# Cost Effective Soil and Water Conservation – Establishment of a Demonstration Area with People's Participation

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January 2006

**Project Report**

# Cost Effective Soil and Water Conservation – Establishment of a Demonstration Area with People's Participation

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*"Water is a powerful indicator of sustainability. It also is an indicator of the level of social development in a particular community. It is an indicator of poverty and social tensions. Water is also an issue that is linked with health, nutrition and many other factors that affect our society including the condition of nature itself. It is not an exaggeration to say that water is life itself"*

**Klaus Topfer, Executive Director, UNEP, 1998**

# CONTENTS

# ACKNOWLEDGEMENTS

We are beholden to the Honourable Chief Minister of Kerala Sri. Oommen Chandy for providing an opportunity to create a model watershed, which is a dream project. We travelled fast and forward, thanks to the support from Dr. A.E. Muthunayagam, Executive Vice- President of KSCSTE, Dr. J.K. Sharma, Director, KFRI and members of the project monitoring committee comprising Dr. R. Gnanaharan, Research Coordinator, KFRI, Dr. K. Jayaraman, Dr. Jose Kallarackal, and Dr. P.K. Muraleedharan. Sri. N. Premkumar, District Soil Conservation Officer, Thrissur and his team, Smt. Thara and Sri. Ranganathan, provided the design of the model watershed. We owe everything to them. The design was realised by Sri. George and his team of workers in a short time. We are grateful to Sri. Sajeev Kumar K.B, who remained on the watershed for over 8 months and coordinated the establishment, monitoring and supervision. We were ably supported by Sri. John P. Inchakalodi, who designed the gauging unit at the outlet, Sri. Praveen B.K who supported the monitoring, Sri. Ajith Kumar C and Sri. Subhash who carried out the photography. The authors are thankful to Sri. M. Pradeepkumar for GIS and mapping work and Sri. Sujeesh for conducting the socio-economic survey. The stakeholders and the project steering committee supported the implementation of the project and participated in the programme. The engineering feat was ably organised by Sri. K.R. Mukundan, Engineer, KFRI to whom we are extremely grateful. Sri Arun, Sri Sudheesh and Smt Ajitha put the report together. We are indebted to them.

# INTRODUCTION

Water is a vital natural resource which is indispensable for the existence of all living matter: plant, animal and man (Ullah *et al.*, 1972). From the very beginning of the history of mankind the need for water has attracted man to settle near riverbanks. All ancient civilizations of the world developed on the banks of rivers (Das, 1964). Today also, the availability of water influences to a considerable extent the pattern of landuse and the social and economic well being of the people. Since water is a vital resource, the necessity for its conservation needs emphasis. To control the water yield and to improve the water resources, the proper approach is sound watershed management. Watershed integrates all the hydrological phenomena pertaining to its boundaries and as such is a logical unit for planning optimal development of soil and water resources (Holton, 1969).

The State of Kerala, although receives an annual rainfall of ca. 3000 mm is affected either by floods or droughts. This is due nature of the terrain with steep slope, absence of vegetative cover and intensive downpours of short duration. Conventional methods of creating reservoirs, dams, inter-basin transfers have failed to achieve the desired results on the one hand and cost the exchequer dearly on the other. In this context cost effective localised methods to control the flow of water and also to enhance infiltration gather importance. Although, such methods have been tested and tried at various places throughout the state, a demonstration area for experimenting and learning is visibly absent.

**Thus a project was proposed to establish a demonstration area with soil and water conservation measures with emphasis on vegetative control practices and people's participation.**

## OBJECTIVE

To establish a demonstration area with soil and water conservation measures with emphasis on vegetative control practices and people's participation

## METHODOLOGY, STUDY AREA AND PEOPLE

### Methodology

In situ soil and water conservation practices were applied such as contour bunding, bunding along hedges with vegetation, under planting and vegetative strengthening of banks. Soil pits, trenches and drainage channel treatments were undertaken. All efforts were with active participation of stakeholders. A monitoring system was created using GIS for measuring hydrological parameters and impacts during and after the project.

### Study Area

The area for the model watershed was identified at the Field research Centre (FRC) of the Institute at Velupadam. A small stream flowing out into the main road and facing St. Joseph church and the area draining into it was chosen. In the upstream of this watershed, the devotees had collected water from a perennial spring in the past and this water was found holy. But during the past few years, the spring had dried up and no water was available after the rainy season. Further, during heavy rains, the water from the stream used to overflow, waters cross the road and enter church premises. The interests behind choosing this watershed was bifold:

1. To rejuvenate the spring
2. To prevent overflow of water across the road and to the premises of the church.

The chosen watershed in situated in Palappilly Range of Chalakudy Forest Division (Fig.1).

The Model Watershed is a part of the micro-watershed (51.91 ha) draining into Kurumali Puzha (Fig. 2) The model watershed covering an area of 7.591 ha is situated in

the western end of the FRC campus and drains into the Chimmoney dam -Amballur road. The watershed is laminar in shape having a length of 435 m and an average width of 184 m (Fig. 3). The soils belong to eroded oxisols with boulders, rocks and coarse gravel. The soils are well drained, medium deep, acidic in reaction and low in nutrients. A small stream drains out of the watershed and is joined by three streams above the outlet. The slope changes from medium to steep as one moves upstream.

In the lower portions there are two experimental plots of mahogany planted during 2003 (1.080ha) and 2004 (1.115 ha). In the upstream it is a degraded moist deciduous forest (5.395 ha), which was a failed teak plantation earlier, felled due to borer attack (Fig. 4).

**Biodiversity**

The watershed is a dynamic and unique area. It is a complex web of natural resources – soil, water, air, plants and animals.

The model watershed, being a part of the Palappilly Forests of Chalakudy Forest Division, is rich in biodiversity. A list of tree species (23) found in the watershed is given in Table 1. The density of trees was only 102 trees/ ha, which indicates severe degradation. The area is diverse in butterflies, other entomofauna, snakes and birds. The mammalian diversity comprises porcupine, wild pigs, sambar deer, spotted deer, monkeys (bonnet macaque), toddy cat, malabar giant squirrel and mongoose.

**Table 1.Tree species in the watershed**

| No | Name |
|---|---|
| 1 | *Acacia intsia* |
| 2 | *Albizia odoratissima* |
| 3 | *Alstonia scholaris* |
| 4 | *Atlantia racemosa* |
| 5 | *Bombax ceiba* |
| 6 | *Calycopteris floribunda* |
| 7 | *Careya arborea* |
| 8 | *Cassia fistula* |

| | |
|---|---|
| 9 | *Cordia wallichii* |
| 10 | *Dalbergia latifolia* |
| 11 | *Grewia tillifolia* |
| 12 | *Helicteres isora* |
| 13 | *Holarrhena pubescence* |
| 14 | *Macaranga peltata* |
| 15 | *Melia dubia* |
| 16 | *Santalum album* |
| 17 | *Sterculia guttata* |
| 18 | *Streblus asper* |
| 19 | *Strychnos nuxvomica* |
| 20 | *Tectona grandis* (Teak) |
| 21 | *Terminalia bellarica* |
| 22 | *Wrightia tinctoria* |
| 23 | *Xylia xylocarpa* |

**People**

Forty-one households belong to the micro watershed of which our model watershed is a part (see appendix for more details).

The population is predominantly Christians followed by Hindus and Muslims. Of the total number of 172, 95 are male and 77 females. Age-wise, the dominant age group is 20-40 followed by 40-60.

Nearly 20% of the population is illiterate and belongs to the age group above 60. Most have studied up to $10^{th}$ standard. A few are degree holders.

Percentage of unemployed youth is high. Nearly 30% of the population is unemployed. Only 11% practices agriculture as a profession.

Most people reside here for the past 25 years. New settlers are few. Most have purchased the land, while others have inherited. Homegarden type of cropping dominates (58.5%) followed by coconut and areca nut.

Most draw water from one's own well (78%) and the rest from neighbour's well. Access to drinking water is more or less similar.

Most respondents were keen in the protection of the stream although majority do not use it directly. Most have little or no knowledge about water conservation and hence are eager to learn.

**Watershed partners, Sensitising and Training**

Effective watershed management planning relies on an effective partnership that includes representatives of all stakeholders and works cooperatively toward a common goal. The stream running out of the selected watershed is joined by yet another stream and flows into Kurumalipuzha. There are over 40 households on the way, and the members of the same were identified as the primary stakeholders.

**Table 8. List of Trainees**

| No | Name |
|---|---|
| 1 | Babu Nerinjappally |
| 2 | Beeran Thevarkattil |
| 3 | Chakkalakal Kochuvareed |
| 4 | George Kannampathapul |
| 5 | Govindan K.R. |
| 6 | Jolly K.K |
| 7 | Jose Attokkaran |
| 8 | Joseph A.A. |
| 9 | Kalathingalthodi Thomas |
| 10 | Kunju Kunju |
| 11 | Moideen N. |
| 12 | Paul Punnari |
| 13 | Puthenpeedika Sabu |
| 14 | Sukumaran Panikaveetil |
| 15 | Vareed Thommana |

We organised a meeting of all stakeholders (Table 8), communities living with in the watershed, Forest Department officials, and representatives of Panchayathi Raj Institutions (Grama Panchayath and Block Panchayath) on 11-05-2005. This pre-launch meet was conducted in the premises of the St. Joseph's church. Dr. S. Sankar detailed on the aims, objectives and draft action plan for creating a model watershed. As we proceeded we found many people who want to be involved in developing a plan to protect the watershed. The stakeholders contributed to developing a plan of action and a steering committee was constituted to coordinate and monitor the work with Fr. Jose Maliekkal, the Vicar of the St. Joseph's Church as convener (Table 9). The committee met on four occasions (Table 10)

**Table 9. Project steering committee**

| No | Name |
|---|---|
| 1 | Fr. Jose Maliekkal (Convener) |
| 2 | Babu Njerinjampally |
| 3 | George K.T. |
| 4 | Govindan K.R. |
| 5 | Jose Attokkaran |
| 6 | Joseph Arukakkal |
| 7 | Kunju Kunju |
| 8 | Thoman Valliyil |

**Table 10. The meeting schedule of the steering committee**

| No | Date, Month, Year |
|---|---|
| 1 | 11-05-2005 |
| 2 | 12-07-2005 |
| 3 | 30-08-2005 |
| 4 | 12-12-2005 |

Training in watershed design, development, implementation and management was accorded (Table 8) and local people participated in building the model watershed.

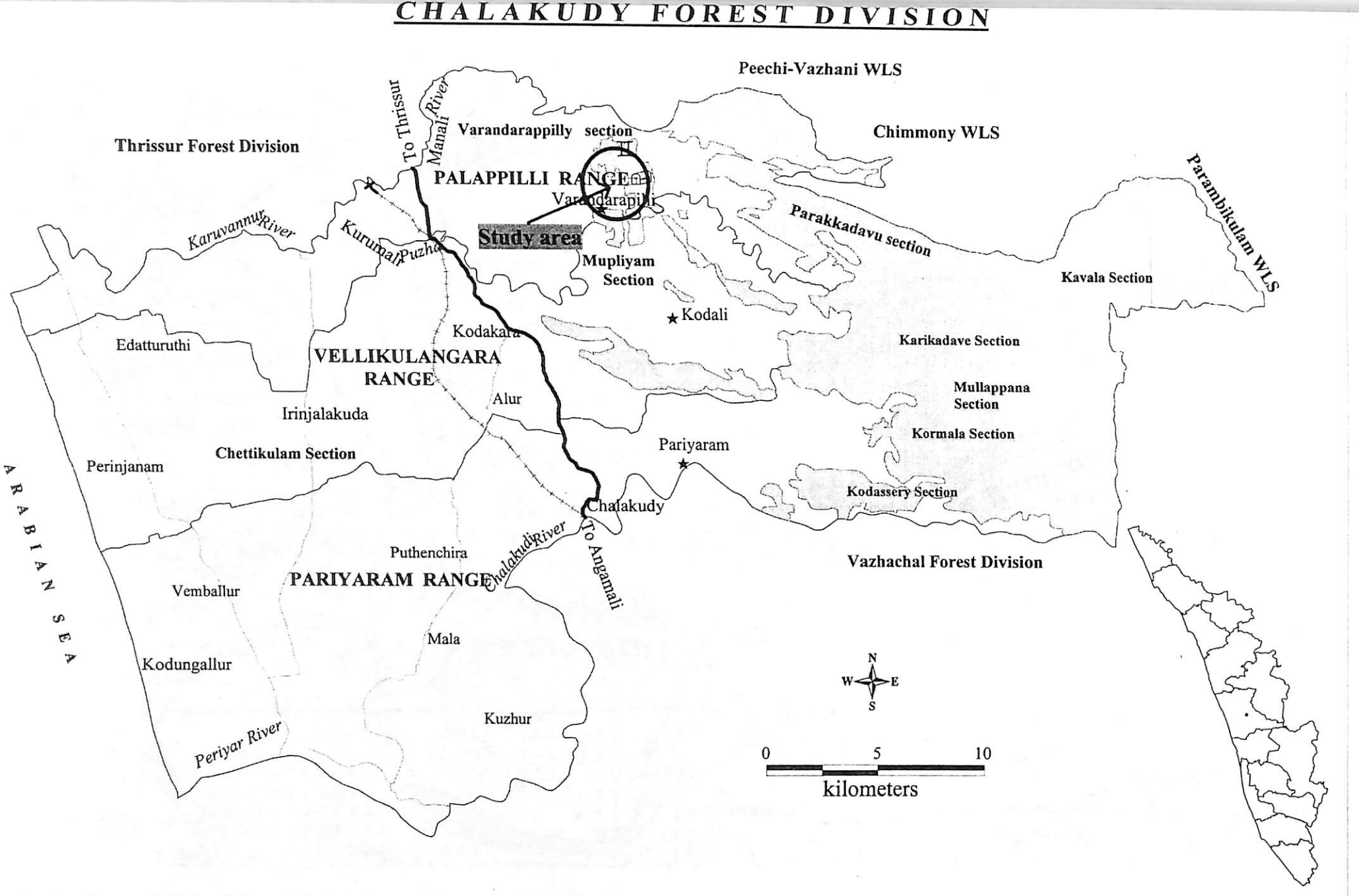


Fig. 1. General view of the study area

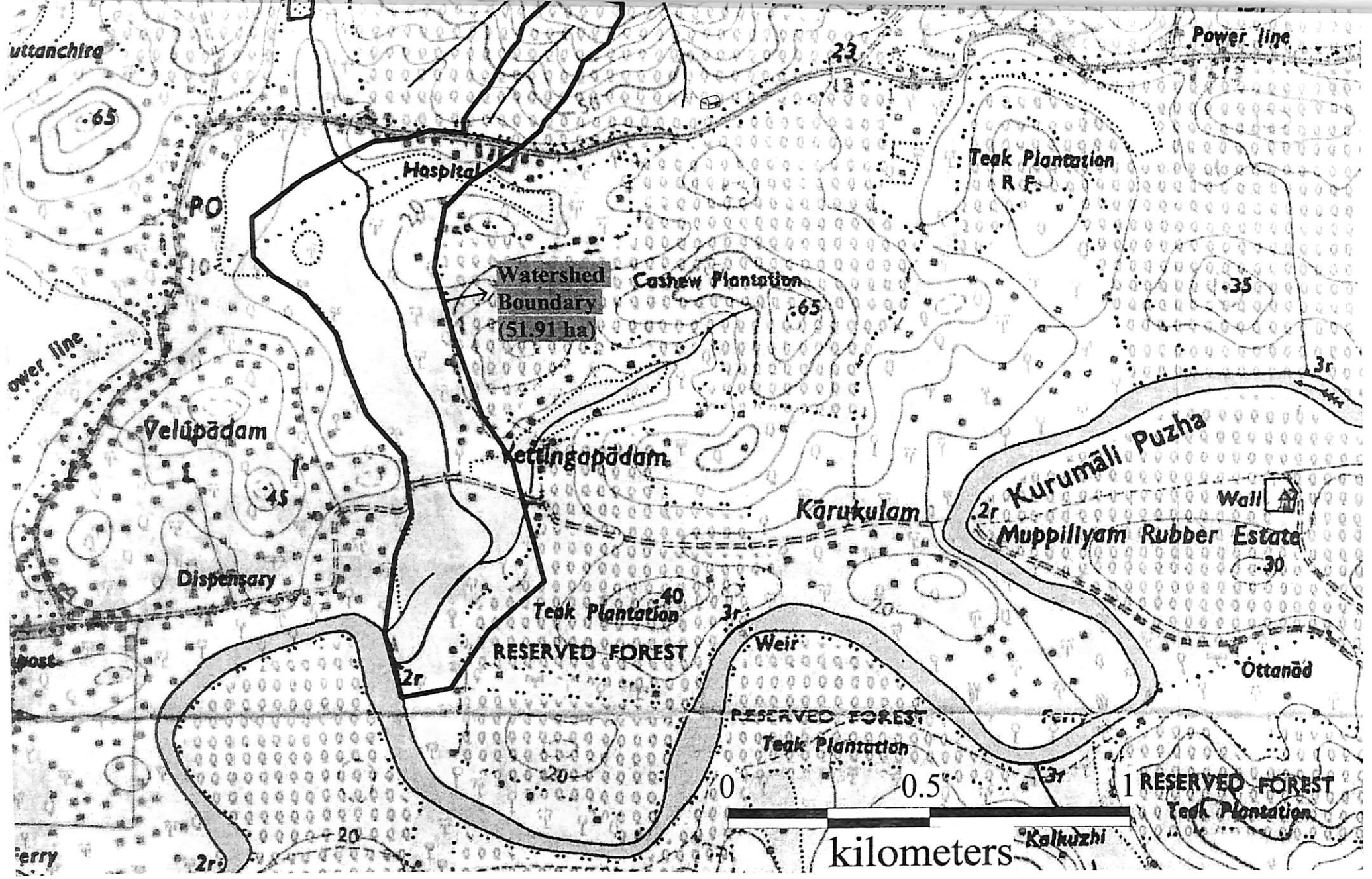


Fig. 2. Overview of the sub-watershed

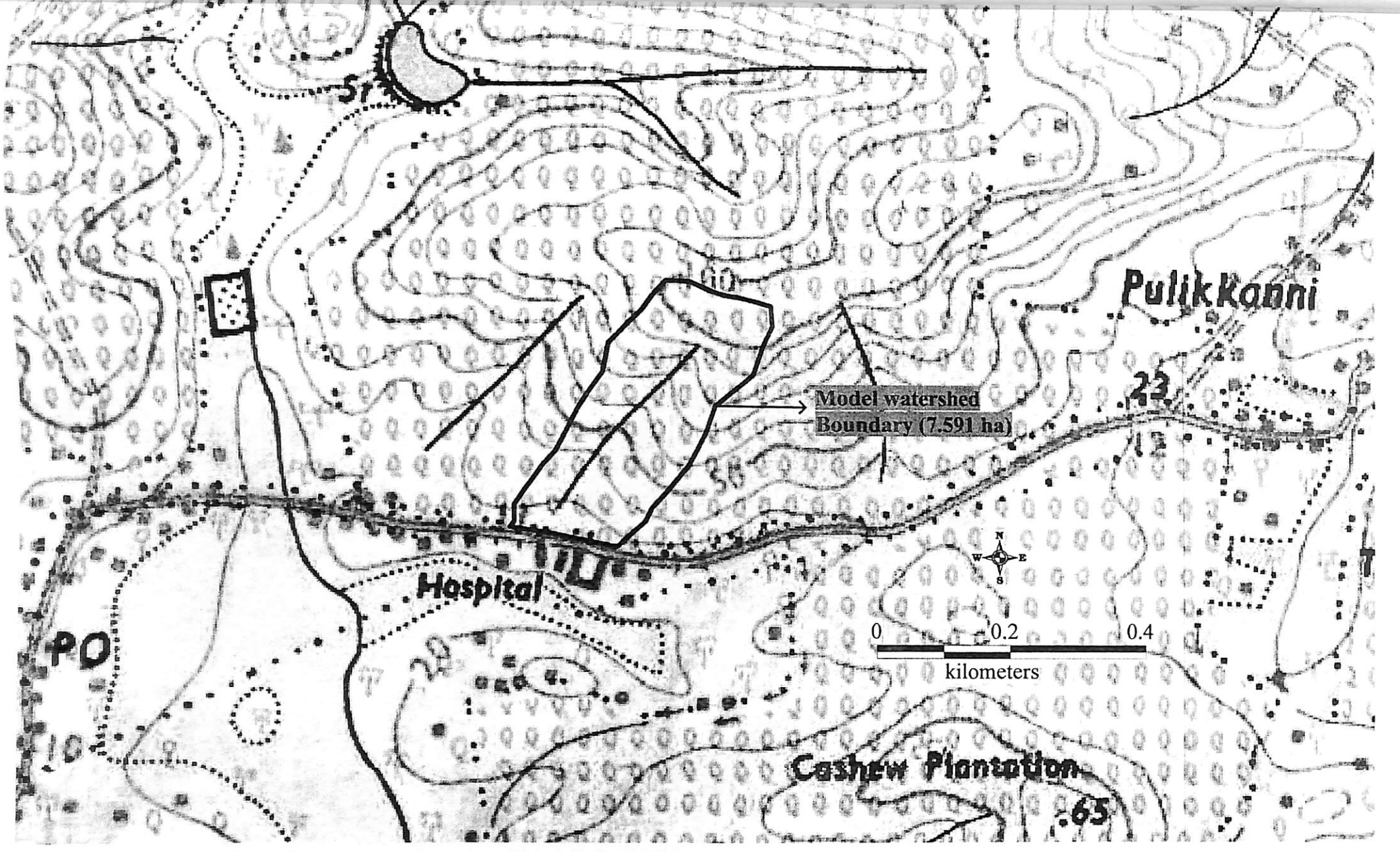


Fig. 3. Close view of the model watershed

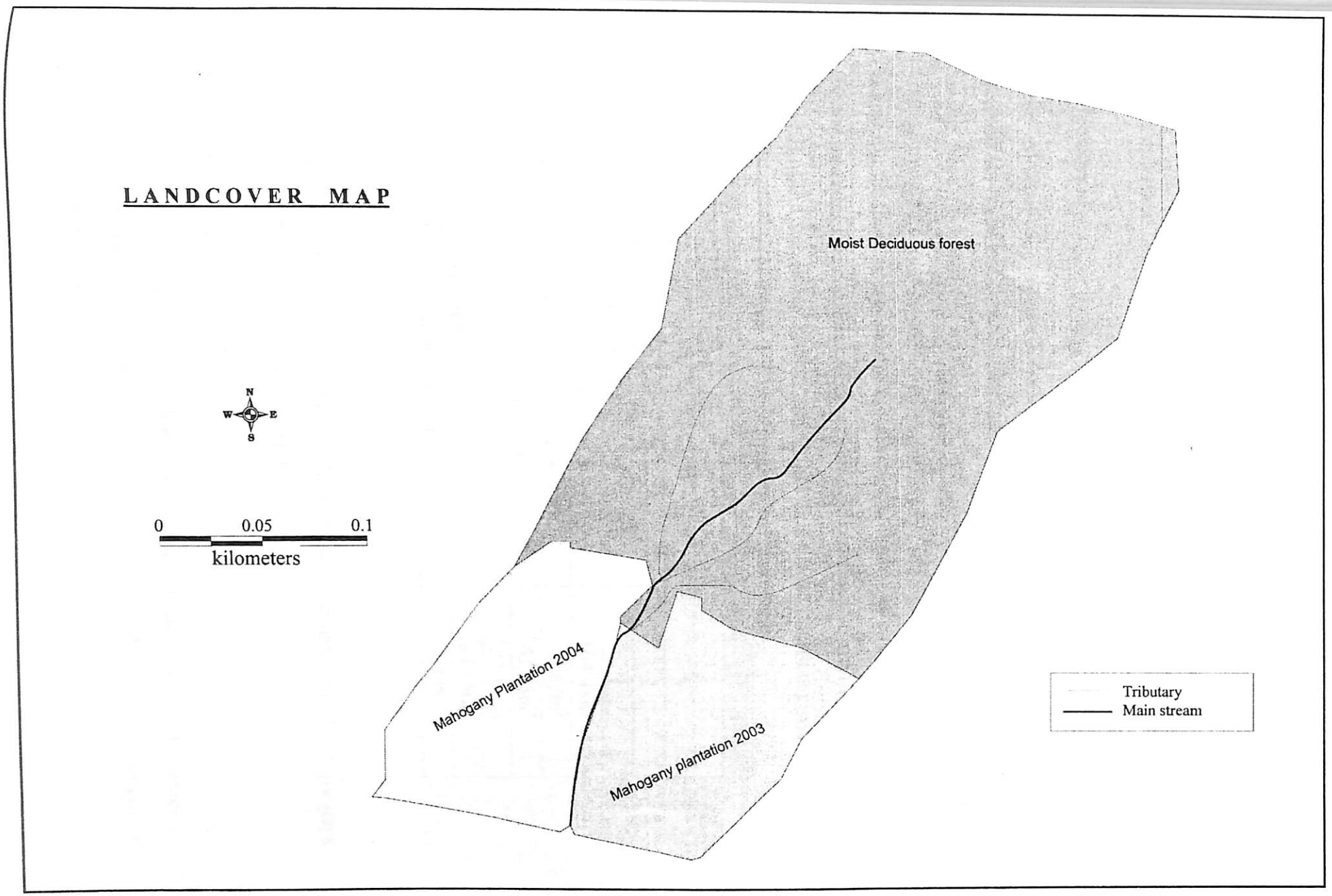


Fig. 4. Landcover in the model watershed

# TREATMENTS TO ESTABLISH A MODEL WATERSHED

Mechanical and vegetative restorative actions were implemented within the model watershed during March-December 2005. The activities were as follows:

## 1. Mechanical

Mechanical practices for soil and water conservation were carried out. The area was surveyed and contours marked on the ground. The sub streams and the major stream were perambulated and locations of structures were fixed. Contour bunds, contour trenches, moisture conservation pits, etc were taken. The streams were packed at specific locations using rubble, thus creating a number of check dams (Plates 1-6). At few locations live checkdams using bamboos were made to see the efficacy. A list (Table 2) of the mechanical structures established in the study area is provided below.

**Table 2. List of mechanical structures**

| No | Structures | Number/ volume |
|---|---|---|
| 1 | Check dam | 1 |
| 2 | Cross-checks | 3 |
| 3 | Bamboo check dam | 2 |
| 4 | Dry log check dam | 1 |
| 5 | Dry rubble rock pack | 104.48$m^3$ |
| 6 | Dry rubble (local stone) pack work | 39.87$m^3$ |
| 7 | Contour bunds with packing in between | 43.03$m^3$ |
| 8 | Contour bunds | 122.11 $m^3$ |
| 9 | Contour trenches | 630.50m |
| 10 | Moisture conservation pits | 448 |

## 2. Vegetative

An enumeration of the existing biodiversity was carried out and canopy gaps were identified. The gaps were planted with tree saplings.

### 2.1. Planting of trees

Through the watershed development programme saplings of 33 species of trees (over 400 saplings) were planted (Table 3 and Plates 11-12). The species choice was dictated by preference to indigenous, moist deciduous and evergreen ones. The

banks of the watercourse were stabilised by planting *Ochlandra* and *Melocanna* (bamboos) The survival is nearly 80% (as on 31st December, 2005).

**Table 3. Species planted in the study area**

| No | Name |
|---|---|
| 1 | *Aglaia lawii* |
| 2 | *Aglaia malabarica* |
| 3 | *Albizia odoratissima* |
| 4 | *Aporusa lindleyana* |
| 5 | *Bauhinia malabarica* |
| 6 | *Calamus sp* |
| 7 | *Calophyllum inophyllum* |
| 8 | *Chukrasia tabularis* |
| 9 | *Cinnamomum zeylanica* |
| 10 | *Dimocarpus longan* |
| 11 | *Diospyros sp.* |
| 12 | *Elaeocarpus glandulosus* |
| 13 | *Flacourtia montana* |
| 14 | *Garcinia gummi-gutta* |
| 15 | *Gmelina arborea* |
| 16 | *Grewia tiliifolia* |
| 17 | *Hopea parviflora* |
| 18 | *Hopea racophloea* |

| No | Name |
|---|---|
| 19 | *Hydnocarpus pentandra* |
| 20 | *Ixora brachiata* |
| 21 | *Lagerstreomia microphylla* |
| 22 | *Melia dubia* |
| 23 | *Melocanna baccifera* |
| 24 | *Memecylon deccanense* |
| 25 | *Myristica dactyloides* |
| 26 | *Myristica sp.* |
| 27 | *Ochlandra travancorica* |
| 28 | *Olea dioica* |
| 29 | *Polyalthia fragrans* |
| 30 | *Samanea saman* |
| 31 | *Sapindus trifoliata* |
| 32 | *Syzygium cumini* |
| 33 | *Terminalia bellerica* |
| 34 | *Terminalia crenulata* |
| 35 | *Vitex altissima* |

## 2.2. Planting of grass along contour bunds

Grass slips were planted on contour bunds to strengthen them. The roots of grass have capability of binding soil and preventing erosion. Two species of local grass were used viz., *Vetiver* and *Cympapogon* (Plates 7-8).

# PLATES

Plate 1. Cross check

Plate 2. Crosscheck

Plate 3. Check dam

Plate 4. Bamboo check dam

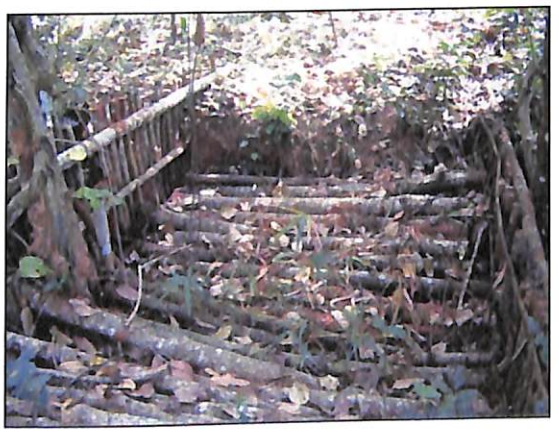

Plate 5. Dry log check dam

Plate 6. Dry rubble rock pack

Plate 7. Contour bund with Vetiver

Plate 8. Contour bund with Cympapogon

Plate 9. Contour trench

Plate 10. Moisture conservation pit

Plate 11. *Cinnamomum zeylanica*

Plate 12. *Syzygium cumini*

# RESULTS

## Impacts

The impact of the watershed was evaluated using parameters like water quality, runoff and soil moisture.

### Evaluation of water quality

When a watershed is managed effectively, the runoff is controlled and infiltration is enhanced. This will reflect in the quality of water. The following two parameters were adopted for testing water quality:

1. Turbidity
2. Chemical content (N and P)

Our results reveal (Table 4) that the quality of water flowing out of the model watershed has zero turbidity and lower content of N and P. The low level of nutrients and the absence of turbidity can be related to the enhanced rates of infiltration and reduced runoff (Santhosh Kumar, 2000). In other words there has been a significant reduction in soil loss.

**Table 4. Turbidity and chemical content**

| Parameter | Model watershed | Adjacent area |
|---|---|---|
| Turbidity | Nil | 2.26 g/l |
| N | 0.251 ppm | 0.886 ppm |
| P | 0.154 ppm | 0.424 ppm |

### Rainfall and run-off

The most important criterion for characterising any watershed is the incident rainfall and the subsequent runoff from the watershed. The rainfall-runoff relationship indicates the health of the watershed. In degraded watersheds runoff is increased and floods and gullies are imminent during the rainy season. Rainfall in the watershed was measured at 8 AM daily using a FRP raingauge (Plate 13). At the outlet of the watershed a gauging station (Plate 14) was constructed. The structure was 4 x 1.5 x 1 m in size (length, breadth, height). It was constructed using country bricks and

plastered with cement. A metallic measuring scale with 2 cm graduation was fixed to measure the height of the flow of water. Days when flow of water was observed, the height and speed of the water (using float and stopwatch) was recorded six times daily.

**Table 5. Rainfall**

| Date | June | July | August | September | October | November |
|---|---|---|---|---|---|---|
| | Rainfall (mm) | Rainfall (mm) | Rainfall (mm) | Rainfall (mm) | Rainfall (mm) | Rainfall (mm) |
| 1 | 18.60 | 57.11 | 54.12 | 9.35 | 0 | 5.87 |
| 2 | 2.40 | 39.70 | 45.97 | 0 | 0 | 2.99 |
| 3 | 61.40 | 28.35 | 35.72 | 95.22 | 0 | 0 |
| 4 | 1.79 | 40.79 | 8.75 | 33.73 | 0 | 0 |
| 5 | 4.88 | 45.57 | 11.54 | 86.36 | 22.09 | 6.02 |
| 6 | 13.93 | 22.38 | 1.39 | 18.80 | 0 | 8.56 |
| 7 | 0 | 14.12 | 0 | 42.08 | 0 | 0 |
| 8 | 0 | 6.86 | 0 | 32.23 | 3.38 | 0 |
| 9 | 8.76 | 60.39 | 0 | 26.16 | 0 | 0 |
| 10 | 12.54 | 38.30 | 8.45 | 9.55 | 35.02 | 0 |
| 11 | 2.49 | 12.13 | 6.56 | 67.16 | 0.50 | 2.79 |
| 12 | 0 | 5.57 | 4.57 | 35.12 | 1.69 | 22.59 |
| 13 | 1.79 | 5.47 | 11.14 | 27.46 | 22.09 | 11.24 |
| 14 | 45.27 | 3.78 | 4.67 | 17.51 | 17.31 | 2.79 |
| 15 | 2.79 | 13.63 | 23.68 | 0 | 0 | 0 |
| 16 | 33.13 | 8.05 | 53.83 | 17.21 | 0 | 0 |
| 17 | 89.35 | 19.40 | 19.50 | 0 | 0 | 0 |
| 18 | 30.35 | 63.78 | 7.16 | 0 | 0 | 0 |
| 19 | 54.73 | 34.32 | 0 | 10.84 | 0 | 0 |
| 20 | 92.04 | 0 | 0 | 5.97 | 0 | 0 |
| 21 | 52.84 | 9.95 | 0 | 30.34 | 0 | 0 |
| 22 | 47.76 | 0 | 0 | 6.46 | 36.07 | 0 |
| 23 | 9.35 | 11.74 | 0 | 0 | 31.64 | 0 |
| 24 | 2.59 | 30.44 | 0 | 0 | 5.47 | 0 |
| 25 | 48.76 | 22.48 | 0 | 0 | 0 | 0 |
| 26 | 17.31 | 17.81 | 0 | 0 | 5.67 | 0 |
| 27 | 14.43 | 13.83 | 0 | 0 | 0 | 0 |
| 28 | 20.10 | 65.07 | 0 | 0 | 0 | 0 |
| 29 | 15.97 | 57.41 | 0 | 0 | 17.51 | 0 |
| 30 | 18.31 | 56.71 | 0 | 0 | 0.50 | 0 |
| 31 | 0 | 89.45 | 0 | 0 | 0 | 0 |
| **Total** | **723.66** | **894.59** | **297.05** | **571.55** | **198.94** | **62.85** |

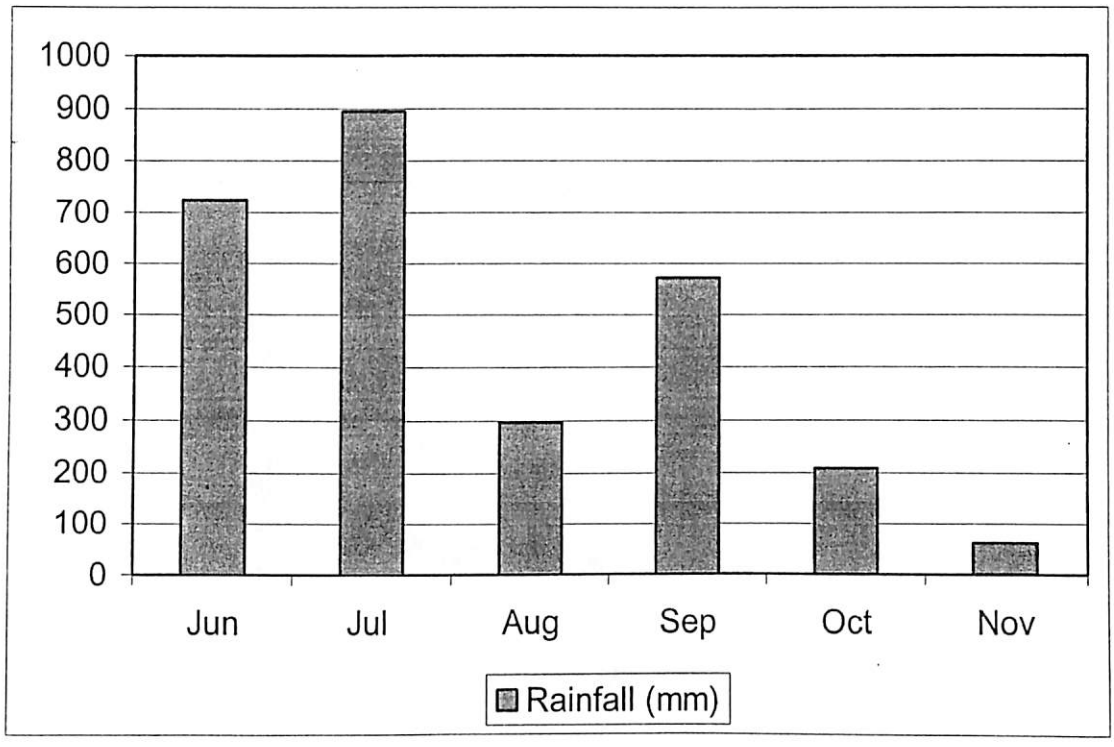


**Fig 5. Rainfall**

The rainfall during the period from 1st June to 30th November is provided in Table 5 and Figure 5. The total rainfall during the period was 2758.6 mm. This rainfall provided an input of 220698.4 $m^3$ of water within an area 7.591 ha. The total outflow from the watershed was 23220.78 $m^3$ (Table 6).

**Table 6. Rainfall and runoff**

| Month | Rainfall (mm) | Total amount of water ($m^3$) | Total runoff ($m^3$) | % of flow |
|---|---|---|---|---|
| Jun | 723.66 | 57903.2 | 0 | 0 |
| Jul | 894.59 | 71567.2 | 8486.81 | 11.86 |
| Aug | 297.05 | 23764.0 | 5244.32 | 22.07 |
| Sep | 571.55 | 45724.0 | 9489.65 | 20.75 |
| Oct | 208.91 | 16712.8 | 0 | 0 |
| Nov | 62.84 | 5027.2 | 0 | 0 |
| **Total** | **2758.6** | **220698.4** | **23220.78** | **10.06** |

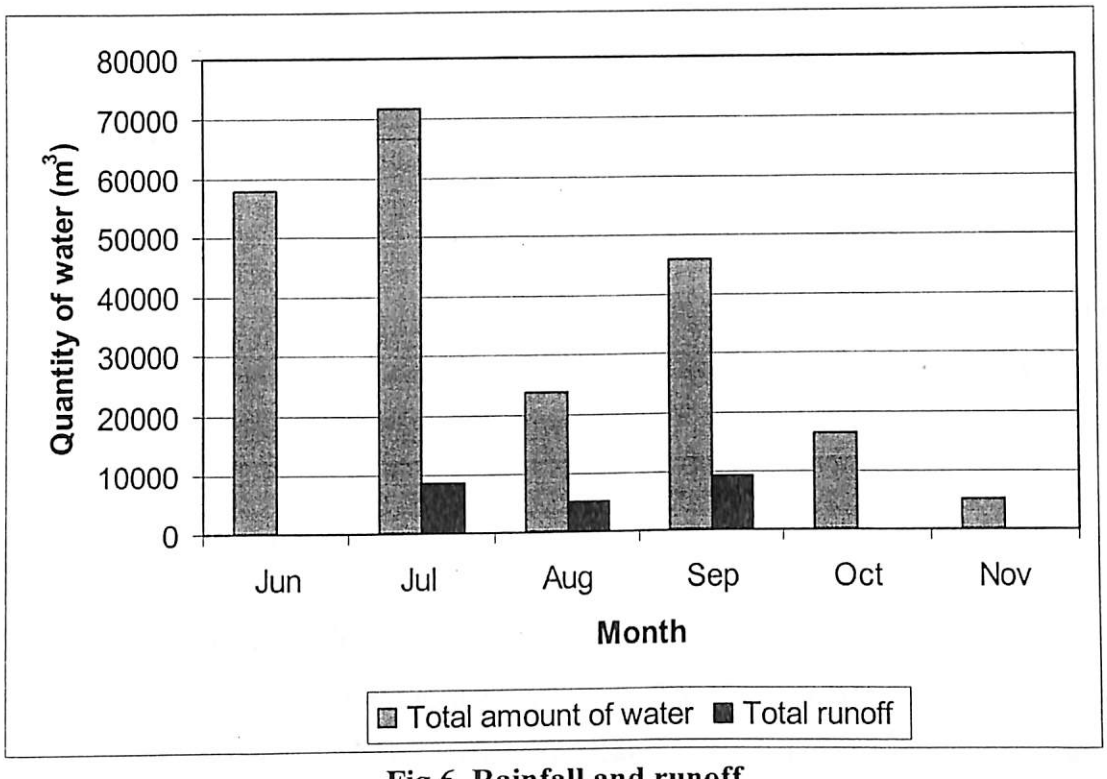


**Fig 6. Rainfall and runoff**

The relationship between run-off and rainfall (Table 6 and Fig. 6) indicates that run-off has been controlled to nearly 10.06% of the rainfall. It is interesting to note that during June 2005, when the rainfall was 723.66 mm, there was no run-off. This clearly proves that the water is being stored within the watershed by enhanced infiltration.

**Soil Moisture**

The level of soil moisture was measured using gravimetry in the soil column 10-20 cm periodically after rains both in the model and adjacent untreated area. The results are given in Table 7.

**Table 7. Percentage of Soil moisture (n=20)**

| Area | Soil moisture (%) | | |
|---|---|---|---|
| | October | November | December |
| Model watershed | 38 | 34 | 28 |
| Adjacent area | 26 | 20 | 18 |

The data show that in the treated watershed, the level of soil moisture is higher than untreated. This trend indicates that conservation and infiltration of water has been enhanced by the measures implemented.

**Rejuvenation of springs**

A few springs in the upstream were rejuvenated (Plates 15 and 16) due to soil and water conservation efforts in the watershed. The enhancement of availability of surface water (streams, springs, etc) has drastically increased the biodiversity status of the model watershed (Plate 17) in comparison with control. A dramatic increase in the presence of the following groups has been observed: birds, snakes, deer (ungulates) etc.

The news about the success of the watershed management initiative has spread and many groups visit the area:

**Table 11. Agencies which visited the watershed**

| No | Name |
|---|---|
| 1 | Block Panchayath, Kodakara |
| 2 | INFACT, Palai |
| 3 | Jalanidhi, Thrissur |
| 4 | Oxfam-Svaraj, Bangalore |

Many Panchayaths have expressed keen interest in the 'model' and requested means and ways of replicating this experience.

# PLATES

Plate 13. Rain gauge

Plate 14. Gauge station

Plate 15. Water stored at check dam

Plate 16. Water flow at upstream

Plates 17 & 18. Enhanced biodiversity

## CREATION OF AN INFORMATION SYSTEM TO MONITOR AND ANALYSE THE IMPACTS

A Geographic Information System (Figs. 7 and 8) was created through the following steps. On a digitised map of the watershed the following overlays were created:

1. Landuse
2. Slope
3. Civil works
4. Vegetative structures
5. Bench marks for monitoring impact (soil moisture, water availability etc)

It is aimed at integrating attribute data (soil moisture, runoff, infiltration, etc) collected from fixed locations over time to develop time series data necessary for trend analyses.

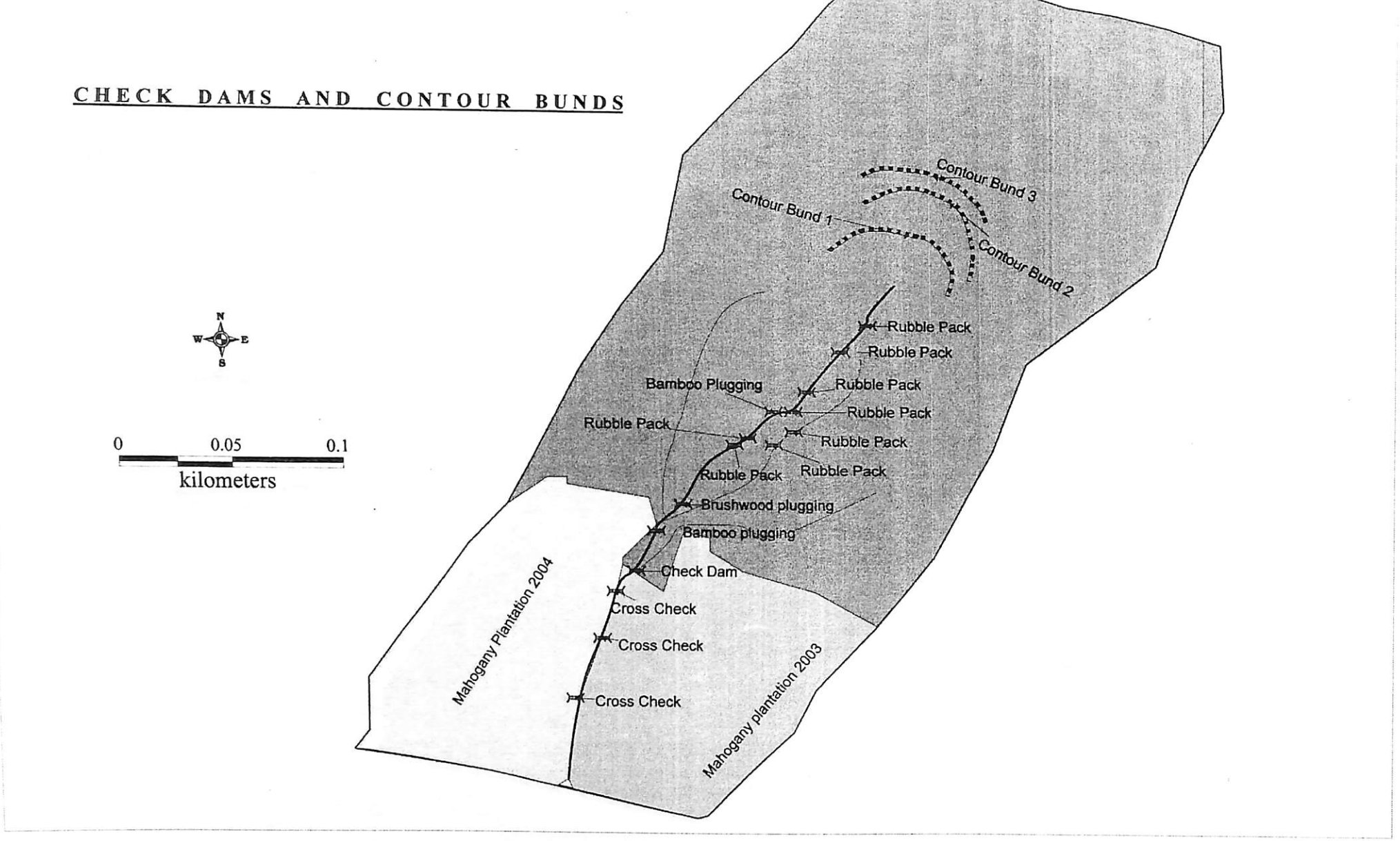


Fig. 7. Interventions in the model watershed - a

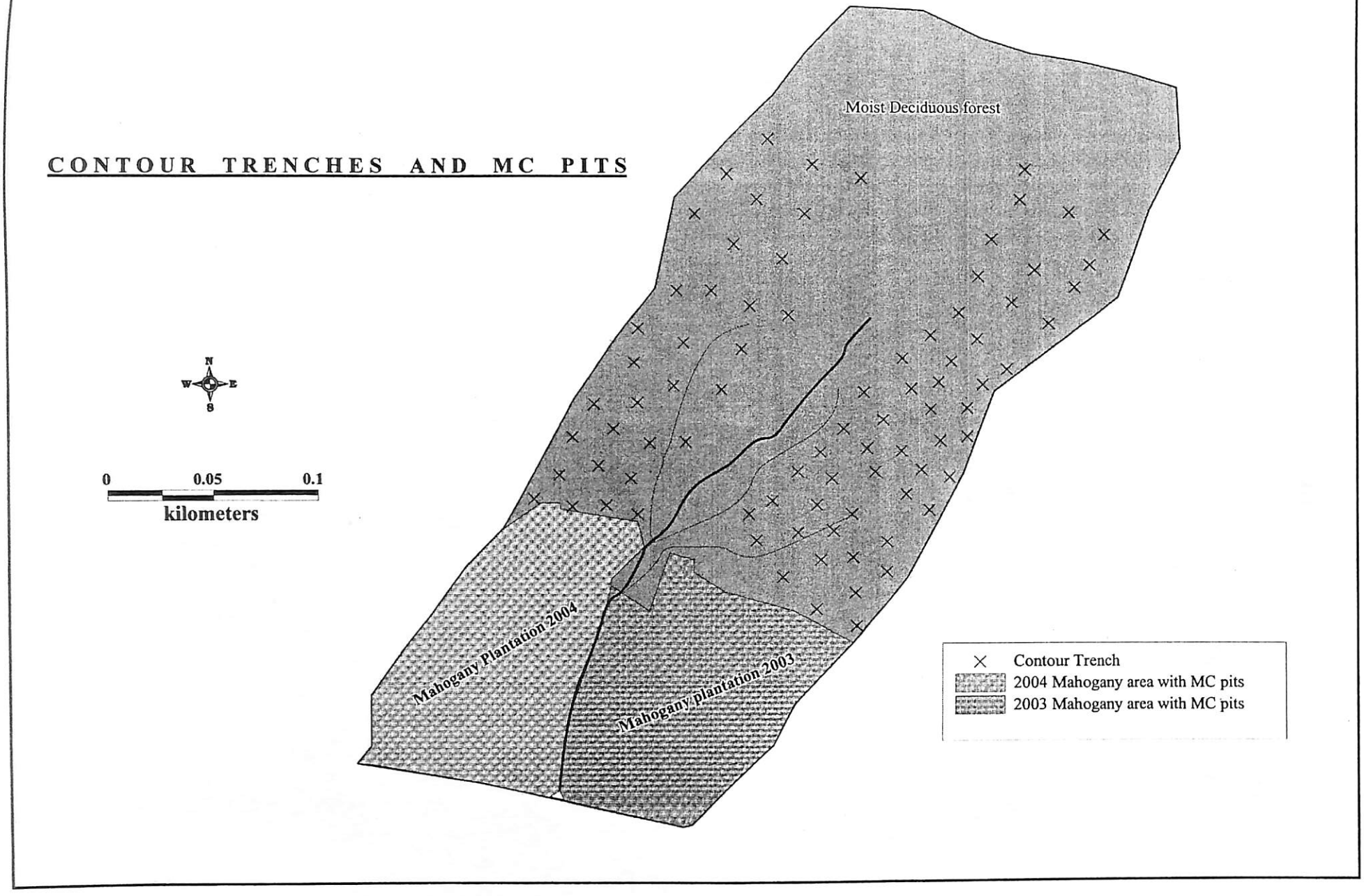


Fig. 8.Interventions in the model watershed - b

## DELIVERABLES

The following deliverables viz., Cover cropping under cropping and Mixed cropping were not achieved as the area was not under agricultural landuse and the steering committee was not favourable to incorporate them.

**The following deliverables were achieved:**

**Model watershed of 7.591 ha was established resulting in reduction in runoff by 90%, enhanced soil moisture and water quality, increase in spring out put.**

**Stakeholders (20) were sensitised and trained in good land ethics of watershed management**

**A GIS based monitoring system for watersheds has been created.**

# CONCLUSION

1. A model watershed has been successfully established, which has delivered the cherished goals of soil and water conservation by increasing the rates of infiltration, reducing runoff and enhancing water availability in (soil moisture) and above soil level (springs). The watershed can demonstrate all possible methods of soil and water conservation to interested parties.
2. The project has sensitised and trained the local community and also the neighbourhood Panchayaths in watershed design, development and management.
3. The GIS based monitoring system was developed to monitor the watershed benefits over time.

# RECOMMENDATION

It is hoped that this experience in a small area will be replicated in watersheds of larger size with more number of stakeholders and beneficiaries.

# REFERENCES

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# APPENDIX

**Details of the community residing with in the watershed**

**1. Religion**

| No | Religion | No. of families | Percentage |
|---|---|---|---|
| 1 | Hindu | 15 | 36.59 |
| 2 | Christian | 19 | 46.34 |
| 3 | Muslim | 7 | 17.07 |
| | **Total** | **41** | **100** |

**2. Demography - Gender**

| No | Gender | No. of | Percentage |
|---|---|---|---|
| 1 | Male | 95 | 55.23 |
| 2 | Female | 77 | 44.77 |
| | **Total** | **172** | **100** |

**3. Demography - Age**

| No | Age | No. of | Percentage |
|---|---|---|---|
| 1 | Below 10 | 9 | 5.23 |
| 2 | 10 - 20 | 15 | 8.72 |
| 3 | 20 - 40 | 78 | 45.35 |
| 4 | 40 - 60 | 42 | 24.41 |
| 5 | Above 60 | 28 | 16.28 |
| | **Total** | **172** | **100** |

**4. Educational Status**

| No | Educational status | No. of Male (Percentage) | No. of female (Percentage) | No. of People | Percentage |
|---|---|---|---|---|---|
| 1 | Primary | 10 (10.52 ) | 8 (10.38) | 18 | 10.47 |
| 2 | 5 to 10 | 48 (50.52 ) | 28 (36.36 ) | 76 | 44.19 |
| 3 | 10 to +2 | 17 (17.89 ) | 12 (15.58) | 29 | 16.86 |
| 4 | Degree and above | 6 (6.31) | 10 (12.98 ) | 16 | 9.30 |
| 5 | Illiterate | 14 (14.73 ) | 19 (24.67) | 33 | 19.19 |
| | **Total** | **95 (100)** | **77 (100)** | **172** | **100** |

### 5. Occupation

| No | Occupation | No. of Male (Percentage) | No. of Female (Percentage) | No. of People | Percentage |
|---|---|---|---|---|---|
| 1 | Agri & AH | 18 (18.94) | 2 (2.59) | 20 | 11.62791 |
| 2 | Labour | 18 (18.94) | 1 (1.29) | 19 | 11.04651 |
| 3 | Govt. Service | 1 (1.05) | 2 (2.59) | 3 | 1.744186 |
| 4 | Private | 6 (6.31) | 4 (5.19) | 10 | 5.813953 |
| 5 | Trade/Shop | 10 (10.52) | 0 | 10 | 5.813953 |
| 6 | Unemployed | 3 (3.15) | 50 (64.93) | 53 | 30.81395 |
| 7 | Other (Gulf) | 18 (18.94) | 0 | 18 | 10.46512 |
| 8 | Students | 12 (12.63) | 9 (11.68) | 21 | 12.2093 |
| 9 | Aged | 9 (9.47) | 9 (11.68) | 18 | 10.46512 |
| | **Total** | **95 (100)** | **77 (100)** | **172** | **100** |

### 6. Residence

| No | Residing | No. of families | Percentage |
|---|---|---|---|
| 1 | Near by the stream | 25 | 60.98 |
| 2 | In other land away from the stream | 16 | 39.02 |
| | **Total** | **41** | **100** |

### 7. Length of Occupancy

| No | Length | No. of | Percentage |
|---|---|---|---|
| 1 | 0 - 5 years | 6 | 14.63 |
| 2 | 5 - 15 years | 13 | 31.71 |
| 3 | 15 - 25 years | 7 | 17.07 |
| 4 | Above 25 years | 15 | 36.59 |
| | **Total** | **41** | **100** |

### 8. Ownership

| No | Ownership | No. of | Percentage |
|---|---|---|---|
| 1 | Bought by them | 25 | 60.98 |
| 2 | Acquired | 16 | 39.02 |
| | **Total** | **41** | **100** |

**9. Land ownership.**

| No. | Land area | No. of | Percentage |
|---|---|---|---|
| 1 | Below 10 cent | 4 | 9.76 |
| 2 | 10 - 25 | 9 | 21.95 |
| 3 | 25 - 50 | 7 | 17.07 |
| 4 | 50 - 1 acre | 13 | 31.71 |
| 5 | 1 acre and above | 8 | 19.51 |
| | **Total** | **41** | **100** |

**9. Agriculture**

| No | Agriculture | No. of | Percentage |
|---|---|---|---|
| 1 | Paddy/Plantain/Tapioca | 2 | 4.88 |
| 2 | Home garden | 24 | 58.54 |
| 3 | Fallow field | 0 | 0 |
| 4 | Rubber | 1 | 2.44 |
| 5 | Coconut/Arecanut | 14 | 34.15 |
| | **Total** | **41** | **100** |

**10. Drinking water facilities**

| No | Drinking water facility | No. of | Percentage |
|---|---|---|---|
| 1 | Own well | 32 | 78.05 |
| 2 | Neighbours well | 8 | 19.51 |
| 3 | Public Tap | 0 | 0 |
| 4 | Others | 1 | 2.44 |
| | **Total** | **41** | **100** |

**10a. Drinking water facilities for those residing near the stream**

| No | Drinking water facility | No. of | Percentage |
|---|---|---|---|
| 1 | Own well | 18 | 72 |
| 2 | Neighbours well | 7 | 28 |
| 3 | Public Tap | 0 | 0 |
| 4 | Others | 0 | 0 |
| | **Total** | **25** | **100** |

**11. Availability of water for Agriculture**

| No. | Facility | No. of | Percentage |
|---|---|---|---|
| 1 | Well/ Pond | 25 | 60.98 |
| 2 | River | 2 | 4.88 |
| 3 | Not irrigated | 14 | 34.15 |
| | **Total** | **41** | **100** |

**12. Nature of stream use**

| No. | | No. of | Percentage |
|---|---|---|---|
| 1 | Little use | 4 | 9.76 |
| 2 | Very useful | 0 | 0 |
| 3 | No use | 37 | 90.24 |
| | **Total** | **41** | **100** |

**13. People interested in the protection of stream**

| No. | | No. | Percentage |
|---|---|---|---|
| 1 | Interested | 40 | 97.56 |
| 2 | Not interested | 1 | 2.44 |
| | **Total** | **41** | **100** |

**14. Knowledge about water conservation**

| No. | Nature of knowledge | No. of | Percentage |
|---|---|---|---|
| 1 | Little knowledge | 18 | 43.90 |
| 2 | Know very well | 2 | 4.88 |
| 3 | Do not know | 21 | 51.21 |
| | **Total** | **41** | **100** |