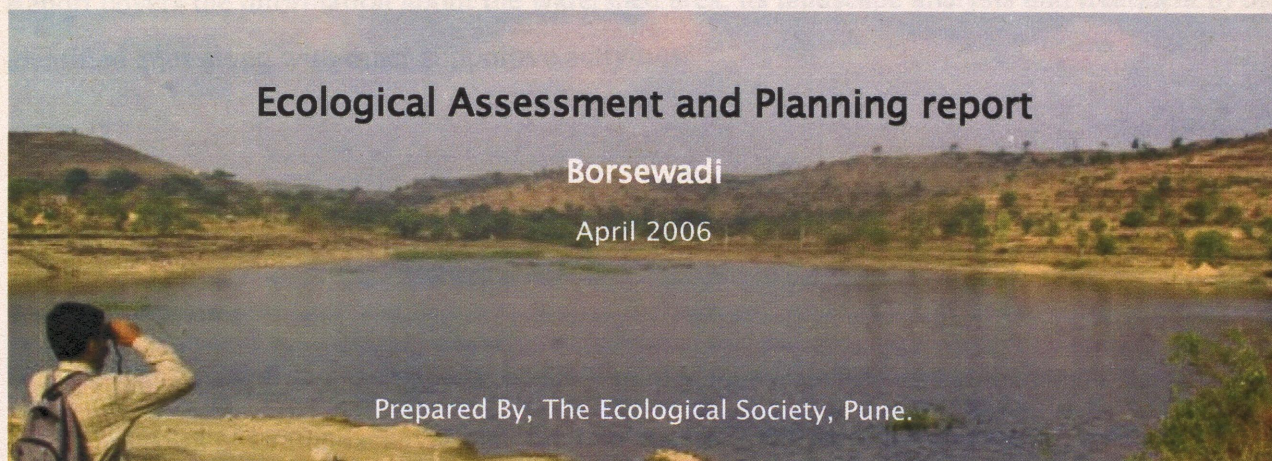
Watershed development is developing physical and biological elements for sustainable and self-reliant interdependence. Present watershed development projects are more focused on production approach and soil & water conservation remains as their core of activities. However for sustainable development, ecological perspective and long term planning of resources is very essential.

It is a known that during last many decades there has been drastic change in land use pattern and agricultural practices, which has resulted in depletion of natural resources and natural processes. To safeguard our future, ecologically appropriate land use must be planned, along with the ways to enhance productivity and self-sufficiency of the land in terms of water, energy and food.

As a methodology it was decided to carry out ecological survey on selected watershed and then decide the ecological interventions in the particular watershed which should be very site specific. Present report is the outcome of this three day survey, for ecological assessment, done by Ecological society during 15<sup>th</sup> to 17<sup>th</sup> March 2006. Ecological assessment is a screening tool to know the present situation and potential of the land. It is necessary to identify the status of existing biological diversity, natural resources and natural processes. In this assessment detailed analysis of soil, water, flora & fauna and natural processes is done. Based on the survey results, ecologically appropriate land use can be decided, along with the ways to enhance productivity and self-sufficiency of the land in terms of water, energy and food.

Components of Ecological Assessment:

- Natural resources.
- Bio-diversity.
- Ecologically important / sensitive sites. (includes difficult areas)
- Ecological Processes.



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- Natural resources.
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Report covers the information about the watershed area, its landscape analysis and treatment to the identified sites along with other supportive activities.

## 2. About the area

### 2 a) Location :

The selected project area is located in the Pathardi Taluka, Ahmadnagar District and consists of Grampanchayat including villages and settlements Borsewadi.

### 2 b) Topography & Geology :

The watershed is about 25 km towards South of Pathardi. (Longitude-75° 10' E, Latitude-19° 05' N)

The village Borsewadi is located in the Pathardi Taluka, Ahmadnagar District. The villages located in the ovate watershed of the nala (fourth order stream), which flows towards South, and is a part of the Sina river basin. The total area of the watershed bounded by the small hills from North, East and West sides is about 1305 ha. The Ridge tops exhibit flat undulating topography, with highest elevations of about 770 m to 790 m. The slopes of the hills are steeper, leading to the narrow stream basins exhibiting elevation lesser than 660m. Thus, in general, moderately flat ridges, steep slopes and the narrow stream basins demarcate the topography of the watershed.

The watershed forms a part of the elevated plateau region towards the West of the Sahyadri Ranges, dissected by the drainage. This area falls in the rain shadow area of Sahyadri, characterized by semi-arid climate. On broader basis, the volcanic basaltic rocks exposed in the watershed indicate different characteristics, which can be observed at different elevations with respect to the basalt flows. At the higher elevations, is exposed highly fractured Compact Basalt, which is highly weathered and is covered with varying soil cover at different hill tops. The middle elevations are characterized by the well-jointed Compact Basalt, which after weathering has formed the bouldery topography. Big boulders scattered in this region make it difficult for conventional land use by human beings. After this, separated by a small brecciated grayish red flow, in the lowest elevations in the

watersheds, exposed at many places in the stream bottoms, is the Compact Basalt with fragmentary top.

**2 c) Rainfall and climate:**

Average annual rainfall in the watershed recorded from 1994 to 2003 is 550mm. Climate is usually dry

**3. Socio economic and socio ecological picture of the village**

**Population:** Population of the village is 1350. The number of men is 714 while the number of female is 636. The literacy rate in the village is average with only 20 individuals attaining education above graduation.

**Cast Composition in the village:** The most common cast in the village is Maratha, almost 90% of the population belongs to the same caste.

**Occupations in the village:** The main occupation in the village is rain fed agriculture. Average landholding is 7.99 ha, with 3.27% being landless families. The agriculture is majority practiced in the valley area. Initially the agriculture was mainly rain fed but due to the watershed project one dam was build in the village which resulted in raising the water levels in the wells of the villages. So this water is now used to irrigate the second crop in the year of serial and pulses. The major rain fed crop is Jowar and Bajra. The secondary crops are of serials and pulses like Matki, Moong, Toor, Gram, ground nut etc. Green vegetables are also cultivated for the domestic usage. Mostly the crops taken are food crops with very little land under cash crops like onion. Though, some farmers are planning to start cultivation of Sugar cane with the additional water available for irrigation. The seeds used for cultivation are mostly local varieties except for Bajra, the hybrid seeds are used.

**Alternative Livelihoods present in the village:** Almost 70% of the village population goes for cutting the sugarcane to the adjacent area as laborers. This has been the most promising alternative livelihood apart from agriculture. The annual income from this activity is Rs.20000 to 30000 per family consisting of 3 members. This money is sought after the end of the season. The boys completing the age of 15 year start going as the laborer.

**Details about the land use in the village:** Most of the land in the valley bottom is used for agriculture. The slopes of the hills are mostly not cultivated and are kept barren due to lack of good soil. The slopes are covered by poor quality grass. Same is the case with the mountain tops.

**Practices related to the horticultural activity:** NABARD is promoting horticultural activities in the area. Some farmers have opted for cultivation of Pomegranate, Sapota etc. The activities are initiated only 2-3 years back in the village.

**Livestock composition in the village:** The number of livestock is good enough for the villagers to indulge into the dairy business. Daily 200 liters of milk is collected from the village and is exported to the nearby village called Manikdaundi. Also a by product called Khoya is produced from the village and is sold twice weekly at the rate of Rs 50 to 65 Kg. This business is proving to be a good supplement to the current agricultural practices as the crop residue is also used as fodder.

**Practices related to fodder and fuel:** Traditionally the fodder and domestic fuel needs are fulfilled from the wilderness in the nearby area. Trees, shrubs, bushes of any species are used as fuel. There has been no effort till now to do energy plantation or maintaining grassland for their fodder needs.

**Water related practices:** The condition of water available for domestic usage in the village is good as the water levels in the wells from which the village gets its drinking water is high even in the month of March. It stays till the rains. The village apparently faces no drinking water scarcity. This situation is due to the dam present in the village resulting in the rise of the ground water table. It is reported that few years back the village faced acute scarcity of drinking water. The water had to be fetched from the nearby village Jatdeola located nearly 8 Km away from the village.

Their Kharif crops are rain fed and the Rabi crops are irrigated using the water from the wells dug in the farms. Due to water availability now even third crop of grams or vegetables is also produced using this water. In case of some farmers who have bigger land holding due to the excess water availability they are planning to start cultivating cash crops like sugarcane, groundnut, onion etc.

Some measures like digging pits in the farms are taken to retain moisture in the soil in the fields. Apart from this there is no traditional water harvesting practice is reported from the village.

**Sanitation and waste management:** The issue of sanitation and waste management is apparently completely neglected by the village. The village is devoid of toilets. The liquid waste from the

kitchens is directly let out on the roads outside the house. The villagers do not practice kitchen gardens.

**Marketing systems in the village (input/output):** The agricultural produce remaining from the domestic consumption is sold in the Pathardi market. The village exports crops like Jowar, Bajra, and oil seed like Teel, Jawas and also milk and khoya.

There is one ration shop in the village. The village is dependent on Manikdaundi for there other grocery need like cooking oil, spices, vegetables etc. The consumer durables, farming equipments, seeds for the cultivation, medicines are brought from nearby town Pathardi or from Ahmednagar.

#### **Ecological implications of all these aspects**

**Livesock:** The number of buffalo and cow livestock is 2000 approximately. Currently stall feeding is not practiced strictly; also there is no specific cultivation for good quality grass to meet the fodder requirement. Uncontrolled grazing results in degradation of land. This activity also accelerates the soil erosion. If stall feeding is practiced, these ecological losses would be controlled. Stall feeding also helps in getting cow dung on the spot reducing the time consumed in collecting the cow dung. The business of milk collection and also khoya making is flourishing (the village, this business could be accelerated by cultivating good variety of grasses in enclosures. So grassland development activity should be promoted. Currently hill slopes are barren, grass can be cultivated on these patches.

**Fuel:** Dried wood is burnt for cooking purposes. The wood is collected form the wilderness in the village. There has been no energy plantation in the village so far. Uncontrolled cutting of trees is not a sustainable practice. Separated energy plantation has to be considered to suffice the fuel wood demand of the village. Also some of the house hold in the village are engaged is commercially producing Khoya from the milk. This activity requires substantial amount of burning of wood. To get 1 Kg khoya one has to boil 4 liters of milk continually for minimum 2 hours. The village supplies 100 kg khoya twice weekly. If we calculate the wood required to be burnt in the production of this amount of khoya, we will find that the forest is being largely exploited. If we suggest and do energy plantation the fuel needs will be satisfying which can result in production of more khoya in a sustained manner.

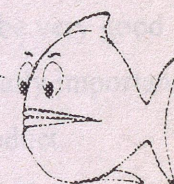
**Sanitation and Waste Management:** The village completely lacks any sanitation. This results in spreading diseases. If the kitchen gardens are implemented, the liquid waste from the kitchen can be treated and used for producing vegetables for domestic consumption.

**Livelihoods:** 70% of the village population goes to adjacent areas as sugarcane cutting laborers. They stay outside their village for the complete season for sugarcane cutting which lasts for 4 to 5 months. This reflects positively on the usage of natural resources like water usage.

#### 4. Landscape analysis

There are four well defined land classes which can be demarcated by the slope characteristics, land-use pattern, along with other ecological factors like the vegetation types, habitats and the weathering profiles and Geological characters. Landscape structure is revealed in these four land classes with potential landscape elements like vegetation clusters, streams, corridors and old growth trees. Each land element has certain ecological value. Many a times these land elements are not seen clearly. In such cases 'habitats' play an important role along with 'surrounding buffer'. So total ecological value or productivity of any land can be judged according to its land elements or classes and habitat units.

A habitat is the place where a population lives. The habitat must supply the needs of organisms, such as food, water, temperature, oxygen, and minerals. If the population's needs are not met, it will move to a better habitat.



As discussed in the ecological history, the area is constantly under change and degraded to a great extent. But landscape still retains a set of natural patches and 'stepping stones' (i.e. old growth trees or clusters), connected by stream and riparian vegetation corridors. Also old abandoned Pandan, with grass clumps, serving as good habitat for birds like Bush quails. These can be the basis of a conservation pattern with links across the whole region.

##### 4 a) Plateaus

- Rocks exposed here are weathered basalt with probably good moisture holding capacity and providing good substrate for growth of vegetation. They exhibit good soil cover in thickness though being a region of higher elevation – hilltops.
- Land use – The ridge tops and plateaus show good grass cover. Grasses seen : *Sehima* (*Pavnya*), *Apluda*, *Heteropogon*, *Andropogon*, *Aristada*. Moderate to low grazing in

practice as dung was seen scattered. Clusters and clumps are scattered on the plateaus. Movement of people is evident from the dust – mud tracks cutting across the plateaus.

- The clusters show the dominance of Karavand along with Lokhandi, Lantana. The clumps are being used as source for fuel wood as lot of cutting is in progress.
- Regeneration is very less in number and is of Palas, Beheda and Ain.
- Middle growth trees standing on the plateaus and are important as stepping stones. Composition is *Ficus religiosa*, *Azadiracta indica*, *Terminalia bellirica*. The density of these trees is very low.
- Dominant exotic species – *Lantana*, but it is seen only in those areas which show lesser soil cover. They also act as wind barriers and provide safe sites. Grasses and regeneration is observed growing in such clusters.
- One wet patch (wetland) is observed on the hill top on the ridge towards east of mail stream. Presently containing mud and wet soil, this depression can be seasonal, and ecologically important site – habitat, animal wallows...
- At certain locations on the plateaus very good soil cover is seen. It is seen being helped by the CCTs, WATs, and constructions of the bouldery walls. These can be very good sites for the development of the soil and then plantation of some ecologically important trees which can also serve as source of fuel wood or some forest food/product.
- Ecologically important sites and habitats : The heaps of boulders, bouldery walls, wet patches, the standing trees – stepping stones and the good soil pockets.
- Owl pellets were seen near the Sacred Behada (Yela) tree near Padaidevi temple indicating presence of Spotted Owlet. Old growth trees play important role in creating habitats.

#### 4 b) Slopes

- Five to six inches top soil, very less humus content, many tracks traversing across the slopes, at many places wherever the slopes are gradual, agriculture is being practiced by contour – terracing. Slopes are covered with grasses, and grasses are seen being cut and carried. Moderate to low grazing is also present. The agriculture on slopes is being benefited by the constant supply of pediment from the higher elevations. These terraced fields are under one season cultivation of harbhara, maka, kaddhanya. This though is

not a very good soil, contains very low humous and contains a lot of gravel. As compared to the quantity of soil stopped on terraces, in the fields is much greater than the soil covering the hill slopes.

- Land use: Harvesting of grasses, twice an year, at places on gradual slopes – terracing and agriculture (one season) in practice, settlements near the bottoms of the slopes, the slopes in general are very steep in the vallies and gradual on the spurs.
- Microenvironments: Clusters and clumps of Karvand, henkal, char, bor etc. Some stumps and boles (dead standing wood) being used by birds as perches, Medium to old growth trees are scattered over the slope, though the distance between the stepping stones is large in most cases. The species of trees present here are neem, ficus bengalensis, ficus retusa, palas, erithrina sp, babhul, chinch, char.
- The old growth trees are also seen, though more in number near the base of the slopes, at the edges of the fields. They include chinch, ficus bengalensis, rohin, mango.
- On the slopes along with grasses, some herbs are also seen like Makadshingi.
- Dominant exotics – Tarvad, Lantana and Congress grass in fallow agricultural fields.
- Depositional areas : Pediment deposits along the slopes, at the base of the slopes, and in the terraced fields on the slopes. Raised fields are also present along the steams, gullies. Pockets of fertile soil are present scattered at places along the slopes.
- Erosional areas – Stream channels, gullies, ditches.
- Habitat list : Safe sites – clusters and clumps, Boulder heaps and other water conservation structures, insect galleries, root wads, corridors, mud cliffs along the tracks and gullies, sheltered corners.
- On the middle slopes, all along the hill slopes in the watershed, is observed a zone of bouldery terrain. This belongs to the flow, which is composed of well-jointed Compact Basalt. As the rock is jointed, huge spherical boulders loosen out from the strata and roll down along the slopes over the period of years. This has made the complete zone a difficult terrain and no agriculture or settlement or any other land – use is practiced by the villagers here. However, the boulders are also holding together good soil around them, making it a good substrate along with providing refuge and protection from human interference. This zone is one of the ecologically important sites and needs to be

protected. In the next survey during monsoons, more detailed research can be done if any medicinal and rare species and the wild life inhabit this particular zone.

- On the lower slopes, near the base of the valley, there exists a brecciated volcanic basaltic rock, which does not encourage any growth of vegetation and provides very poor substrate. This particular zone is practically barren and is not being used by human beings, neither for agriculture nor for any other purpose. However considering the different physical conditions present here, it can act as an ecologically important zone, and could be providing refuge to some wildlife along with some herbaceous flora which does not grow at other locations. This needs to be confirmed in the next survey during the monsoons, the time when this flora flourishes.

#### 4 c) Streams

- The main stream has few structures built over it – the dam in the northern part of the watershed, KT bunds towards South.
- Order : Highest stream order - of the main stream is fourth order.
- Width : 10m to 15 m. Depth variable at places. At many locations the stream has raised fields on either sides of it, which increases the apparent depth of the stream. The stream has moderate amount of vegetation along its bank and the inflows of matter from the surrounding land use to the streams is high in terms of biotic and abiotic – mineral matter. The streams contributing to the originate at the altitudes of about 760 to 790 meters and drop in elevation by about 100 meters before the main stream leaves the watershed boundary.
- Channel : There are many nalas which originate on the ridge tops and meet the main stream. The streambeds show the accumulation of sand, boulders along the field walls, some transported soil, clays, and murum along with the dead fallen plant material. At present the water is seen accumulated along the stream at various locations forming miniature wetlands. This stagnant water in the depressions has formed pools, which shows insect activity. Cattle are using such pools as water source.
- Instream vegetaion : Patches of algae and submerged vegetation also seen in the stream wherever water is present in the stream. Along with this 'besharam' and cyperus is also seen. As the streams share their boundaries with agriculture fields, the trees on the field

bunds act as the stream vegetation. Old growth trees are present at many places along the channels, which comprise Behda, Chinch, Ficus species.

- Few instream islands are also seen, habited by Typha and Besharam.
- Dry watercourses run down the hill slopes and streams in the valley area are also dry at place. The bank vegetation, riparian vegetation is not continuous, but is in patches.
- Insect colonies, rootwads, animal wallows, corridors, mud cliffs are present scattered along the nalas and streams.
- Bank : The streams do not have defined banks at most of the places. They share their limits with the field boundaries and bunds. The hedges of the fields, raised margins, stonewalls act as the banks of the streams. In southern part, one rocky cliff is present along the course of the main stream. Here again the brecciated basalt is exposed and hardly any growth of vegetation is seen supported by the same. AT some places along the stream, the trees on the bank form hanging overheads – canopy covers which serve as corridors and bridges, insect galleries. The old growth trees along the farm-bunds along the stream serve as the stepping-stones and at few places as corridors. Near the hedges of the fields in some cases, small patches of fields are left unused and thus act as sheltered corners. Bird activity is greater in such regions. Sagargota, babhul form hedges at many places.

#### 4 d) Valley bottom

Agriculture is dominant in the valley bottoms. Alluvial pans which are ideal for agriculture are very few along the streams. Most of the agriculture terraces in the bottom are comprised of pediment. Edges of the fields are mostly open except for few old growth trees like Mango, which are serving as stepping stones in the landscape. Hedges are lacking. At some places Niwdung hedge is planted specially for protection.

### 5. Ecological Planning and Management

After assessing the area ecologically, potential of the watershed is concluded so as to start the ecological activities at the watershed. It can be done in two ways,

- By changing the approach and procedures of current standardized activities,

- By treating some areas in watershed ecologically.

In first case, concrete changes can be suggested after the second survey or year round survey and ore interaction with the watershed committee. Right now it can be started with the native plantations. List of appropriate species is given in the next section.

From the assessment it is understood that the treatment can be given as per the land classes as the status of degradation, strata, quality of soil, availability of moisture changes as per the land class. So those areas are identified during the survey which are suitable for this kind of work. These are called as Ecologically Important Sites (EIS)

### 5 a) Ecologically Important Sites (EIS) and its treatment

| No | Activity   | Place  | Procedure  | Time period                     |
|----|--|--|--|---------------------------------|
| 1  | Grassland improvement                              | Plateau and Slope Area                                       | Spreading of good quality grass seed   | 1 <sup>st</sup> week<br>June    |
| 2  | Enclosures ( 1 + 1 ) Each 2.5 acres                | In the land of Uttam piraji chitale and Jalinda damu chitale | Fencing with stone bolder  | 1 <sup>st</sup> week<br>May     |
| 3  | Microbial reserves on private lands (1 to 5 acres) |  | This has to be discussed with the villagers first and then the committee will finalise the areas | April                           |
| 4  | Plantation of native trees                         | Streamside, Ridge top and C.T. C.                            | Getting the saplings, as per the list given by Ecological Society, for this year                 | June                            |
| 5  | Seed collection                                    | From whole watershed area                                    | Collection of ripe fruits, seeds and pods etc. and drying  | April to<br>May<br>continuously |
| 6  | Seed dispersal                                     | Streamside   | Collection of native seeds and its treatment as per requirement                                  | June                            |
| 7  | Natives nursery                                    | Near natural   | Preparation of saplings at   | Whole year                      |

|   |                       |             |  |     |
|---|-----------------------|-------------|--|-----|
|   |                       | spring      | nursery with the help of seed material collected or cuttings for the next years  |     |
| 8 | Waste water treatment | Near School | <ul style="list-style-type: none"> <li>▪ Collection of waste water through channel</li> <li>▪ Plantation of wetland species</li> </ul> | May |

**5 b) Management of vegetation as per land classes (Plantation of native species, Protection and habitat creation)**

Plantation of species could become supportive to the livelihood if it is planned properly along with the development of market links for various products generating from plants. This system can be evolved through training of the villagers for the same. So, ecological benefits of management of vegetation are given below along with plant lists which can be used commercially.

**5 b) i Ridge top**

Objective: To convert ridge top into a dry deciduous forest cover

Treatment :

- Creating "Sponge effect" - Together with well stocked grassland, soil and ground cover improvements
- Fencing - Dry and Live hedge List1
- Plantation - Native and Economic List2
- Protection to special habitats

**5 b) ii Slopes and plains**

Objective: To develop an alternative non agricultural tree based production system and bio diversity enhancement

Treatment :

- Protection
- Plantation of non timber tree crops (forest food) List3
- Plantation of shrubs and grasses for fodder List4

- Seed dispersal
- Protection to difficult areas, rare plants

### 5 b) iii Streams

Objective: Restoration of streams to increase infiltration, slow down run off and create habitats.

Treatment :

- Bank protection by maintaining a buffer zone
- Plantation of aquatic and water tolerant species List5
- Habitat creation through instream overflow obstructions to increase instream vegetation
- Protection to riparian vegetation

### 5 c) Nursery of native plants

Nursery of native and rare or special plant species which needs to be created at the watershed as these saplings are not readily available at the nurseries. In this nursery, common species for mass plantation, commercially valued species and medicinal species can be grown along with the special species which needs to be conserved.

### 5 d) Education and training programmes for villagers

Capacity building of locals is important for effective implementation and future maintenance. The perspective building as well as skills development training will be required for the local community, community organisations and the project implementing agency. Hence orientation training for project staff is suggested.

## 6. Annexure I

### 6 a) Flora list

| Sr. No. | Scientific Name | Common Name | Remarks |
|---------|-----------------|-------------|---------|
|---------|-----------------|-------------|---------|

|     |                               |                |   |
|-----|-------------------------------|----------------|---|
| 1.  | <i>Acacia nilotica</i>        | Babhul         | Timber for agricultural equipment.        |
| 2.  | <i>Acacia leucophloea</i>     | Hivar          |   |
| 3.  | <i>Acacia catechu</i>         | Khair          | Timber and Tannin value                   |
| 4.  | <i>Albizia lebbeck</i>        | Shirish        |   |
| 5.  | <i>Albizia procera</i>        | Kinai          |   |
| 6.  | <i>Alianthus exelsa</i>       | Maharukh       | Soft wood tree                            |
| 7.  | <i>Aegle marmalos</i>         | Bel            | Forest food and Medicinal use             |
| 8.  | <i>Anona squamosa</i>         | Sitaphal       | Forest food sp.                           |
| 9.  | <i>Anona reticulata</i>       | Ramphal        | Forest food sp.                           |
| 10. | <i>Azadirachta indica</i>     | Neem           | Timber and Medicinal IMP sp.              |
| 11. | <i>Bauhinia racemosa</i>      | Apata          |   |
| 12. | <i>Boswellia serrata</i>      | Salai          | Medicinal sp.                             |
| 13. | <i>Bridelia retusa</i>        | Asana          | Forest food and Timber sp.                |
| 14. | <i>Buchanania lanzan</i>      | Char           | Forest food, Fruit edible .               |
| 15. | <i>Butea monosperma</i>       | Palas          | Timber                                    |
| 16. | <i>Citrus medica</i>          | Limbu          | Edible fruit                              |
| 17. | <i>Cordia myxa</i>            | Bhokar         | Edible fruit                              |
| 18. | <i>Dalbergia sisoo</i>        | Shisoo         | Timber useful                             |
| 19. | <i>Diospyros Montana</i>      | Tembru         | Forest food sp. Leaf used for Bidi.       |
| 20. | <i>Erythrina suberosa</i>     | Pangara        | Fodder valuable                           |
| 21. | <i>Euphorbia tirucalli</i>    | Sher           | Medicinal use                             |
| 22. | <i>Emblica officinalis</i>    | Avala          | Forest food, Medicinal                    |
| 23. | <i>Eucalyptus maculate</i>    | Nilgiri        | Non native species                        |
| 24. | <i>Feronia limonia</i>        | Kavath         | Forest food, Edible fruit                 |
| 25. | <i>Ficus bengalensis</i>      | Vad            |   |
| 26. | <i>Ficus recemosa</i>         | Umbar          | Fruit edible                              |
| 27. | <i>Ficus cordifolia</i>       | Payar          |   |
| 28. | <i>Ficus tsiela</i>           | Pimpri         |   |
| 29. | <i>Gmelina arborea</i>        | Shivan         | Medicinal IMP sp.                         |
| 30. | <i>Ixora brachlata</i>        | Lokhandi       | Fuel wood sp.                             |
| 31. | <i>Launnea coromandallica</i> | Moi            |   |
| 32. | <i>Leucena leucocephala</i>   | Subhabul       | Non native species Leaves used for fodder |
| 33. | <i>Madhuca indica</i>         | Moha           | Forest food sp. Flowers edible            |
| 34. | <i>Melia azedarach</i>        | Bakan-Nimb     | Fodder valuable sp.                       |
| 35. | <i>Mitragyna parviflora</i>   | Kalam          | Timber sp.                                |
| 36. | <i>Moringa oleifera</i>       | Shewga         | Edible sp.                                |
| 37. | <i>Morinda tinctoria</i>      | Bartondi       |   |
| 38. | <i>Mangifera indica</i>       | Amba           | Timber and edible fruit                   |
| 39. | <i>Phoenix sylvestris</i>     | Shindi         | Fruit edible                              |
| 40. | <i>Pithecolobium dulce</i>    | Vilayatichinch | Non native species Fruit edible           |
| 41. | <i>Pongamia glabra</i>        | Karanj         | Seed useful for Bio- diesel               |
| 42. | <i>Psidium guavaja</i>        | Peru           | Fruit edible                              |
| 43. | <i>Santalum album</i>         | Chandan        | Useful for oil                            |
| 44. | <i>Semicarpus anacardium</i>  | Bibba          | Forest food and Medicinally Valuable sp.  |

|                 |                                  |               |                             |
|-----------------|----------------------------------|---------------|-----------------------------|
| 45.             | <i>Soymida febrifugu</i>         | Ruhin         |                             |
| 46.             | <i>Stereospermum chelenoides</i> | Patal         | Rare tree species.          |
| 47.             | <i>Syzygium cuminii</i>          | Jambhul       | Fruit edible and Timber sp. |
| 48.             | <i>Schrebera swietenoides</i>    | Mokha         |                             |
| 49.             | <i>Tamarindus indica</i>         | Chinch        | Fruit edible                |
| 50.             | <i>Terminalia arjuna</i>         | Arjun         | Medicinally useful sp.      |
| 51.             | <i>Terminalia bellerica</i>      | Behada        | Medicinally useful sp.      |
| 52.             | <i>Terminalia elliptica</i>      | Ain           | Timber sp.                  |
| <b>Shrubs</b>   |                                  |               |                             |
| 53.             | <i>Zizyphus jujube</i>           | Bor           | Fruit edible                |
| 54.             | <i>Abrus precatorius</i>         | Gunj          | Leaf edible                 |
| 55.             | <i>Ehretia aspera</i>            | Dhatrang      |                             |
| 56.             | <i>Carissa congesta</i>          | Karvand       | Forest food, Fruit edible   |
| 57.             | <i>Cassia auriculata</i>         | Tarwad        | Useful for fuel wood        |
| 58.             | <i>Caesalpinia bonducella</i>    | Sagargota     | Useful for fencing          |
| 59.             | <i>Flacourtia sepiara</i>        | Tambat        |                             |
| 60.             | <i>Gymnosporia Montana</i>       | Henkel        | Fuel wood, Medicinal        |
| 61.             | <i>Ipomea carnea</i>             | Besharam      | Non native species          |
| 62.             | <i>Jatropha curcas</i>           | Mogali-eranda |                             |
| 63.             | <i>Lantana camara</i>            | Tantani       | Non native species          |
| <b>Climbers</b> |                                  |               |                             |
| 64.             | <i>Tragia involucrate</i>        | Khajkoyri     |                             |
| 65.             | <i>Combretum extensum</i>        | Piluk         |                             |
| <b>Grasses</b>  |                                  |               |                             |
| 66.             | <i>Andropogon annulatus</i>      | Marvel        | Fodder value                |
| 67.             | <i>Apluda mutica</i>             | Ral           | Fodder value                |
| 68.             | <i>Sehima sulcatum</i>           | Pavana        | Fodder value                |
| 69.             | <i>Heteropogon insigini</i>      | Kusali        | Fodder value                |
| 70.             | <i>Heteropogon</i>               | Kusali        | Fodder value                |

*The list will be updated after year round survey.*

## 6 b) Fauna list

### 6 b) i Plateau

#### A} Insects+ Arthropods

#### B} Herpetofauna

Sitana ponticeriana

#### C} Birds

1. Spotted Owlet
2. Great Horned Owl (?)

The nest and pellets of a large owl were found which could be Great Horned Owl. This indicates the abundance of small mammals.

6 b) ii *Slope*A} Insects+ Arthropods

1. *Dysdorchus indicus*
2. *Xylocopa fenestra*
3. *Brachythemis contaminata*

B} Herpetofauna

*Calotes versicolor*

C} Avifauna

1. Mahratta Woodpecker
2. Small Minivets
3. Coppersmith Barbet
4. Baya Weaver Bird
5. Barn Swallow
6. Indian Nightjar
7. Large Grey Babbler
8. Little Brown Dove
9. Small Green Bee-eater

The Mahratta Woodpecker sighting indicates the presence of a Moist Deciduous forest or at least the potential of the watershed in having succeeding into one.

6 b) iii *Valley Bottom*A} Insects+ Arthropods

1. Ants
2. Termites
3. *Apis indica*
4. *Apis dorsata*
5. *Xylocopa fenestra*
6. Grasshoppers-2 sp.
7. Waterskators

B} Herpetfauna

1. *Calotes versicolor*
2. *Bufo bufo*

C} Avifauna

1. Indian Robin
2. Stonechat
3. Bank Myna
4. Iora
5. Ashy Wren Warbler
6. Black Drongo
7. Barn Swallow
8. Brahminy Myna
9. Little Brown Dove
10. Purple Rumped Sunbird
11. Purple Sunbird
12. Small Green Bee-eater
13. Rock Bush Quail

6 b) iv Stream :

A} Insects+ Arthropods

1. Common Castor Butterfly
2. Common Crow Butterfly
3. Aquatic Beetle
4. Scarabid Beetle
5. Common Three Ring Butterfly
6. Apis indica
7. Apis dorsata
8. Xylocopa fenestra
9. Orthetrum glaucum (?)
10. Trithemis aurora
11. Ischnura aurora
12. Ceriagrion olivaceum

B} Herpetofauna

1. Calotes versicolor
2. Brahminy Skink
3. Striped Keelback Snake
4. Bufo bufo

C} Avifauna

1. Rock Bush Quail
2. Little Brown Dove
3. Prinia sp.
4. Small Minivet
5. Iora
6. Pond Heron
7. Common Sandpiper
8. Yellow Wagtail
9. Ashy Wren Warbler
10. Common Myna
11. Paddyfield Pipit
12. Rufous backed Shrike
13. Brahminy Myna

#### 7. Annexure II

##### Recommended plant list

##### List 1

##### Hedges

| Sr.No. | Scientific Name                | Common Name |
|--------|--------------------------------|-------------|
| 1      | <i>Adhathoda vasica</i>        | Adulasa     |
| 2      | <i>Crotolaria pallida</i>      | Jangli tag  |
| 3      | <i>Lowsonia alba</i>           | Mendi       |
| 4      | <i>Phyllanthus reticulatus</i> |             |
| 5      | <i>Vitex nigundo</i>           | Nirgudi     |
| 6      | <i>Caesalpinia sepiaria</i>    | Chilar      |
| 7      | <i>Caesalpinia bonducella</i>  | Sagargota   |

##### List 2

##### Economic trees

## Hard wood timbers On ridge tops

| Sr.No. | Scientific Name                 | Common Name |
|--------|---------------------------------|-------------|
| 1.     | <i>Acacia nilotica</i>          | Babhul      |
| 2.     | <i>Albizia lebbeck</i>          | Shirish     |
| 3.     | <i>Anogeissus latifolia</i>     | Dhawda      |
| 4.     | <i>Bauhinia variegata</i>       | Kanchan     |
| 5.     | <i>Chloroxylon swietenia</i>    |             |
| 6.     | <i>Dalbergia sisoo</i>          | Shisoo      |
| 7.     | <i>Dalbergia paniculata</i>     | Phanashi    |
| 8.     | <i>Gmelina arborea</i>          | Shivan      |
| 9.     | <i>Grewia tiliifolia</i>        | Dhaman      |
| 10.    | <i>Hardwickia binata</i>        | Anjan       |
| 11.    | <i>Lagerstroemia parviflora</i> |             |
| 12.    | <i>Miliusa tomentosa</i>        | Umb         |
| 13.    | <i>Ougeinia ooijeinensis</i>    | Kala Palas  |
| 14.    | <i>Pterocarpous marsupium</i>   | Bija        |
| 15.    | <i>Mitragyna parviflora</i>     | Kalam       |
| 16.    | <i>Terminalia elliptica</i>     | Ain         |
| 17.    | <i>Ixora</i>                    | Lokhandi    |

## Soft wood timber On slopes

| Sr.No. | Scientific Name                | Common Name |
|--------|--------------------------------|-------------|
| 1.     | <i>Ailanthus exelsa</i>        | Maharukh    |
| 2.     | <i>Boswellia serrata</i>       | Salai       |
| 3.     | <i>Erythrina spp.</i>          | Pangara     |
| 4.     | <i>Haldina cordifolia</i>      | Hedu        |
| 5.     | <i>Holoptelia integrifolia</i> | Wawal       |
| 6.     | <i>Mangifera indica</i>        | Amba        |
| 7.     | <i>Mitragyna parviflora</i>    | Kalam       |

## Agricultural implements

| Sr.No. | Scientific Name | Common Name |
|--------|-----------------|-------------|
|--------|-----------------|-------------|

|    |                              |            |
|----|------------------------------|------------|
| 1. | <i>Acacia leucophloea</i>    | Hivar      |
| 2. | <i>Albizzia amara</i>        | Lalai      |
| 3. | <i>Bauhinia purpurea</i>     | Kanchan    |
| 4. | <i>Emblica officinalis</i>   | Awala      |
| 5. | <i>Flacourtia indica</i>     | Tambat     |
| 6. | <i>Ougeinia ooijeinensis</i> | Kala Palas |
| 7. | <i>Tamarindus indica</i>     | Chinch     |
| 8. | <i>Citrus medica</i>         | Limbu      |

### List 3

#### Forest Food Species and Minor timber species

| Sr.No. | Scientific Name                  | Common Name    |
|--------|----------------------------------|----------------|
| 1.     | <i>Acacia leucophloea</i>        | Hivar          |
| 2.     | <i>Aegle marmalos</i>            | Bel            |
| 3.     | <i>Artocarpus heterophyllous</i> | Phanas         |
| 4.     | <i>Bauhinia racemosa</i>         | Apta           |
| 5.     | <i>Bridelia retusa</i>           | Asana          |
| 6.     | <i>Buchanania lanzan</i>         | Charoli        |
| 7.     | <i>Cassia fistula</i>            | Bahava         |
| 8.     | <i>Cordia myxa</i>               | Bhokar         |
| 9.     | <i>Craetava adansonii</i>        | Waywarna       |
| 10.    | <i>Diospyros melanaxylon</i>     | Tendu / Tembru |
| 11.    | <i>Emblica officinalis</i>       | Awala          |
| 12.    | <i>Feronia limonia</i>           | Kavath         |
| 13.    | <i>Garuga pinnta</i>             | Kakad          |
| 14.    | <i>Gerwia asiatica</i>           | Phalsa         |
| 15.    | <i>Launnea coromandallica</i>    | Moi            |
| 16.    | <i>Madhuca indica</i>            | Moha           |
| 17.    | <i>Mangifera indica</i>          | Amba           |
| 18.    | <i>Moringa oleifera</i>          | Shewga         |
| 19.    | <i>Phoenix sylvestris</i>        | Shindi         |

|     |                           |                      |
|-----|---------------------------|----------------------|
| 20. | <i>Santalum album</i>     | Chandan              |
| 21. | <i>Sesbania sesban</i>    | Hatga                |
| 22. | <i>Spondias pinnata</i>   | Ambada               |
| 23. | <i>Sygygium cumini</i>    | Jambhul              |
| 24. | <i>Tamarindus indica</i>  | Chinch               |
| 25. | <i>Wrightia tinctoria</i> | Kala kuda / Dahikudi |
| 26. | <i>Zizyphus jujuba</i>    | Bor                  |

### Shrubs

| Sr.No. | Scientific Name              | Common Name |
|--------|------------------------------|-------------|
| 1.     | <i>Carrisa congesta</i>      | Karwanda    |
| 2.     | <i>Cassia tora</i>           | Takla       |
| 3.     | <i>Clerodendrum serratum</i> | Bharangi    |
| 4.     | <i>Holarrhena pubescens</i>  | Kuda        |
| 5.     | <i>Murraya koenigii</i>      | Kadhipatta  |
| 6.     | <i>Solanum indicum</i>       | Chichardi   |

### List 4

#### Shrubs and grasses for slope stabilization

##### Shrubs

| Sr.No. | Scientific Name              | Common Name  |
|--------|------------------------------|--------------|
| 1.     | <i>Barleria cuspidata</i>    | Kate koranti |
| 2.     | <i>Bauhinia tomentosa</i>    | Kanchan      |
| 3.     | <i>Capparis divaricata</i>   | Pachunda     |
| 4.     | <i>Capparis decidua</i>      |              |
| 5.     | <i>Carissa congesta</i>      | Karawand     |
| 6.     | <i>Cassia auriculata</i>     | Tarwad       |
| 7.     | <i>Dichrostachys cinerea</i> | Sigam kati   |
| 8.     | <i>Ehretia aspera</i>        | Dhatarang    |
| 9.     | <i>Gymnosporia montana</i>   | Henkel       |
| 10.    | <i>Helicteres isora</i>      | Murud sheng  |

|     |                             |         |
|-----|-----------------------------|---------|
| 11. | <i>Mimosa hamata</i>        |         |
| 12. | <i>Woodfordia fruticosa</i> | Dhayati |

### Fodder plants

#### Grasses

| Sr.No. | Scientific Name                 | Common Name  |
|--------|---------------------------------|--------------|
| 1.     | <i>Andropogon annulatus</i>     | Marwel       |
| 2.     | <i>Apluda mutica</i>            | Ral          |
| 3.     | <i>Bambusa arundinacea</i>      | Kateri kalak |
| 4.     | <i>Cenchrus</i>                 |              |
| 5.     | <i>Coix lacryma jobi</i>        | Kashed       |
| 6.     | <i>Dichantheum</i>              |              |
| 7.     | <i>Echinochloa colomum</i>      | Pakad        |
| 8.     | <i>Ischaemum spp</i>            |              |
| 9.     | <i>Oxytenanthera monostigma</i> | Udha bamboo  |
| 10.    | <i>Panicum</i>                  |              |
| 11.    | <i>Sehima sulcatum</i>          | Pavana       |
| 12.    | <i>Sporobolus</i>               |              |
| 13.    | <i>Themeda quadrivalvis</i>     | Bondwel      |
| 14.    | <i>Zoysia matrella</i>          |              |

#### Herbs

| Sr.No. | Scientific Name                | Common Name |
|--------|--------------------------------|-------------|
| 1.     | <i>Boerhaavia diffusa</i>      | Punarnava   |
| 2.     | <i>Desmodium dichotomum</i>    |             |
| 3.     | <i>Elephantopus scaber</i>     | Hastipad    |
| 4.     | <i>Indigophera astragalina</i> |             |
| 5.     | <i>Indigophera glandulosa</i>  |             |
| 6.     | <i>Scoparia dulcis</i>         |             |
| 7.     | <i>Sida acuta</i>              | Bala        |
| 8.     | <i>Sida cordifolia</i>         | Bala        |
| 9.     | <i>Tribulus terrestris</i>     | Gokhru      |

|     |                               |  |
|-----|-------------------------------|--|
| 10. | <i>Stylosanthes fruticosa</i> |  |
|-----|-------------------------------|--|

#### Trees used as fodder plants

| Sr. no. | Scientific Name             | Local name  | Season                            | Part eaten      |
|---------|-----------------------------|-------------|-----------------------------------|-----------------|
| 1.      | <i>Bauhinia racemosa</i>    | Apta        | All                               | Foliage         |
| 2.      | <i>Bridelia retusa</i>      | Asana       | All                               | Foliage         |
| 3.      | <i>Ficus racemosa</i>       | Umbar       | Fruits in summer,<br>Lvs- sep-May | Foliage, fruits |
| 4.      | <i>Grewia tiliifolia</i>    | Dhaman      | All                               | Foliage         |
| 5.      | <i>Helicteres isora</i>     | Murud sheng | All                               | Tender Foliage  |
| 6.      | <i>Moringa oleifera</i>     | Shewga      | All                               | Foliage         |
| 7.      | <i>Syzygium cuminii</i>     | Jambhul     | All                               | Foliage         |
| 8.      | <i>Terminalia belerica</i>  | Behada      | May-Dec                           | Foliage         |
| 9.      | <i>Terminalia elliptica</i> | Ain         | May-Dec                           | Foliage         |

#### List 5

#### Aquatic Plants And Water tolerant plants

| Sr.No. | Scientific Name              | Common Name  | Type                |
|--------|------------------------------|--------------|---------------------|
| 1.     | <i>Bauhinia semla</i>        | Kanchan      | Tree High elevation |
| 2.     | <i>Pongamia glabra</i>       | Karanj       | Tree                |
| 3.     | <i>Terminlia arjuna</i>      | Arjun sadada | Tree                |
| 4.     | <i>Scleichera oleosa</i>     | Koshimb      | Tree                |
| 5.     | <i>Syzygium cuminii</i>      | Jambhul      | Tree                |
| 6.     | <i>Ficus glomerata</i>       | Umbar        | Tree                |
| 7.     | <i>Trapa bispinosus</i>      | Shingada     | Shrub               |
| 8.     | <i>Polygonum glabra</i>      |              | Tall herb           |
| 9.     | <i>Asclepias curassavica</i> | Halad kumku  | Tall herb           |
| 10.    | <i>Ludwigia octovalvis</i>   | Pan lavang   | Shrub               |
| 11.    | <i>Tamarix dioica</i>        | Kad sherani  | Shrub               |
| 12.    | <i>Homoinea riparia</i>      | Sherani      | Shrub               |

|     |                         |            |                              |
|-----|-------------------------|------------|------------------------------|
| 13. | <i>Cyperus rotundus</i> | Nagarmotha | Grass                        |
| 14. | <i>Cyperus spp</i>      |            | Grass                        |
| 15. | <i>Commelina spp</i>    |            | Streamside and Instream herb |
| 16. | <i>Cyanotis spp</i>     |            | Instream herb                |
| 17. | <i>Mollugo spp</i>      |            | Instream herb                |
| 18. | <i>Rhabdia spp</i>      |            | Instream herb                |

