

Soil Erosion Status, Priority Treatment Areas and Conservation Measures for Different Districts of Karnataka



ICAR-Indian Institute of Soil & Water Conservation (IISWC)

218, Kaulagarh Road, Dehradun (Uttarakhand 248 195)



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FOREWORD



डा. टी. महापात्रा
 सचिव एवं महानिदेशक

Dr T. Mahapatra
 SECRETARY & DIRECTOR GENERAL



भारत सरकार
 कृषि अनुसंधान और शिक्षा विभाग एवं
 भारतीय कृषि अनुसंधान परिषद
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 DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION
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Land degradation due to Soil erosion is a major conservation challenge across the globe in achieving Sustainable Development Goals. The much envisaged goal of land degradation neutral world by 2030 largely depends on the innovative land use and management approach where further land degradation is prevented and already degraded land is restored. A restored land can help in accommodating different land uses and support livelihoods, biodiversity, supply clean water, and reduce erosion. It would enhance soil fertility, conserve soil moisture, sequester carbon and increase food production. The treatments of erosion affected land is of high priority to comply with the 'Like for Like approach' of LDN targets.

Assessment of soil erosion risk is of paramount importance for making treatment plan to preserve soil's productive potential and ensures sustainable land use while reversing land degradation. Land managers and policy makers need to have adequate knowledge of intensity and distribution of soil erosion risk areas to check land degradation, and efficiently plan and execute various cost-effective land-based interventions.

Effective planning and implementation of watershed development programmes have proven results in terms of sustainable production and ecosystem services and therefore can be fine tuned for holistic and sustainable development by incorporating knowledge of various relevant disciplines and Social behaviors.

In order to provide information on soil erosion status, priority treatment area and district and problem specific intervention measures for arresting soil erosion and promoting ecosystem services a document on "Soil erosion status, priority treatment areas and conservation measures for different districts of Karnataka" has been prepared by the ICAR-IISWC, Dehradun. The material in this document is largely drawn from Institute's research work and other organizations besides covering regional experiences.

I appreciate the efforts made by the ICAR-IISWC, Dehradun and its Research Centre at Ballari in bringing out this valuable publication for planning mitigation of the land degradation problem in Karnataka state. I hope, it will be very much useful to the policy planners, field functionaries and all stakeholders working for the sustainable development and to achieve land degradation neutrality.

Dated the 23rd August, 2021
 New Delhi


 (T. Mahapatra)



MESSAGE

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I am delighted to know that ICAR-Indian Institute of Soil & Water Conservation, Dehradun along with its Research Centre- Ballari has prepared a technical document on Soil erosion status, priority treatment areas and conservation measures for different districts of Karnataka” in compliance to the recommendations of the Regional Committee-VIII. Soil erosion induced land degradation and productivity decline is one of the most dominant problems of Karnataka despite that the majority of Karnataka fall under semiarid tracts.

The risk of soil erosion in Karnataka states is more serious - mainly due to high intensity rainfall at places, deforestation, overgrazing and faulty land use practices - leading to abandonment of many lands. Besides this, the low and fluctuating farm income is the reason for lessening interest in farming. About 81% of the total geographical area of the state requires different degrees of soil erosion management. I am fully aware that all the land under various form of degradation cant of treated in one go due to resource limitations and technical infeasibility therefore, estimation of losses due to soil erosion and delineating critical land degradation areas through prioritization process is crucial for developing open-space plans that protect soil and water resources.

This document deals with a greater focus on district wise severity of erosion areas, soil erosion risk map of the state with different priority classes and their extent, critical problems and soil and water conservation measures including district wise agronomic, vegetative, and agro forestry measures. The details given in this document is in "easy to understand" and ready to apply" mode by the users across the state.

I congratulate the team ICAR-IISWC, Dehradun and its Research Centre-Ballari for their excellent efforts in compiling and bringing out this document in the field of vital importance. I am sure, this document would be immensely useful to the executives, field functionaries and other stakeholders engaged in the dissemination of soil and water conservation technologies in the watersheds.

Dated the 23rd August, 2021
New Delhi


(S. K. Chaudhary)



PREFACE

The ICAR- Indian Institute of Soil and Water Conservation (IISWC), Dehradun is one of the national institute of Natural Resource Management Division (NRM) of the Indian Council of Agricultural Research, Ministry of Agriculture and Farmer's Welfare, Govt. of India. The Institute along with its eight research centres is continuously working for development of location specific, cost effective soil and watershed conservation technologies, imparting training to state government officials and developing model watersheds as a learning sites for further adoption and upscaling in the field of Soil Water Conservation (SWC) technologies and watershed management. The Research Centre (RC)–Ballari located in Karnataka state is mandated to develop land reclamation technologies for dry land area in Karnataka.

The background of development of this document on “Soil Erosion Status, Priority Treatment Areas and Conservation Measures for Different Districts of Karnataka” lies in the deliberations and subsequent recommendation of the Regional Committee-VIII. The committee stressed on developing strategy for arresting soil erosion on priority for sustainable development of the Southern Region. On the recommendations and subsequent suggestions of the ADG (Agronomy, Agroforestry and Climate Change), a team comprising members from the RC- Ballari was formulated at the institute.

As per the estimation of the Institute, about 22% of total geographical area (TGA) of Karnataka experiences moderate or moderate to severe soil erosion loss due to water erosion thereby leading to an annual production loss of 24.6% alone in rainfed cereal, oilseed and pulse crops. Such degradation of land due to various forms of soil erosion leads to decrease in land productivity, economic loss propel risks to local food systems and livelihoods. The recently released IPCC's Sixth Assessment Report (AR6, 2021) predicts increase in heat waves, droughts, rainfall events and a likelihood of more cyclonic activity for India and the subcontinent over the coming decades. The prediction of more severe rains over southern India in the coming decades further underscores the requirement of refined and redesigned regional coping strategies.

Considering the immediate need of various stakeholders for arresting soil erosion and averting land degradation, this document focus on identification of critical areas based on the permissible soil erosion rate and existing erosion rate at a given location in each districts of State. The document contains soil erosion status and erosion induced losses including production and monetary losses at national level as well as for Karnataka state. Besides, priority map, area under various degrees of risk and district specific agronomic, vegetative and engineering soil and water conservation (SWC) measures have also been presented in details. The list of location specific SWC and agroforestry measures for each district has been compiled as ready reckoner for policy makers, researchers, planners, NGOs and extension functionaries working to address the various land degradation problems.

(Authors)



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1.0

INTRODUCTION

Soil erosion is one of the most serious environmental concerns affecting all natural and human-managed ecosystems. Soil erosion, besides having significant impact on productivity of cultivated land also adversely affects chemical, physical and biological functions of soil leading to soil degradation and depletion of multiple soil functions. Although soil erosion is a global phenomenon, it has intensified in recent years due to population pressures, developmental activities, unscientific land use and land management practices. Erosion induced loss in crop production and farmers income, are of utmost concern in India and globally. The total annual production loss was estimated as 13.4 million tonnes @ 15.7% (Sharda et al., 2010). As per valuation based on Government's minimum support prices during 2018-19, the loss was worth Rs 382.78 billion *i.e.* about 0.273% of Gross Domestic Product (GDP) of Rs 140.03 trillion. Further, by adopting a more pragmatic approach it was estimated that productivity loss at state level ranges 0.2-10.9 q ha⁻¹ in rainfed crops of cereals, 0.1-6.3 q ha⁻¹ in oilseeds, and 0.04-4.4 q ha⁻¹ in pulses. India as a whole suffers a loss of 1.63 q ha⁻¹ in productivity of rainfed crops (Sharda and Dogra, 2013). This loss was valued at Rs 4631 ha⁻¹ considering the minimum support prices during 2018-19. The risk of soil erosion in south Indian states is more serious as many lands can no longer be sustained for production, mainly due to high intensity rainfall, deforestation, overgrazing and faulty land use practices thus leading to their abandonment. About 22%, 9% and 5% of total geographical area (TGA) of Karnataka, Tamil Nadu and Kerala states, respectively, experiences moderate or moderate to severe soil erosion loss (Mandal et al., 2020). Further, these states suffer an annual production loss of 24.6%, 20% and 23.5%, respectively due to water erosion in rainfed cereal, oilseed and pulse crops (Sharda and Dogra, 2013). In an agrarian country like India, assessment of soil erosion risk is of paramount importance to preserve soil's productive potential and ensure sustainable land use (Mandal and Giri, 2021, Sharda and Mandal, 2018). Land managers and policy makers need to have adequate knowledge of intensity and distribution of soil erosion risk areas to check land degradation, and efficiently plan and execute various cost-effective land-based interventions to achieve the targets of land degradation neutrality (LDN) (UNCCD, 2013). Hence, it is imperative to quantify the risks associated with overuse of soil functions, which lead to land degradation and consequently impacting on eco-system services.

2.0 LAND DEGRADATION THROUGH SOIL EROSION AND ITS IMPACTS

2.1 Land Degradation

In India, about 121.7 M ha area, which includes arable and non-arable lands, is subjected to various forms of land degradation (ICAR 2010), with maximum (82.6 M ha, 68.4%) contribution by water erosion (49% area accounts for soil loss $>10.0 \text{ t ha}^{-1} \text{ yr}^{-1}$). The Soil erosion and other associated losses is presented in Fig.2.1

2.2 Gross Erosion Rate

The gross annual soil erosion of our country is 5.11 billion tonnes out of which 34.1 % deposited in the reservoirs, 22.9 % is discharged outside the country (mainly to oceans), and 43.0 % is displaced within the mainland (Sharda and Ojasvi, 2016). Average annual reduction in water storage capacity of dams by 1.2% from 4937 big dams and average life span reduction of dams by 25 yrs (Range 8-53 yrs).

2.3 Production Loss & Monetary Loss

Annual production and monetary losses due to water erosion were estimated by ICAR-IISWC, Dehradun by evolving and adopting a systematic approach which integrates data on erosion category-wise potentially eroded areas under major soil groups (alluvial, black or red) in each state with productivity loss factors (PLF) of 27 major rainfed crops, including cereals (8), oilseeds (10) and pulses (9), evolved through experimental studies in rainfed areas of different agro-climatic regions of the country. Following this approach, the total annual production loss was estimated as 13.4 million tonnes @ 15.7% (Sharda et al., 2010a). As per valuation based on Government's minimum support prices during 2018-19, this loss was Rs 382.78 billion. The GDP during 2018-19 was Rs 140.03 trillion and the loss was about 0.273% of the GDP. Productivity loss at state level ranges 0.2-10.9 q ha⁻¹ in rainfed crops of cereals, 0.1-6.3 q ha⁻¹ in oilseeds, and 0.04-4.4 q ha⁻¹ in pulses. National average loss in productivity of rainfed crops was estimated to be 1.63 q ha⁻¹ (Sharda and Dogra, 2013). This loss was valued at Rs 4631 ha⁻¹ considering the minimum support prices during 2018-19.

2.4 Nutrients Loss

A significant amount (8 to 11 M t of NPK) of nutrients gets transported with runoff and eroded soil leading to net loss of ecosystem services. Soil loss resulting in loss of 5.37 to 8.40 M t of nutrients in India (Sharda and Ojasvi, 2016) estimated total monetary loss of Rs 38,540 to 45,410 crores annually (2020 price). Further the estimated erosion linked loss

of N, P, K, and S nutrient displacement as 4.41 to 9.61, 0.387 to 2.31, 4.43 and 1.27-1.65 million tonnes amounting to the corresponding monetary loss of Rs13500- 29300, 1850-8320, 17300 and 5890-7790 crore rupees (2020 price), respectively.

2.5 Carbon Loss

Release of extra carbon dioxide into the atmosphere by organic matter dislodgement followed by decomposition has serious implications on climate change. The soil pool loses of 1100 Mt C into the atmosphere as a result of soil erosion and another 300-800 Mt C annually to the ocean (Lal, 2011). Quantity of organic C displacement due to water erosion in India is about 115 Mt yr⁻¹ which consequently emits about 34.6 Mt of C to the atmosphere; erosion control can reduce C emission by 19.0–27.0 Mt yr⁻¹ (Mandal et al., 2020).

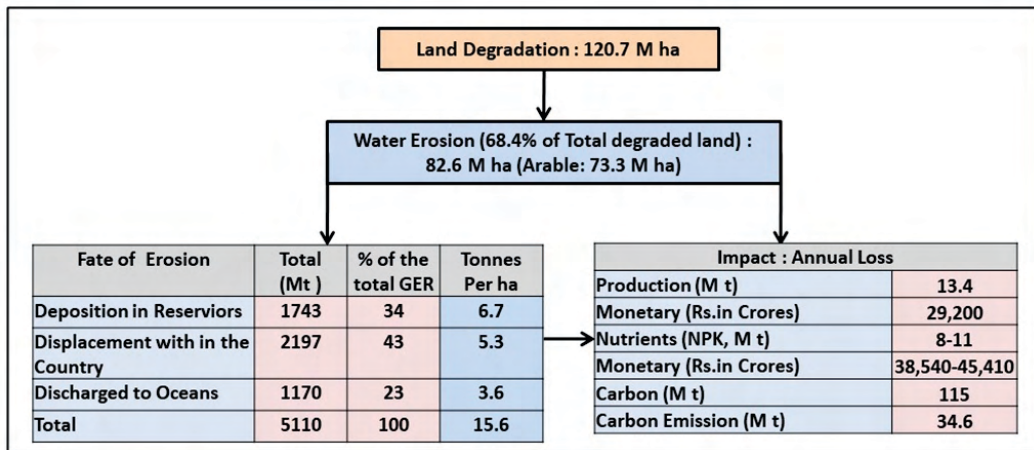


Fig. 2.1. Soil erosion and associated losses in India (GER- Gross erosion rate)

2.6 Loss in Reservoir Capacity

The total sediment trapped in the reservoirs with a total gross capacity of 299.5 G m³ was estimated at 1679 M m³ yr⁻¹, as a result of which the average annual capacity loss of the reservoirs was calculated as 1.04% with a range of 0.47 to 3.05% (Sharda and Ojasvi, 2016). Loss of gross storage capacity in the range of 0.50 % to 0.80 % per year is experienced in the case of larger dams with capacity varying from 51 to >1000 M m³. Smaller dams of 1 to 50 M m³ capacity experience a reduction in storage capacity ranging from 0.80 % to > 2.00 % per year. The annual total storage loss and dead storage loss in Sardar Sarovar dam has been estimated to be 0.495% and 1.27%, respectively resulting to annual capitalized loss of 1070 to 1137 million rupees for loss in power generation and irrigated area under different scenario of rainfall (Pande et al., 2014).

3.0

THE APPROACH

Soil erosion risk depends upon the balance between prevailing soil erosion rate and the permissible rate or soil loss tolerance limit. While prevailing soil erosion rate is a function of physiographic, edaphic and climatic factors at a given location, the assessment of site-specific soil loss tolerance limit of the location helps in understanding capacity of the soil to withstand the forces of soil erosion. For example, about 32% areas of Peninsular Plateau can only afford a soil loss ranging from 2.5 to 7.5 t ha⁻¹ yr⁻¹ (NAAS, 2017, Biswas et al., 2015) while soil erosion rates in such area is more than 10 t ha⁻¹ yr⁻¹.

The district wise prioritisation/risk area was assessed from the data base on potential soil erosion rates and soil loss tolerance limits for the state of Karnataka. The potential soil erosion rate was compared with the value of soil loss tolerance limit, the differences in value of potential soil erosion and soil loss tolerance limit of a place was used for deciding priority class, higher the difference (Potential soil erosion rate – soil loss tolerance limit), higher the priority. Based on the difference of soil erosion and tolerance limits, five priority classes have been defined normalizing the difference values between 35 and 5 t ha⁻¹ yr⁻¹ (Class 1: > 35 t ha⁻¹ yr⁻¹, Class 2 : 25 – 35 t ha⁻¹ yr⁻¹, Class 3 : 15 - 25 t ha⁻¹ yr⁻¹, Class 4: 5-15 t ha⁻¹ yr⁻¹ Class 5: < 5 t ha⁻¹ yr⁻¹). In addition to the above difference, an area having T-value of 2.5 t ha⁻¹ yr⁻¹ is considered most sensitive due to shallow soil depth and poor quality, it is highly vulnerable to loss of crop productivity if soil erosion exceeds the T–value. This makes peninsular India an area of great concern from soil erosion point of view. For operational point of view the sum of priority class 1, 2 and 3 has been taken into consideration and the severity of soil erosion risk has been reclassified. According to this re-classification, severity class A, B and C were defined based on the cumulative area of < 50000 ha, 50000-100000 ha and > 100000 ha, respectively.

Soil erosion in a given priority class has to be brought within the permissible rate or T-value to achieve sustainability of production systems, and for carbon sequestration. The identification of critical areas in the priority classes based on the permissible soil erosion rate or T-value at a given location in each districts of respective state and the proposed conservation measures for each district are aimed to reduce soil erosion below the soil tolerance limit.

4.0 EROSION STATUS AND CONSERVATION PLANNING FOR THE STATE OF KARNATAKA

4.1 About the State

It's located in western part of Deccan Peninsular region of India covering TGA of 19.17 M ha. The state has four principal physiographic regions, namely South Deccan Plateau, Western Ghats, Eastern Ghats (south) and West Coast Plains. The climate varies widely from arid and semi-arid in the plateau region with annual average rainfall varying from 350 mm to 1000 mm to humid tropical monsoonic type in the west coast plains with high average annual rainfall varying from 3000 mm to 3600 mm.

4.2 Soil Erosion Rate

Analysis of soil erosion data revealed that soil erosion rates vary enormously across the state, ranging from less than $5 \text{ t ha}^{-1} \text{ yr}^{-1}$ in 0.01% area to very severe ($> 40 \text{ t ha}^{-1} \text{ yr}^{-1}$) in 10.64% area. As per harmonized data base on land degradation, about 80,592 km^2 areas (42%) of the state is affected due to soil erosion by water, and soil acidity and sodicity. Out of the total degraded area, about 95% is affected exclusively by water erosion, while 2% area in acid soils also suffers from water erosion. Percentage of area under slight ($< 10 \text{ t ha}^{-1} \text{ yr}^{-1}$), moderate ($10\text{-}20 \text{ t ha}^{-1} \text{ yr}^{-1}$) and severe ($20\text{-}40 \text{ t ha}^{-1} \text{ yr}^{-1}$) soil erosion classes are 16.07, 61.23 and 10.99, respectively (Fig. 4.1). Analysis of the data also revealed that nearly 82.96% area across the state has erosion rates of more than $10 \text{ t ha}^{-1} \text{ yr}^{-1}$, which indicates that soil erosion is a serious problem in major parts of the state. The severity of soil erosion is due to aggressive climatic conditions coupled with steep topography and erodible soils. Although occurrence of severe droughts is a common feature in north Karnataka, excessive soil erosion due to heavy rain in 2016 indicates high erosion vulnerability of the agricultural land (Down to Earth, 2016). Intense rain after a prolonged drought increases the risk of soil erosion.

4.3 Soil Loss Tolerance Limit (SLTL)

Data pertaining to soil loss/erosion tolerance limits indicated that it varies between 2.5 and $12.5 \text{ t ha}^{-1} \text{ yr}^{-1}$. The areas having lower T-values ranging from 2.5 to $5.0 \text{ t ha}^{-1} \text{ yr}^{-1}$ are most sensitive and need greater attention for adopting soil and water conservation measures to minimize further deterioration. Soil erosion risk map of the state showing different priority classes and their extent is given in Fig. 4.1.

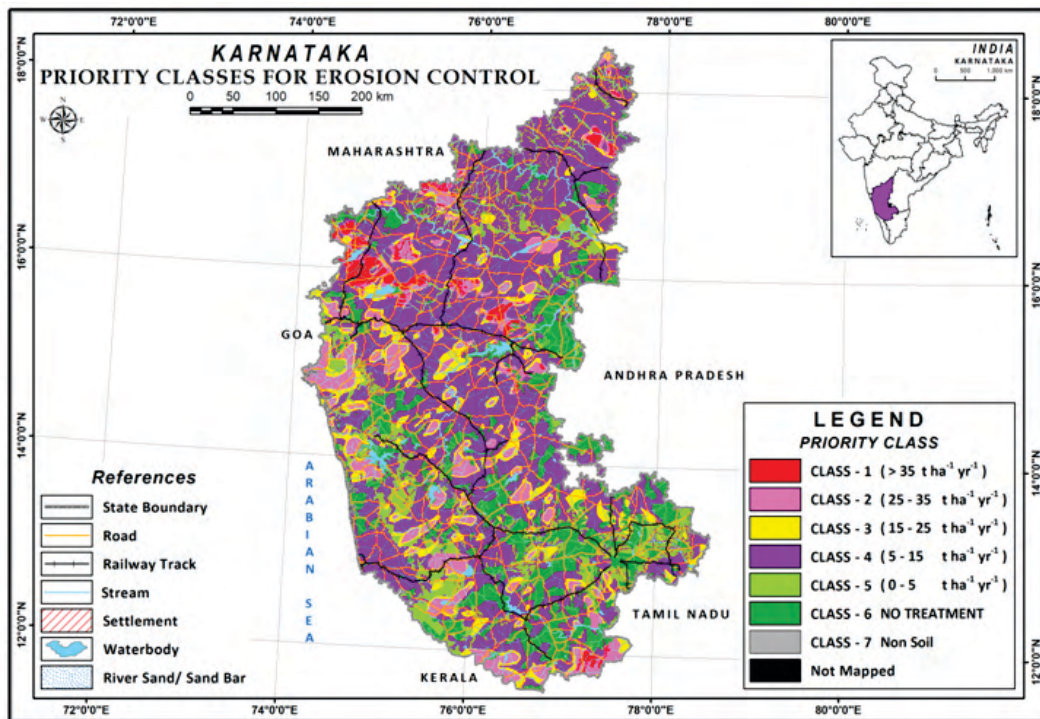


Fig. 4.1: Priority classes for erosion control in Karnataka state

4.4 Production and Monetary Loss from Rainfed Crops Due to Soil Erosion

On an average, the cereal, oilseed and pulse crops together lose 25% of their production in the state due to water erosion. Out of 2.1 million tonne in total production losses, 69.8% is due to losses in cereals and millets, followed by 17.6% in oilseeds and 12.7% in pulses. In terms of monetary losses, 48.7% of the total loss of Rs 65,655 million that occurs in Karnataka is due to production losses in cereals and millets, followed by 27.9% in oilseeds and 23.4% in pulses (Fig. 4.2). The largest contribution is from groundnut (20%) followed by finger millet (19%) and maize (13%). The average productivity loss of all these crops together is 267 kg ha^{-1} (Sharda and Dogra, 2013), which in monetary terms was Rs 8330 ha^{-1} during 2018-19 (Fig 4.3). The Gross State Domestic Product (GSDP) of Karnataka for 2018-19 at current prices was estimated to be Rs 14,08,112 crore (PRS, 2019). Therefore, the State lost 0.5% of its GSDP during 2018-19 due to loss of production of its cultivated rainfed cereal, oilseed and pulse crops as a result of soil erosion by rain water.

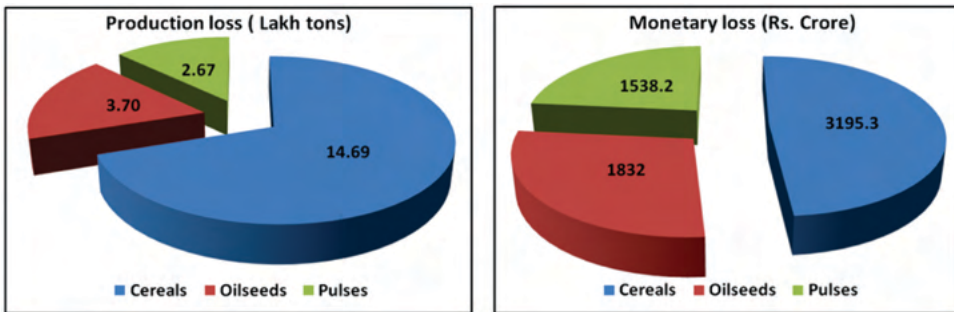


Fig. 4.2: Estimated total production and monetary loss of rainfed crops due to soil erosion in Karnataka State

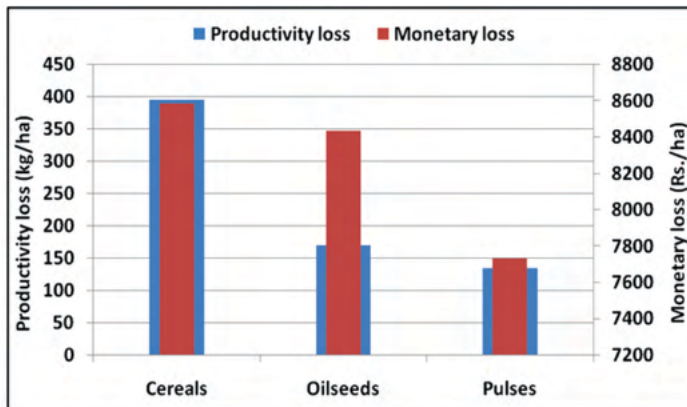


Fig. 4.3: Estimated productivity (kg ha⁻¹) and monetary loss (Rs ha⁻¹) of rainfed crops due to soil erosion in Karnataka State

4.5 Area Under Risk and Treatment Measures

It is evident that 80.88% of TGA of the state requires different degrees of soil erosion management and only 18.6% of TGA falls under no treatment category in view of the fact that soil loss is within permissible erosion limits. Though 21.63% area of the state falls under severe and very severe soil erosion categories, 43.93% has high priority from conservation point of view with a T-value upto 7.5 t ha⁻¹ yr⁻¹ (Fig 4.1). Similarly, though 16.08% area has prevailing soil erosion rates of less than 10 t ha⁻¹ yr⁻¹ but 60.19% area still falls under priority classes 4 and 5 requiring less degree of conservation treatment. Delineating critical land degradation areas through prioritization process is crucial for developing open-space plans that protect soil and water resources, and in turn the ecosystems. Detail account of district wise severity of erosion areas and critical problem with their possible solutions has been given in Table 4.1. The last column of Table 4.1 refers Table 4.2, Table 4.3 and Table 4.4 which are given in the succeeding sections of the document. Table 4.2 which presents soil and water conservation measures, under different land situations, Table 4.3 presents district wise agronomic and vegetative measures and Table 4.4 presents district wise agroforestry measures.

Table 4.1: District wise severity of erosion areas and critical problem with their possible solutions in Karnataka

S. No	District	TGA (000, ha)	Area under risk (*000 ha)	% of TGA	Special erosion problem	Conservation measures
Severity Risk –A						
1	Bengaluru Rural	229.8	20.11 (3:20.1)	8.8	Loss of agricultural land to urbanization	Table 4.2-Sr. No. 1.1-1.8, 2.1, 2.6, 3.1.1, 3.2.3 Table 4.4- Sr. No.-5
2	Bengaluru Urban	219.6	14.04 (2:4.0, 3:10.0)	6.4	Mining	Table 4.2-Sr. No. 2.1, 2.4, 2.6, 3.1.1, 3.2.3 Table 4.4- Sr. No.-5
3	Chikballapura	424.4	48.55 (2:0.05, 3:48.5)	11.6	Open scrub; mining	Table 4.2-Sr. No. 2.1, 2.4, 2.6, 3.1.1, 3.2.3 Table 4.4- Sr. No.-5
4	Dakshin Kannada	486.1	38.38 (2:11.6, 3:26.8)	7.9	Coastal Erosion, Flooding	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2-3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-10
5	Kolar	397.9	41.97 (2:0.04,3: 41.9)	10.6	Open scrub; mining	Table 4.2-Sr. No. 6.1.1 -6.1.9, 6.2.1-6.2.12 Table 4.4-Sr. No. 5
6	Mandya	496.2	44.30 (2:14.4, 3:29.9)	8.9	Open scrub; mining	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2-3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1 -6.1.9, 6.2.1-6.2.12 Table 4.4-Sr. No. 6
7	Udupi	358.2	43.65 (2:20.2, 3:23.4)	12.4	Coastal Erosion, Flood	Table 4. 2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2-3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.2- Sr. No.-10
Tot	Risk-A	2612.2	251.00	9.6		
Severity Risk –B						
8	Bidar	544.8	78.57 (1:3.3, 2:40.5, 3:34.8)	14.9	Open scrub;	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1-5.7, 6.1.9-6.1.9, 6.2.1-6.2.6, 6.2.11, 6.2.12, 7.1, 7.7, 7.8 Table 4.4- Sr. No.-1
9	Davangere	592.4	92.60 (1:0.1, 2:48.8, 3:43.7)	15.8	Open scrub; mining	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1-5.7, 6.1.9-6.1.9, 6.2.1-6.2.6, 6.2.11, 6.2.12, 7.1, 7.7, 7.8 Table 4.4- Sr. No.-3
10	Kalaburagi	1095.4	97.38 (1:29.7, 2:43.6, 3:24.1)	9.1	Mining	Table 4.2-Sr. No. 6.1.9-6.1.9, 6.2.1- 6.2.12, 7.1, 7.7, 7.8-7.10, 7.12 Table 4.4- Sr. No.-1, 2
11	Ramnagara	351.6	83.88 (2:46.8, 3:37.1)	23.9	Open scrub; mining	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1-5.7, 6.1.9-6.1.9, 6.2.1-6.2.12, 7.1, 7.7, 7.8 Table 4.4- Sr. No.-5
12	Yadgir	527	53.00 (1:0.6, 2:30.3, 3:22.2)	10.3	Open scrub; mining	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1-5.7, 6.1.9-6.1.9, 6.2.1-6.2.12, 7.1, 7.7, 7.8 Table 4.4- Sr. No.-2
Total		3111.2	405.43	13.03		

Severity Risk –C						
13	Bagalkot	655.2	101.25 (1:20.1, 2:46.9, 3:34.3)	15.8	Open scrub; gullied land	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1- 5.7, 6.1.1-6.1.4, 6.1.6-6.1.8, 7.1-7.10 Table 4.4- Sr. No.-3
14	Ballari	846.1	116.01 (1: 8.1, 2:58.2, 3:49.6)	13.9	Southern part of the district; gullied land, mining land	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1- 5.7, 6.1.1-6.1.4, 6.1.6-6.1.8, 7.1-7.10 Table 4.4- Sr. No.-3
15	Belagavi	1343.3	602.39 (1:232.6, 3:236.5, 3:133.3)	45.9	Central part; gullied land	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1- 5.7, 6.1.1-6.1.4, 6.1.6-6.1.8, 7.1-7.10 Table 4.4- Sr. No.-3
16	Chamarajanag ar	564.8	267.89 (1:34.0, 2:156.2, 3:77.7)	46.9	Open scrub; mining	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1- 5.7, 6.1.9-6.1.9, 6.2.1-6.2.12, 7.1, 7.7, 7.8 Table 4.4- Sr. No.-6
17	Chikkamagaluru	720.2	152.87 (2:70.2, 3:82.7)	21.4	Flood affected, Afforestation and Mining	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-4, 7
18	Chitradurga	835.5	153.38 (1: 1.7, 2:73.8, 3:77.9)	18.4	Northern part	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-4
19	Dharwad	426.0	131.36 (1:2.4, 2:61.8, 3:67.2)	31.4	Deforestation, Water Scarcity, Open cast quarrying	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-3,8
20	Gadag	465.7	112.06 (1:9.8, 2:35.9, 3:66.4)	24.5	Central part	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-3,8
21	Hassan	681.4	138.14 (2:95.3, 3:42.9)	20.4	Open scrub;	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-4, 7
22	Haveri	482.3	115.76 (2:42.8, 3:73.0)	24.3	Water scarcity,	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 3- Sr. No.-8, 9
23	Kodagu	410.2	108.68 (2:70.7, 3:38.0)	26.5	High erosion in hilly area, Flood, Biodiversity loss	Table 2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-9
24	Koppal	557.0	170.48 (1:48.1, 2:86.3, 3:36.1)	31.2	Southern and north-eastern part;	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2- 3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-3
25	Mysuru	630.7	131.68 (2:78.5, 3:53.2)	20.8	Very severe erosion in some pockets, Sedimentation in reservoir.	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1- 5.7, 6.1.9-6.1.9, 6.2.1-6.2.12, 7.1, 7.7, 7.8 Table 4.4- Sr. No.-6

26	Raichur	844.2	121.45 (1:0.7, 2:52.8, 3:67.9)	14.7	Open scrub; mining	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1-5.7, 6.1.1-6.1.4, 6.1.6-6.1.8, 7.1- 7.10 Table 4.4- Sr. No.-2, 3
27	Shivamogga	847.8	137.38 (2:75.8, 3:61.6)	16.4	Open scrub;	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1-5.7, 6.1.9-6.1.9, 6.2.1-6.2.6, 6.2.11, 6.2.12, 7.1, 7.7, 7.8 Table 4.4- Sr. No.-7
28	Tumakuru	1059.7	154.68 (2:38.4, 3:116.3)	14.7	Open scrub; mining	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2-3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-6
29	Uttar Kannada	1027.7	401.26 (1:0.2, 2:236.4, 3:164.7)	40.0	Coastal Erosion, Mining, Forest cover destruction	Table 4.2-Sr. No. 2.1- 2.7, 3.1.1, 3.1.2, 3.2.2-3.2.6, 4.2-4.6, 4.8, 4.9, 5.3- 5.7, 6.1.1-6.1.9, 6.2.1-6.2.12, 7.4, 7.5, 7.7, 7.8, Table 4.4- Sr. No.-9, 10
30	Vijayapura	1049.8	141.46 (1:22.5, 2:73.3, 3:45.7)	13.8	Open scrub; mining	Table 4.2-Sr. No. 2.1, 2.2, 2.4, 2.6, 2.7, 3.1.1, 3.2.3, 3.2.1-3.2.4, 3.2.6, 4.1-4.6, 4.8, 4.9, 5.1-5.7, 6.1.1-6.1.4, 6.1.6-6.1.8, 7.1- 7.10 Table 4.4- Sr. No.- 3
Total		12612.1	3258.16	25.8		

Note: A= < 50,000 ha area is critical; B= between 50,000-1,00000 ha area is critical; C= > 1,00000 ha area is critical in a district. Critical area is the sum of area under priority class 1, 2 and 3. Data in parentheses shows area under different priority class based on difference between potential erosion (E_r) and soil loss tolerance limit (T) *i.e.* ($E_r - TL$); 1: ($E_r - TL$) >35 t ha⁻¹ yr⁻¹, 2: ($E_r - TL$) in the range of 25-35 t ha⁻¹ yr⁻¹, 3: ($E_r - TL$) in the range of 15-25 t ha⁻¹ yr⁻¹. Table 4.3 represents details of agronomical and vegetative measures and Table 4.4 represents district wise potential agroforestry systems (AFS)



Table 4.2: Soil and water conservation measures for different soil erosion priority classes

S. No.	Conservation Measures		Slope <10%		Slope-10-33%	
			Low priority class		High priority class	
			Arable land	Non arable land	Arable land	Non arable land
1.0	Agronomic Measures (upto 6%, agronomic measures alone; >6% with other land management practices) refer Table 4.3 for details					
	1.1	Contour cultivation/farming	√		√	
	1.2	Inter or mixed cropping	√		√	
	1.3	Green manuring & Recycling crop residues	√		√	
	1.4	Crop rotation	√		√	
	1.5	Mulching	√		√	
	1.6	Conservation tillage/Conservation agriculture	√		√	
	1.7	Cover crops	√		√	
	1.8	Fodder/ tea/ medicinal-aromatic crops on the bunds & terrace riser			√	
	1.9	Broad bed and furrow (Black soil)	√			
	1.10	Furrow opening in between the lines (Black soil)	√			
2.0	Vegetative Measures (At lower slope-alone, at higher slope with other conservation measures)					
	2.1	Vegetative barrier*/Mixed vegetative barriers*	√	√	√	√
	2.2	Vegetative strips*		√	√	√
	2.3	Vegetally* guarded conservation trenches and ridges (VGCTR)		√		√
	2.4	Afforestation/reforestation		√		√
	2.5	Grassed waterways	√	√	√	√
	2.6	Live vegetative check dam (Bamboo)		√		√
	2.7	Stream bank stabilization with bamboo and other species		√		√
	*Species: Vetivera grass (<i>Vetiveria zizanioides</i>); Guatemala grass (<i>Tripsacum laxum</i>); Weeping love grass (<i>Eragrostis curvula</i>); Lemon grass (<i>Cymbopogon citratus</i>); Roshia/ palma rosa grass (<i>C. martinii</i>); Malabar (<i>C. flexuosus</i>); Hybrid Napier; Agave (<i>Agave Americana</i> & <i>Agave sisalana</i>); Geranium (<i>Pelargonium graveolens</i>); Mulberry (<i>Morus alba</i>); Pineapple (<i>Ananas comosus</i>)					
3.0	Mechanical/Engineering Measures					
	3.1	Bunding				
	3.1.1	Contour/Field bunding/Trench-cum-bund	√	√	√	√
	3.1.2	Graded bunding (uniformly and variable graded)-Black soils	√			
	3.1.3	Stone bund (Where stones are available onsite)	√	√	√	√
	3.1.4	Compartmental Bunding	√		√	
	3.2	Trenching				
	3.2.1	Contour trenching		√		√

	3.2.2	Continuous contour trenching	√			√
	3.2.3	Contour staggered trenching		√		√
	3.2.4	Graded trenching		√		√
	3.2.5	Water absorption trenches		√		√
	3.2.6	Half-moon trenches/terraces	√	√	√	√
	3.2.7	Recharge pit		√		√
	3.3	Terracing (Bench)				
	3.3.1	Leveled terrace	√		√	
	3.3.2	Inward sloping	√		√	
	3.3.3	Outward sloping	√		√	
	3.3.4	Puertorican type/vegetative	√		√	
	3.3.5	Half-moon terraces			√	√
	3.3.6	Conservation bench terracing	√			
	3.3.7	Narrow based terracing			√	
4.0	Drainage Line Treatments (DLTs)					
	4.1	Earthen Check dam		√		
	4.2	Sandbag check dam		√		
	4.3	Brush wood check dam (BWCD)		√		√
	4.4	Loose boulders check dam (LBCD)		√		√
	4.5	Gabion check dam		√		√
	4.6	RR check dam		√		√
	4.7	Gabion terrace support wall		√		√
	4.8	Retaining wall/ Revetment		√		√
	4.9	Silt detention tank		√		√
5.0	Water Harvesting					
	5.1	Community pond/Ooranies	√	√	√	
	5.2	Embankment pond		√		
	5.3	Pond renovation & Desilting	√	√	√	
	5.4	Farm pond-Dugout	√		√	
	5.5	Subsurface runoff collection wells			√	
	5.5	Pond lining	√	√	√	
	5.6	Roof top water harvesting	√		√	
	5.7	Diversion Based water harvesting			√	√
	Special Problem Area					
6.0	Mine spoil area/ Land Slide Prone Area					
	6.1	Vegetative				
	6.1.1	Vegetative hedges		√		√
	6.1.2	Brushwood check dam				√

	6.1.3	Watling (live)			√
	6.1.4	Double-row Brushwood dam / Log wood brush filled check dam			√
	6.1.5	Grassed contour barrier	√		√
	6.1.6	Bamboo plantation	√		√
	6.1.7	Afforestation	√		√
	6.1.8	Aerial seeding (very high slope or unapproachable area)			√
	6.1.9	Turfing/Soding			√
	6.2	Mechanical/Engineering Measures			
	6.2.1	Contour bunds/Stone bund	√		√
	6.2.2	Stone wall			√
	6.2.3	Staggered trenches and planting	√		√
	6.2.4	Loose Boulder check dam (locally available)			√
	6.2.5	Diversion drain/ Interceptor drain			√
	6.2.6	Nala bunds	√		
	6.2.7	Gabion check dam			√
	6.2.8	Gabion drop structures			√
	6.2.9	Toe wall/toe drain			√
	6.2.10	Retaining wall			√
	6.2.11	Jute geo textiles for slope stabilization/ Coir Jute textiles for stabilization of land slide areas (Slope >33%)			√
	6.2.12	Stream Channelization (Retaining wall, Bank protection walls. Spurs with apron etc)	√		√
7.0	Gullied and Ravine Land				
	7.1	Bio fencing/social fencing	√		√
	7.2	Peripheral bund	√		√
	7.3	Peripheral bund supported by close plantation of bamboo	√		√
	7.4	Safe disposal of water from gully head-Piped/chute spillway-	√		√
	7.5	Bamboo on ravine bed and grass on slope	√		√
	7.6	Bamboo based live check dams	√		√
	7.7	Alternate land use system/Agroforestry	√		√
	7.8	Mechanical/Engineering measures	√		√
	7.9	Earthen check dam	√		√
	7.10	Boribund check dam	√		√
	7.11	Silt retention tank	√		√
	7.12	Staggered trenching + plantation	√		√

Note 1: District wise details of agronomic and vegetative measures for Karnataka, is given in Table 4.3

Note 2: For concept, design and estimates of soil and water conservation measures, kindly refer- Mishra, P. K., Jaul, G. P., Tripathi, K. P., Ojasvi, P. R., Shrimali, S. S., Sena, D. R., Kumar, A., Patra, S. 2017. Field manual on soil and water conservation structures, ICAR, New Delhi, ISBN: 978-81-7164-167-3

Note 3: For agroforestry solutions for soil water conservation in Karnataka, refer Table 4.4

Table 4.3: District wise agronomic and vegetative SWC measures in Karnataka

S. No.	Cropping System (Intercropping, mixed cropping, Conservation Agriculture, crop rotation, etc)	Green manuring, Cover crops and Mulching	Protection-cum-Productive Vegetative Barriers (grasses /Fodder/ Medicinal Aromatic crops/Tea/Pineapple etc.)	Special problem area: Grassed waterways/live check dams/Mine spoil area/ Land Slide Prone Area
Severity Risk: A				
District: Bengaluru Rural, TGA:229.8, A(Er): 20.11(3:20.1), Er (%): 8.8%, Sp.P: Loss of agricultural land to urbanization				
1	<p>Cropping System: Finger millet based mixed cropping with Field bean, Fodder, Sorghum, Pigeon pea and Niger.</p> <p>Suggested contingency crops for Finger millet based mixed cropping: Normal onset of monsoon delayed by 2 weeks (3rd week of June) then recommended Finger millet + Pigeonpea (8:2); Finger millet + Field bean (4:1); Finger millet + Niger (4:1).</p> <p>If Normal onset of monsoon delayed by 4 weeks (1st week of July) recommended Finger millet/ Maize/Maize + Pigeonpea (3:1).</p> <p>If Normal onset of monsoon delayed by 6 or 8 weeks (3rd week of July or 1st week of August) Little millet: CO-2, PRC-3 CO-2, PRC-3 or Foxtail millet: RS-118, RS-118.</p> <p>Groundnut + Pigeonpea.</p> <p>Sole Pigeonpea (BRG-2).</p> <p>Maize: Maize + Pigeonpea (3:1); Greengram/ Ganga-11, Maize + Frenchbean (3:1).</p>	<p>Gliricidia and sunnhemp are cultivated as green manuring crops.</p> <p>Cow pea and potato cover crops.</p>	<p>Gliricidia planted as vegetative barrier</p>	<p>Growing of Napier fodder grass along the bunds to control erosion.</p> <p>Block plantation & community land afforestation - Raising of forest tree and plantations (teak, bamboo etc.) on lands which were not covered with forest and were reduced to scrub due to biotic interference.</p>
District: Bengaluru Urban, TGA: 219.6, A(Er):14.04 (2:4.0, 3:10.0), Er (%):6.4, Sp.P: Mining				
2	-	-	-	<p>Afforestation in open-pit mining areas.</p> <p>Slope treatment measures such as geo-jute matting with plantations.</p>
District: Chikballapura, TGA: 424.4, A(Er): 48.55(2:0.05, 3:48.5), Er (%): 11.6, Sp.P: Open scrub; mining				
3	<p>Finger millet based mixed cropping with Field bean, Fodder, Sorghum, Niger, Mustard.</p> <p>Groundnut + Pigeonpea</p> <p>Sole Pigeonpea</p> <p>Maize</p> <p>Mulberry</p> <p>Tomato and potato etc....</p>	<p>Sunn hemp and dhaincha are cultivated as green manuring crops.</p> <p>Horsegram has a cover crop</p>	<p>Glyricidia as a vegetative barrier</p>	<p>Afforestation of mining areas and community land with suitable local tree species like Bamboo, <i>Pongamia pinnata</i>, Neem etc.</p> <p>Block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference.</p>

4	District: Dakshin Kannada, TGA: 486.1, A(Er): 38.38(2:11.6, 3:26.8), Er (%): 7.9, Sp.P: Coastal Erosion, Flooding		
<p>Paddy Blackgram/Greengram/Sesamum Vegetables (Ridge gourd, Bhendi, etc) Arecanut and Coconut</p>	<p>Sunhemp and dhaincha are cultivated as green manuring crops Blackgram/Greengram as cover crops.</p>	<p>Horticulture/ Plantation crops like cashew, arecanut, coconut, mango and Banana Bio-shielding of the Coast: Coastal bio-shields include mangroves; casuarina plantations protect from wave and tide action, especially during storms.</p>	<p>Sea water intrusion to agriculture lands: Leaching, Selection of salt tolerant varieties, Sowing and in-situ ploughing of green manure species (Sesbania aculeate). Use of Vetiver grass (Khas grass, Lavancha) or <i>Vetiveria zizanioides</i> for dune stabilization. Bio-shielding of the coast through planting of following species of grass and trees: <i>Spinifex littoreus</i>, <i>Ipomoea pes-caprae</i>, <i>Canavalia</i> spp., <i>Borassus flabellifer</i> and <i>Morinda citrifolia</i>.</p>
5	District: Kolar, TGA: 397.9, A(Er): 41.97(2:0.04,3: 41.9), Er (%): 10.6, Sp.P: Open scrub; mining		
<p>Finger millet based mixed cropping with Field bean, Fodder, Sorghum, Niger, Mustard. Groundnut or Groundnut + Pigeonpea Sole Pigeonpea Maize Mulberry Tomato and potato</p>	<p>Trenching and mulching for mulberry crop. Sunhemp and dhaincha are cultivated as green manuring crops</p>	<p>Cultivation of Napier grass along the bunds to reduce erosion and augment fodder production to animals. Waste-lands of the district lands can be brought under permanent plant cover by lands which were not covered and planting of suitable forest species of the dry. Deciduous type, pasture or silvi-pasture, by raising plantations of casuarina, tamarind acacia, Neem, Seethaphal (Custard apple), Amla, Cashew and other economical fruit and fuel trees</p>	<p>Afforestation of mining areas and community land with suitable local tree species like Bamboo, <i>Pongamia pinnata</i>, Neem etc. Block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference. Afforestation of mining areas and community land with suitable local tree species like Bamboo, <i>Pongamia pinnata</i>, Neem etc.</p>
6	District: Mandya, TGA: 496.2, A(Er):44.30 (2:14.4, 3:29.9), Er (%): 8.9, Sp.P: Open scrub; mining		
<p>The major crops of the district are ragi, rice, sugarcane, pulses (predominantly horse gram and to some extent tur, cowpea, green gram, black gram, avare) and oilseeds (mainly groundnut and sesame). (Ref: Cropping System Ragi (Finger millet), varieties - MR-1& 6, GPUJ-28, L-5, HR-911& Indai-8, KMR-301. Ragi intercropping with Redgram (8:2) or Soybean (4:2). Maize: varieties/hybrids - NAC-6004, Hema, NAH-2049 Sugarcane (irrigated): varieties/hybrids -Co-419, Co-86032, Co-Vc-2003-165, Co-8371. Cropping pattern: Ragi-Paddy, Ragi-Pulses, Rice-sugarcane.</p>	<p>Sunhemp and dhaincha are cultivated as green manuring crops. Cowpea, green gram, and black gram as cover crops.</p>	<p>District has potential to become a major destination for horticulture crops production and processing in terms of both dry land horticulture with fruit crops and intensive cultivation of high value crops in irrigated areas of the district. In rainfed areas Mango, grapes, jack, Amla, wood apple, Tamarind, Cashew, Guava, Sapota could be promoted in semi-irrigated taluks. Similarly irrigated areas have potential to grow flowers and vegetable crops apart from seed production.</p>	<p>Mining: Top-soil wherever extracted should be used for plantation work. Application of geo-textiles helps in revegetation of mine-slope areas. Afforestation of mining areas and community land with suitable local tree species like Bamboo, <i>Pongamia pinnata</i>, Neem etc.</p>

7	District: Udupi, TGA: 358.2, A(Er): 43.65 (2:20.2, 3:23.4), Er (%): 12.4, Sp.P: Coastal Erosion, Flood		Sunhemp and dhaincha are cultivated as green manuring crops	Horiculture/ Plantation crops like cashew, arecanut, coconut, mango and Banana	Cultivation of flood resistant red rice variety –Sahyadri Panchamukhi
TGA (000 ha) : 2612.2, Area under severity risk A (000 ha) : 251.00, % of TGA under risk: 9.6					
Severity Risk :B					
8	District: Bidar, TGA: 544.8, A(Er): 78.57(1.3.3, 2:40.5, 3:34.8), Er (%): 14.9, Sp.P: Open scrub		Sunhemp and dhaincha are cultivated as green manuring crops. cowpea and blackgram as covering crop	Drumstick and hedge lucerne as protective/ barrier crops	Block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference.
9	District: Davangere, TGA: 592.4, A(Er): 92.60(1:0.1, 2:48.8, 3:43.7), Er (%): 15.8, Sp.P: Open scrub; mining		Sunhemp and dhaincha are cultivated as green manuring crops. Broad beans as cover crop	Horiculture/ Plantation crops like arecanut, coconut, mango and Banana	Khus (Vetivera zuzenoides) or Nase grass (Pennisetum hohenekere) as cultivated as vegetative barrier to control runoff and soil loss in mine spoil area and block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference.
10	District: Kalaburagi, TGA: 1095.4, A(Er): 97.38(1:29.7, 2:43.6, 3:24.1), Er (%): 9.1, Sp.P: Mining		Glyricidia and sunhemp are cultivated as green manuring crops. Greengram and Blackgram as cover crops	Subabul, Gliricidia & Lemon grass as vegetative barrier	Growing of vetiver, lemon grass, glyricidia and cenchrus tree crop as vegetative barrier to control runoff and soil loss in mine spoil area.
	Redgram + greengram/blackgram/soybean (2:4 or 1:2)				
	Bajra+redgram (2:1) Sorghum+redgram (2:1)				
	Redgram + Groundnut (2:4)				
	Redgram + greengram/blackgram (2:4 or 1:2)				
	Soybean + redgram (4:2)				
	Setaria + redgram (2:1) (Intercropping under rainfed condition during <i>Kharif</i> season.				
	Chickpea + Safflower under rainfed condition during <i>rabi</i> season.				

11	District: Ramnagara, TGA: 351.6, A(Er): 83.88 (2:46.8, 3:37.1), Er (%): 23.9, Sp.P: Open scrub; mining	Sunhemp and dhaincha are cultivated as green manuring crop	Horticulture/ Plantation crops Mango, Banana, sapota, Guava and grapes	Khus (<i>Vetivera zizanioides</i>) or Nase grass (<i>Pennisetum hohenekere</i>) as cultivated as vegetative barrier to control runoff and soil loss in mine spoil area block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference.
12	District: Yadgir, TGA: 527, A(Er):53.00 (1:0.6, 2:30.3, 3:22.2), Er (%):10.3, Sp.P: Open scrub; mining	Dhaincha and Gliricidia sunhemp as green manuring crops, Cowpea as covering crops.	Dryland horticulture / Plantation crops / grass like Papaya, pomegranate, mango, acid lime, custard apple lime improve vegetation and bring soil and water conservation in situ. Lemon grass and Hedge lucerne as protective crops	Growing of vetiver, lemon grass, glyricidia and cenchrus as vegetative barrier to control runoff and soil loss in mine spoil area and block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference.
TGA (000 ha) : 3111.2, Area under severity risk B (000 ha) : 405.43, % of TGA under risk: 13.03				
Severity Risk :C				
13	District: Bagalkot, TGA: 655.2, A(Er): 101.25 (1:20.1, 2:46.9, 3:34.3), Er (%): 15.8, Sp.P: Open scrub; gullied land	Sunhemp, Daincha, Gliricidia, Teprosia as green manure	Vetiver, subabul, lemon grass	Protection and social fencing, staggered trenches Prevention of forest and grass fire, control of grazing
14	District: Ballari, TGA: 846.1, A(Er):116.01 (1: 8.1, 2:58.2, 3:49.6), Er (%): 13.9, Sp.P: Southern part of the district; gullied land, mining land	Sorghum+Groundnut (2:1) Rabi sorghum+Bengalgram (2:1) Bengalgram+safflower (4:2) Bajra+ pigeonpea (2:1) Maize-Bengalgram	Sesbania grandiflora, Gliricidia sepium, Erythrina abyssinica, Euphorbia spp., Acacia spp. Agave sisalana	<i>Cassia mimosoides</i> , <i>Bothriochola pertusa</i> , <i>Cymbopogon</i> spps, <i>Cassia auriculata</i> , <i>Tephrosia purpurea</i> , <i>Indigofera cassioides</i> , <i>Accacia catechu</i> , <i>Albizia lebbek</i> , <i>Euphorbia</i>
15	District: Belagavi, TGA: 1343.3, A(Er): 602.39 (1:232.6, 3:236.5, 3:133.3), Er (%): 45.9, Sp.P: Central part; gullied land	Groundnut/ Soybean, Blackgram Greengram/Rabi jowar/wheat/chickpea/safflower Maize-chickpea Hybrid- sorghum+ Redgram (4:2) Groundnut + Redgram (4:1)	Sunhemp as green manure, green gram and black gram as mulch <i>Saccharum spontaneum</i> (<i>Kanna</i>), <i>Eulaliopsis binata</i> (Bhabar grass), Napier bajra (hybrid), vetiver	Prevention of forest fires and illegal wood cutting, - Prevention of grass fires, - Control of grazing, and revegetation of open and grass lands,

16	<p>District: ChamaraJanagar, TGA: 564.8, A(Er): 267.89(1:34.0, 2:156.2, 3:77.7), Er (%): 46.9, Sp.P: Open scrub; mining</p> <p>Jowar- Groundnut, Fingermillet-Maize, Jowar-Horsegram, Redgram-Maize (1:1), Cowpea-sorghum Redgram- Fingermillet</p>	<p>Cowpea, pea, beans as cover crop</p>	<p>Lemon grass, Napier bajra hybrid, vetiver</p>	<p>For open scrub: Protection and social fencing, Staggered trenches, enrichment planting. For mining; planting of <i>Accacia catechu</i>, <i>Albizia lebbek</i>, <i>Euphorbia</i></p>
17	<p>District: Chikkamagaluru, TGA: 720.2, A(Er): 152.87(2:70.2, 3:82.7), Er (%): 21.4, Sp.P:Flood affected, deforestation and Mining</p> <p>Paddy, sunflower, Groundnut-Horsegram, Onion-Jowar</p>	<p>Sunhemp as green manure, greengram and black gram as mulch</p>	<p><i>Saccharum spontaneum (Kanna)</i>, <i>Eulaliopsis binata</i> (Bhabar grass), Napier bajra (hybrid), vetiver</p>	<p>For flood: provide drainage by constructing drainage channel of 25-30cm deep For deforestation and mine rehabilitation: <i>Cassia mimosoides</i>, <i>Bothriochloa pertusa</i>, <i>Cymbopogon</i> spps, <i>Cassia auriculata</i>, <i>Tephrosia purpurea</i>, <i>Indigofera cassioides</i>, <i>Accacia catechu</i>, <i>Albizia lebbek</i>, <i>Euphorbia</i></p>
18	<p>District: Chitradurga, TGA: 835.5, A(Er): 153.38 (1: 1.7, 2:73.8, 3:77.9), Er (%): 18.4, E : Northern part</p> <p>Paddy, sunflower, Groundnut-Horsegram, Onion-Jowar</p>	<p>Sunhemp as green manure, greengram and black gram as mulch</p>	<p><i>Saccharum spontaneum (Kanna)</i>, <i>Eulaliopsis binata</i> (Bhabar grass), Napier bajra (hybrid), vetiver</p>	<p>For flood: provide drainage by constructing drainage channel of 25-30cm deep For deforestation and mine rehabilitation: <i>Cassia mimosoides</i>, <i>Bothriochloa pertusa</i>, <i>Cymbopogon</i> spps, <i>Cassia auriculata</i>, <i>Tephrosia purpurea</i>, <i>Indigofera cassioides</i>, <i>Accacia catechu</i>, <i>Albizia lebbek</i>, <i>Euphorbia</i></p>
19	<p>District: Dharwad, TGA: 426.0, A(Er): 131.36 (1:2.4, 2:61.8, 3:67.2), Er (%): 31.4, Sp.P: Deforestation, Water Scarcity, Open cast quarrying</p> <p>Intercropping:Maize + Pigeonpea (4:2 or 6:2); Chili + desi Cotton + Onion, Groundnut + Redgram (4:2) intercropping under rainfed. <i>Crop rotation</i>: Soybean – rabi Jowar; Groundnut – rabiJowar / Wheat, Green gram–rabi Jowar / Wheat, Maize-Chickpea</p> <p>Upland paddy – Green-gram / Black-gram /Lab-lab bean</p> <p>Sole crop: Hy. Cotton (Bt)</p>	<p>Sun hemp once in 4 yrs and fodder maize at fallow period. Ridges and furrows method of sowing. Cowpea, Green-gram, Black-gram and Horse-gram as cover crop Conservation furrows, Frequent inter cultivation for soil mulching Legume covers: <i>Hedge-Lucerne</i>, <i>Cassia tora</i>, <i>Hamata</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i>, <i>Leucaena leucocephala</i>, <i>Gliricidia maculata</i> <i>Green manuring</i>: Lucerne in cotton crop Lucerne or Corchorus in Maize</p>	<p>Grasses: Brizantha, Fodder sorghum, Hybrid Napier, Ginigrass, Paragrass, Herbs/Shrubs: Hamata, Siratro, Hedge-Lucerne, Lucerne and Sesbania.</p> <p>Medicinal and aromatic: Ashwagandha, Ginger, Aloe vera, Moringa, Vetiver,</p>	<p>Live check dams: <i>Vitexnegundo</i> + Vetiver + Hamata <i>Dendrocalamusstrictus/ D. stocksii</i> + <i>Spondiaspinnata</i> + <i>Ficusamplissima</i> + <i>F. virens</i> Grass sodding: Aristida, Cymbopogon, Vetiver, Apluda etc. <i>Adhatoda vasica</i>, <i>Erythrina species</i>, <i>Garuga pinnata</i>, <i>Pongamia pinnata</i>, <i>Ficusreligiosa</i>, <i>Terminalia arjuna</i> and <i>Terminalia bellirica</i></p>



20	<p>District: Gadag, TGA: 465.7, A(Er): 112.06(1:9.8, 2:35.9, 3:66.4), Er (%): 24.5, Sp.P: Central part</p>	<p>District: Hassan, TGA: 681.4, A(Er): 138.14(2:95.3, 3:42.9), Er (%): 20.4, Sp.P: Open scrub;</p>
<p><i>Shallow black and red soils</i> <i>Sole cropping:</i> Kharif sorghum; Greengram; Maize; Bt. Cotton <i>Deep black soils</i> <i>Intercropping:</i> Fallow Kharif followed by rabi sorghum + Chickpea (2:1); Chickpea + Safflower (4:2) <i>Crop rotation/ relay cropping:</i> Chilli- Onion -desi Cotton Green gram-rabi sorghum; Groundnut- Sunflower; Groundnut-rabi sorghum; Maize – Chickpea; Sunflower - Chickpea Upland paddy – Green-gram / Black-gram /Lab-lab bean Sole crop: Hy. Cotton (Bt) or cotton</p>	<p>Compartment bunding/ridges and furrows/Tied ridges to conserve the rain water during <i>kharif</i> for regular sowing of <i>rabi</i> crops. Ridges, and furrows method of sowing. Greengram, Sun hemp once in 4 year. Cowpea, Green-gram, Black-gram and Horse-gram as cover crop Conservation furrows, Frequent inter cultivation for soil mulching. Legume covers: <i>Hedge-Lucerne, Cassia tora, Hamata, Mucuna pruriens, Mimosa pudica, Tephrosia purpurea, Leucaena leucocephala, Gliricidia maculata, Green manuring:</i> Lucerne in cotton crop Lucerne or Corchorus in Maize crop</p>	<p>Grasses: Brizantha, Fodder sorghum, Hybrid Napier, Gimigrass, Paragrass, <i>Herbs/Shrubs:</i> Hamata, Siratro, Hedge-Lucerne, Lucerne and Sesbania <i>Medicinal and aromatic:</i> Ashwagandha, Aloe vera, Moringa, Cymbopogon and Vetiver <i>Adhatoda vasica, Erythrina species, Garuga pinnata, Pongamia pinnata, Ficus religiosa</i> Cropping on denuded shallow Soils: Natural pasture with <i>Eragrostis spectabilis; E. tenella; Dichanthium annulatum; Heteropogon contortus, Axonopus compressus, Digitaria angustinalis, Eleusine indica</i></p>
<p><i>Deep Red soils in Plains</i> <i>Sole cropping:</i> Ragi; Soybean; Potato, <i>Intercropping:</i> Potato + Redgram/Castor (6:1); Ragi+ Red gram-Cow pea (5:1 or 10:1), Maize+Redgram-Soybean, Groundnut + Redgram (5:1 or 8:1) <i>Crop rotation/ relay cropping:</i> Potato – Soyabean/ Potato-Cowpea, Potato-Ragi, Sesamum – Ragi, Sesamum-Groundnut, Sunflower – Cowpea/Horsegram/ Lab-lab bean <i>Black soils</i> Rabi: Chickpea (after Potato), Irrigated lands: Sugarcane</p>	<p>Ridges and furrows/Tied water during <i>kharif</i> crops Ridges and furrows method of sowing. Conservation furrows, Frequent in 4 year inter cultivation for soil mulching. Cowpea, Green-gram, Black-gram and Horse-gram as cover crop Legume covers: <i>Hedge-Lucerne, Cassia tora, Hamata, Mucuna pruriens, Mimosa pudica, Tephrosia purpurea, Leucaena leucocephala, Gliricidia maculata, Green manuring:</i> Greengram (once in 2 year),</p>	<p>Coffee, Coconut, Areca nut, Tea based agroforestry systems. Mango, banana, cashew, orchards <i>Melia</i>, sandalwood and teak plantations Grasses: Brizantha, Fodder sorghum, Hybrid Napier, Gimigrass, Paragrass, <i>Herbs/Shrubs:</i> Hamata, Siratro, Hedge-Lucerne, Lucerne and Sesbania <i>Medicinal and aromatic:</i> Ginger, cardamom, turmeric, Ashwagandha, <i>Aloe vera</i>, marigold, Chrysanthemum and Vetiver Live check dams: <i>Vitexnegundo + Vetiver+ Hamata + Hedge-Lucerne</i> <i>Dendrocalamus strictus/ D. stocksii + grasses</i> <i>Spondias pinnata+ Ficus amplissima + F. virens + grasses and shrubs</i> Grass sodding: Cymbopogon, Vetiver, Apluda Shrubs: <i>Adhatodavasica, Erythrina species, Garugapinnata, Pongamiapinnata, Ficus religiosa</i> Cropping on denuded shallow Soils: Natural pasture with <i>Eragrostis spectabilis; E. tenella; Dichanthium annulatum; Heteropogon contortus, Axonopus compressus, Digitaria angustinalis, Eleusine indica, Arundodonax</i> Cashew orchards at open scrubs</p>

<p>22</p>	<p><i>Medium to deep black soils</i> <i>Sole cropping:</i> Hybrid cotton (Bt); Soyabean; Potato, Intercropping: Maize + Redgram (6:2); Chilli+ Desi Cotton(6:1), <i>Crop rotation/ relay cropping:</i> Paddy- followed Green gram/ Black gram Groundnut - rabi sorghum, Soyabean- rabi sorghum, Greengram - rabi sorghum, Maize- rabi sorghum, <i>Red loamy soils</i> <i>Kharif/Sole crop:</i>Maize, Hybrid cotton <i>Intercropping:</i> Sorghum + Pigeonpea (5:1 and 4:2); Little millet +Pigeonpea (6:1) <i>Irrigated lands</i> Sugarcane</p>	<p>District: Haveri, TGA: 482.3, A(Er): 115.76(2:42.8, 3:73.0), Er (%): 24.3, Sp.P: Water scarcity, Mango, banana, sapota and betel vine with sesbania orchards <i>Grasses:</i> Brizantha, Fodder sorghum, Hybrid Napier, Gimgrass, Paragrass, <i>Herbs/Shrubs:</i> Hamata, Siratro, Hedge-Luceme, Luceme and Sesbania, <i>Leucaena leucocephala, Gliricidia maculata, Cassia tora,</i> <i>Medicinal and aromatic:</i> Ginger, Ashw agandha, Aloe vera, marigold, chrysanthemum and Vetiver Coffee, tea, pineapple, orange, Conservation furrows, Frequent inter cultivation for soil mulching Legume covers: Hedge-Luceme, <i>Cassia tora, Hamata, Mucuna pruriens, Mimosa pudica, Tephrosia Purpurea, Leucaena leucocephala, Gliricidia maculata, Green manuring:</i> Lucerne in cotton crop Lucerne or Corchorus in Maize crop</p>	<p>Live check dams: <i>Vitexnegundo</i> + Vetiver + Hamata + Hedge-Luceme <i>Dendrocalamus strictus</i> / <i>D. stocksii</i> + grasses <i>Spondias pinnata</i>+ <i>Ficus amplissima</i> + <i>F. virens</i> + grasses and shrubs Grass sodding: Aristida, Cymbopogon, <i>Adhatoda vasica, Erythrina species, Garuga pinnata, Pongamia pinnata, Ficus religiosa</i> Cropping on denuded shallow Soils:Natural pasture with <i>Eragrostis spectabilis; E. tenella; Dichanthium annulatum; Heteropogon contortus, Axonopus compressus, Digitaria sanguinalis, Eleusine indica</i></p>
<p>23</p>	<p>District: Kodagu, TGA: 410.2, C : 108.68 (2:70.7, 3:38.0), Er (%): 26.5, Sp.P: High erosion in hilly area, Flood, Biodiversity loss Coffee + Pepper + Forest trees (Silver oak, Erythina, Acrocarpus, Teak, Pterocarpus, Terminalia, Dalbergiaetc) Cardamom + Forest Trees Arecanut + Pepper + Cocoa +Banana +Nutmeg <i>Sole crops at low lying areas:</i> Ginger Paddy</p>	<p><i>Grasses:</i> Brizantha, Fodder sorghum, Hybrid Napier, Gimgrass, Paragrass, <i>Herbs/Shrubs:</i> Hamata, Siratro, Hedge-Luceme, Lucerne and Sesbania <i>Medicinal and aromatic:</i> Ginger, Ashwagandha, Aloe veraand Vetiver Coffee, tea, pineapple, orange, etc</p>	<p>Live check dams: <i>Vitex negundo</i> + Vetiver+ Hamata + Hedge-Lucerne <i>Dendrocalamus strictus</i>/ <i>D. stocksii</i> + grasses <i>Spondias pinnata</i>+ <i>Ficus amplissima</i> + <i>F. virens</i> + grasses and shrubs Grass sodding: Aristida, Cymbopogon, Vetiver, Apluda etc. <i>Adhatoda vasica, Erythrina species, Garuga pinnata, Pongamia pinnata, Ficus religiosa</i> Cropping on denuded shallow Soils: Natural pasture with <i>Eragrostis spectabilis; E. tenella; Dichanthium annulatum; Heteropogon contortus, Axonopus compressus, Digitaria sanguinalis, Eleusine indica, Arundo donax</i></p>



24	<p>District: Koppal, TGA: 557.0, A(Er): 170.48(1:48.1, 2:86.3, 3:36.1), Er (%): 31.2, Sp.P: Southern and north-eastern part;</p> <p><i>Rainfed Kharif: Shallow Black/Red sandy soils</i></p> <p><i>Sole cropping (Kharif):</i> Bajra, Sorghum, Groundnut, Sunflower, Maize, Pigeonpea, Sesamum</p> <p><i>Intercropping:</i> Bajra+ Red gram (2:1) Groundnut + Red gram (3:1 or 4:2), Groundnut + Sorghum (5:1 or 8:1)</p> <p><i>Deep black soils</i> <i>Sole cropping(rabi):</i> rabi sorghum, safflower, cotton and sunflower</p> <p><i>Intercropping:</i> Fallow <i>Kharif</i> followed by <i>rabi</i> sorghum + Chickpea (2:1); Chickpea + Safflower (4:2) <i>Canal irrigated</i> black soil Hybrid Jowar-wheat-Hybrid Bajra, Hybrid bajra-cotton-groundnut, Groundnut-Hybrid Jowar, Paddy-Hybrid Jowar/Groundnut Paddy-paddy</p>	<p>Compartment bunding /ridges and furrows/Tied ridges to conserve the rain water during <i>kharif</i> for regular sowing of <i>rabi</i> crops. Ridges and furrows method of sowing. Greengram, Sun hemp once in 4 year. Cowpea, Greengram, Black-gram and Horse-gram as cover crop Conservation furrows, Frequent inter cultivation for soil mulching Legume covers: <i>Hedge-Lucerne, Cassia tora, Hamata, Mucuna pruriens, Mimosa pudica, Tephrosia Purpurea, Leucaena leucocephala, Gliricidia maculata.</i> Green manuring: Lucerne in cotton crop Lucerne or Corchorus in Maize crop</p>	<p><i>Grasses:</i> Brizantha, Fodder sorghum, Hybrid Napier, Gimgrass, Paragrass, <i>Herbs/Shrubs:</i> Hamata, Siratro, Hedge-Lucerne, Lucerne and Sesbania</p> <p><i>Medicinal and aromatic:</i> Ashwagandha, Aloe vera, Moringa, Cymbopogon and Vetiver</p>	<p>Live check dams: <i>Vitexnegundo</i> + Vetiver + Hamata + Hedge-Lucerne</p> <p><i>Dendrocalamus strictus/D. stocksii</i> + grasses</p> <p><i>Spondias pinnata</i>+ <i>Ficus amplissima</i> + <i>F. virens</i> + grasses and shrubs</p> <p>Grass sodding: <i>Aristida, Cymbopogon, Vetiver, Apluda</i> etc.</p> <p><i>Adhatoda vasica, Erythrina species, Garuga pinnata, Pongamia pinnata, Ficus religiosa</i></p> <p>Cropping on denuded shallow Soils: Natural pasture with <i>Eragrostis spectabilis; E. tenella; Dichanthium annulatum; Heteropogon contortus, Axonopus compressus, Digitaria sanguinalis, Eleusine indica</i></p>
25	<p>District: Mysuru, TGA: 630.7, A(Er): 131.68(2:78.5, 3:53.2), Er (%): 20.8, Sp.P: Very severe erosion in some pockets, Sedimentation in reservoir</p> <p>Red & Shallow soils: Maize followed by Horsegram Ragi- Horsegram Pigeonpea – Horsegram</p> <p>Black Soils : Cotton-Bt hybrids-long staple Castor + Ragi Castor sole crop Ragi – Chickpea Greengram –Chickpea Jowar - Chick pea Red soils: Ragi – Horsegram Jowar + Pigeonpea- Horsegram</p>	<p>Cowpea, pea, beans as cover crop Mulching in Banana crop.</p>	<p>Lemon grass, Napier bajra hybrid, vetiver</p>	<p>For open scrub: Protection and social fencing, Staggered trenches, enrichment planting. For mining; planting of Accacia catechu, Albizia lebbeck, Euphorbia</p> <p>SWC Measures: Soil Mulching, Farm pond, Check dams, Nala bund and percolation tank.</p>
26	<p>District: Raichur, TGA: 844.2, C : 121.45(1:0.7, 2:52.8, 3:67.9), Er (%): 14.7, E : Open scrub; mining</p> <p>Redgram + Greengram (1:2 or 2:4) Greengram + Redgram (2:1or 4:2) Redgram + Bajra (1:2) Redgram + Sorghum (1:2) Redgram + Groundnut (2:4)</p>	<p>Sunhemp and dhaincha are cultivated as green manuring crop and also Greengram <i>in situ</i> green</p>	<p>Subabul, Gliricidia & Lemon grass as vegetative barrier</p>	<p>Growing of vetiver, lemon grass, glyricidia and cenchus as vegetative barrier to control runoff and soil loss in mine spoil area and block plantation & community land</p>

	Groundnut + Redgram (4:2) under rainfed condition during <i>Kharif</i> season. Sorghum + Chickpea (2:1) Chickpea + Safflower (4:2) under rainfed condition during <i>rabi</i> season.	manuring crop	afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference.
27	District: Shivamogga, TGA: 847.8, A(Er): 137.38(2:75.8, 3:61.6), Er (%): 16.4, Sp.P: Open scrub; Paddy as irrigated crop Cotton + Chilli Cotton + Chilli+French bean Groundnut + Redgram (8:2) Maize + Redgram (3:1) Sunflower / Ragi / Groundnut + Redgram (8:2) under rainfed condition	Sunhemp, dhaincha and legumes are green manuring crops. Cowpea and velvet beans are cover crops	Block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and glyricidia) on lands which were not covered with forest and were reduced to scrub due to biotic interference.
28	District: Tumakuru, TGA: 1059.7, A(Er):154.68(2:38.4, 3:116.3), Er (%):14.7, Sp.P: Open scrub; mining Finger millet + Redgram (4:1)/Field bean Groundnut + Redgram Maize+Redgram under rainfed condition during <i>Kharif</i> season	Gliricidia and subabul as green manuring crops	Block plantation & community land afforestation - Raising of forest tree and plantations (teak, pongamia, silver oak acacia species, <i>Melia dubia</i>) on lands which were not covered with forest and were reduced to scrub due to biotic interference.
29	District: Uttar Kannada, TGA: 1027.7, A(Er): 401.26(1:0.2, 2:236.4, 3:164.7), Er (%): 40.0, Sp.P: Coastal Erosion, Mining, Forest cover destruction Paddy – Pulses Maize Paddy – Paddy Paddy – Groundnut Paddy – Vegetables	Sunhemp and dhaincha are cultivated as green manuring crops	Cultivation of flood resistant red rice variety. Coastal erosion: Use of Vetiver grass (Khas grass, Lavancha) or <i>Vetiveria zizanioides</i> for dune stabilization. Bio-shielding of the coast through planting of following species of grass and trees: <i>Spinifex littoreus</i> , <i>Ipomoea pes-caprae</i> , <i>Canavalia spp.</i> , <i>Pandanus spp.</i> , <i>Borassus flabellifer</i> and <i>Morinda citrifolia</i> .

30	<p>District: Vijayapura, TGA: 1049.8, A(Er):141.46(1:22.5, 2:73.3, 3:45.7), Er (%):13.8, Sp.P: Open scrub; mining</p> <p>Pearl millet + Pigeonpea (2:1) Ground nut + Pigeonpea (4:2) Redgram + Groundnut (2:4) under rainfed condition during <i>khari</i>f season Chickpea + Safflower (4:2) Rabi sorghum + Chickpea (2:1) under rainfed condition during <i>rabi</i> season.</p>	<p>Gliricidia plants as green manuring improve soil quality and legume crops greengram and cowpea cultivated as cover crop for improving soil fertility.</p>	<p>Khus/Subabul/Dicanthium as vegetative barrier</p>	<p>Block plantation & community land afforestation - Raising of forest tree and plantations (teak, neem and pongamia) on lands which were not covered with forest and were reduced to scrub due to biotic interference. The growing of suitable perennial dry land horticultural crops such as bet, guava, tamarind, aonla, sapota and water conservation <i>in situ</i>, but also custard apple and lime not only brings soil makes best use of available moisture.</p>
<p>TGA (000 ha) : 13447.6, Area under severity risk category C (000 ha) : 3258.16, % of TGA under risk: 24.2</p>				

Note: Severity risk $A \leq 50,000$ ha area is critical; Severity risk $B =$ between $50,000-1,00,000$ ha area is critical; Severity risk $C \geq 1,00,000$ ha area is critical in a district. Critical area is the sum of area under priority class 1, 2 and 3. Data in Parentheses shows area under different priority class based on difference between potential erosion (Er) and soil loss tolerance limit (T) i.e. $(E_r - TL)$; 1: $(E_r - TL) > 35 \text{ t ha}^{-1} \text{ yr}^{-1}$, 2: $(E_r - TL)$ in the range of $25:35 \text{ t ha}^{-1} \text{ yr}^{-1}$, 3: $(E_r - TL)$ in the range of $15:25 \text{ t ha}^{-1} \text{ yr}^{-1}$. Table 4.2 represents different soil and water conservation measures for different land situations, Table 4.3 represents details of agronomical and vegetative measures and Table 4.4 represents district wise potential agroforestry systems (AFS)

Table 4.4: Agroforestry solutions for soil water conservation in Karnataka,

S. No.	Agroclimatic Zone	Districts	AFS for arable lands	AFS for non-arable lands	Special problem area (Mining/gully/open scrub)
1	North east transition zone	Bidar, Kalaburagi	<p>a) Bund planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Melia dubia</i></p> <p>b) Boundary planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Melia dubia</i> <i>Grevillea robusta</i></p> <p>c) Boundary planting + Block plantation: <i>Anacardium occidentale</i>, <i>Tectona grandis</i>, <i>Eucalyptus tereticornis</i>, <i>Melia dubia</i> + <i>Ziziphus mauritiana</i></p> <p>d) Silvihorti + Block plantations (Mango + Guava + <i>Melia dubia</i> or <i>Phyllanthus emblica</i> + <i>Grevillea robusta</i> or <i>Achras sapota</i> + <i>Melia dubia</i></p> <p>e) Monoculture of <i>Anacardium occidentale</i></p> <p>f) Intercropping of sugarcane, pigeonpea, groundnut and pulses with <i>Acacia nilotica</i>, <i>Prosopis cineraria</i></p>	<p>a) Monoculture of <i>Anacardium occidentale</i> <i>Dalbergia sissoo</i></p> <p>b) Mixtures of <i>Anacardium occidentale</i>, <i>Semecarpus anacardium</i>, <i>Ziziphus mauritiana</i>, <i>Annona squamosa</i>, <i>Azadirachta indica</i>, <i>Aegle marmelos</i>, <i>Prosopis cineraria</i>, <i>Pongamia pinnata</i>,</p> <p>c) Pastures: Grass + <i>Prosopis juiffora</i>, <i>P. pallida</i>, <i>Ficus drupaceae</i>, <i>F. religiosa</i> and <i>Ficus bengalensis</i></p>	<p>a) Mixtures of <i>Hardwickia binata</i>, <i>Bambusa arundinacea</i>, <i>Albizia lebbek</i>, <i>Terminalia catappa</i>, <i>Butea monosperma</i>, <i>Balanites roxburghii</i>, <i>Pongamia pinnata</i>, <i>Madhuca indica</i>, <i>Pithecellobium dulce</i>, <i>Chloroxylon swietenia</i>, <i>Wrightia tinctoria</i> <i>Ficus drupaceae</i>, <i>Prosopis juiffora</i>, <i>P. pallida</i>, <i>Dodonaea viscosa</i>, <i>Cassia auriculata</i>, <i>Agave Americana</i> b) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Cassia occidentalis</i>, <i>Syloxanthus hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>c) Preventing firewood collection from open scrub and protection against annual bushfire</p>
2	Northeastern dry zone	Kalaburagi, Yadgir, Raichur	<p>a) Bund planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Melia dubia</i></p> <p>b) Boundary planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Melia dubia</i> <i>Grevillea robusta</i></p> <p>c) Boundary planting + Block plantation: <i>Anacardium occidentale</i>, <i>Tectona grandis</i>, <i>Eucalyptus tereticornis</i>, <i>Melia dubia</i> + <i>Ziziphus mauritiana</i></p> <p>d) Silvihorti + Block plantations (Mango + Guava + <i>Melia dubia</i> or <i>Phyllanthus emblica</i> + <i>Grevillea robusta</i> or <i>Achras sapota</i> + <i>Melia dubia</i></p> <p>e) Monoculture of <i>Anacardium occidentale</i></p> <p>f) Intercropping of sugarcane, pigeonpea, groundnut and pulses with <i>Acacia nilotica</i>, <i>Prosopis cineraria</i></p>	<p>a) Monoculture of <i>Tamarindus indica</i>, <i>Azadirachta indica</i>, <i>Hardwickia binata</i>, <i>Phyllanthus emblica</i>, <i>Bambusa arundinacea</i>, <i>Albizia lebbek</i>, <i>A. odoratissima</i></p> <p>b) Mixtures of <i>Ziziphus mauritiana</i>, <i>Annona squamosa</i>, <i>Azadirachta indica</i>, <i>Aegle marmelos</i>, <i>Prosopis cineraria</i>, <i>Pongamia pinnata</i>, <i>Albizia lebbek</i>, <i>Pithecellobium dulce</i></p> <p>c) Pastures: Grass + <i>Prosopis juiffora</i>, <i>P. pallida</i>, <i>Ficus drupaceae</i>, <i>F. religiosa</i> and <i>Ficus bengalensis</i></p>	<p>a) Mixtures of <i>Hardwickia binata</i>, <i>Bambusa arundinacea</i>, <i>Albizia lebbek</i>, <i>Terminalia catappa</i>, <i>Butea monosperma</i>, <i>Balanites roxburghii</i>, <i>Pongamia pinnata</i>, <i>Madhuca indica</i>, <i>Pithecellobium dulce</i>, <i>Chloroxylon swietenia</i>, <i>Wrightia tinctoria</i> <i>Ficus drupaceae</i>, <i>Prosopis juiffora</i>, <i>Prosopis pallida</i>, <i>Dodonaea viscosa</i>, <i>Cassia auriculata</i>, <i>agave Americana</i></p> <p>b) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Syloxanthus hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>c) Preventing firewood collection from open scrub and protection against annual bushfire</p>



3	Northern dry zone	Ballari, Bagalkot, Belagavi, Vijayapura, Davanagere, Dharwad, Gadag, Koppal, Raichur	<p>a) Bund planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Melia dubia</i></p> <p>b) Boundary planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Melia dubia</i> <i>Grevillea robusta</i></p> <p>c) Boundary planting + Block plantation: <i>Anacardium occidentale</i>, <i>Tectona grandis</i>, <i>Ziziphus mauritiana</i></p> <p>d) Silvihorti + Block plantations (Mango + Guava + <i>Melia dubia</i> or <i>Phyllanthus emblica</i> + <i>Grevillea robusta</i> or <i>Achras sapota</i> + <i>Melia dubia</i></p> <p>e) Monoculture of <i>Anacardium occidentale</i></p> <p>f) Intercropping of sugarcane, pigeonpea, groundnut and pulses with <i>Acacia nilotica</i>, <i>Prosopis cineraria</i></p>	<p>a) Monoculture of <i>Tamarindus indica</i>, <i>Azadirachta indica</i>, <i>Hardwickia binata</i>, <i>Phyllanthus emblica</i>, <i>Bambusa arundinacea</i>, <i>Albizia lebbek</i>, <i>A. odoratissima</i></p> <p>b) Mixtures of <i>Ziziphus mauritiana</i>, <i>Annona squamosa</i>, <i>Azadirachta indica</i>, <i>Aegle marmelos</i>, <i>Prosopis cineraria</i>, <i>Pongamia pinnata</i>, <i>Albizia lebbek</i>, <i>Pithecellobium dulce</i></p> <p>c) Pastures: Grass + <i>Prosopis juiffora</i>, <i>P.pallida</i>, <i>Ficus drupaceae</i>, <i>F. religiosa</i> and <i>Ficus bengalensis</i></p>	<p>a) Mixtures of <i>Hardwickia binata</i>, <i>Bambusa arundinacea</i>, <i>Albizia lebbek</i>, <i>Terminalia catappa</i>, <i>Butea monosperma</i>, <i>Balanites roxburghii</i>, <i>Pongamia pinnata</i>, <i>Madhuca indica</i>, <i>Pithecellobium dulce</i>, <i>Chloroxylon swietenia</i>, <i>Wrightia tinctoria</i> <i>Ficus drupaceae</i>, <i>Prosopis juiffora</i>, <i>Prosopis pallida</i>, <i>Dodonaea viscosa</i>, <i>Cassia auriculata</i>.</p> <p>Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Stylosanthes hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>c) Preventing firewood collection from open scrub and protection against annual bush fire</p>
4	Central dry zone	Chitradurg, Davanagere, Tumkur, Chikkamagaluru, Hassan	<p>a) Block plantations: <i>Cocos nucifera</i>, <i>Areca catechu</i>, <i>Tectona grandis</i>, <i>Melia dubia</i>, <i>Santalum album</i>, <i>Casuarina equisetifolia</i></p> <p>b) Boundary planting: <i>Pongamia pinnata</i>, <i>Sesbania grandiflora</i>, <i>Melia dubia</i>, <i>Agave americanac</i></p> <p>c) Boundary planting + Block plantation: <i>Tectona grandis</i> + <i>Cocos nucifera</i>, <i>Areca catechu</i> + <i>Grevillea robusta</i>, <i>Melia dubia</i> + <i>Casuarina equisetifolia</i></p> <p>d) Silvihorti: <i>Melia dubia</i> + <i>Grevillea robusta</i> + <i>Santalum album</i> + Lemon</p>	<p>a) Blocks of <i>Hardwickia binata</i>, <i>Albizia lebbek</i>, <i>Ziziphus mauritiana</i>, <i>Azadirachta indica</i>, <i>Acacia nilotica</i>,</p> <p>b) Mixtures of <i>Ziziphus mauritiana</i>, <i>Annona squamosa</i>, <i>Azadirachta indica</i>, <i>Aegle marmelos</i>, <i>Prosopis cineraria</i>, <i>Pongamia pinnata</i>, <i>Santalum album</i>,</p> <p>c) Pastures: <i>Prosopis juiffora</i>, <i>Prosopis pallida</i>, <i>Dodonaea viscosa</i>, <i>Cassia auriculata</i>, <i>Agave Americana</i></p> <p>Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Stylosanthes hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>c) Preventing firewood collection from open scrub and protection against annual bushfire</p>	
5	Eastern dry zone	Bangalore Rural, Ramanagara, Bangalore Urban, Kolar, Chikkaballapura, Tumakuru	<p>a) Block plantations: <i>Eucalyptus tereticornis</i>, <i>Casuarina equisetifolia</i>, <i>Tectona grandis</i>, <i>Melia dubia</i>, <i>Santalum album</i>, <i>Cocos nucifera</i>, <i>Areca catechu</i>, <i>Mangifera indica</i>,</p> <p>b) Boundary planting: <i>Pongamia pinnata</i>, <i>Sesbania grandiflora</i>, <i>Melia dubia</i>,</p> <p>c) Block plantations and mixtures of Tamarind, Jackfruit, Mango, Jamoon, Amla, Wood apple, Custard apple, Syzgium jambos, Cashewnut</p>	<p>a) Blocks of <i>Hardwickia binata</i>, <i>Albizia lebbek</i>, <i>Ziziphus mauritiana</i>, <i>Azadirachta indica</i>, <i>Acacia nilotica</i>, <i>Ficus drupaceae</i></p> <p>b) Mixtures of <i>Ziziphus mauritiana</i>, <i>Annona squamosa</i>, <i>Azadirachta indica</i>, <i>Aegle marmelos</i>, <i>Prosopis cineraria</i>,</p>	<p>a) Mixtures of <i>Hardwickia binata</i>, <i>Bambusa arundinacea</i>, <i>Dendrocalamus stocksii</i>, <i>Dendrocalamus strictus</i>, <i>Albizia lebbek</i>, <i>Terminalia catappa</i>, <i>Butea monosperma</i>, <i>Balanites roxburghii</i>, <i>Pongamia pinnata</i>, <i>Madhuca indica</i>, <i>Pithecellobium dulce</i>, <i>Chloroxylon swietenia</i>, <i>Wrightia tinctoria</i> <i>Ficus drupaceae</i>, <i>Prosopis juiffora</i>, <i>Prosopis pallida</i>.</p> <p>Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Stylosanthes hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>c) Preventing firewood collection from open scrub and protection against annual bushfire</p>

6	Southern dry zone	Mysuru, Chamaraajanagar, Mandya, Tumakuru, Hassan	<p>d) Bund planting: Pongamia, Gliricidia, Casearia siamea, Samanea saman, Commiphora caudate, Azadirachta indica, Acacia pycnantha, Vitex nigundo.</p> <p>a) Ficus based AFS in Mandya: <i>Ficus benghalensis</i>, <i>F. religiosa</i> <i>F. amplissima</i>, <i>F. virens</i>, <i>F. racemosa</i> <i>F. mysorensis</i> var. <i>pubescens</i></p> <p>b) Bund planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Grevillea robusta</i>, <i>Melia dubia</i>, <i>Agave americana</i></p> <p>c) Block plantations: <i>Eucalyptus tereticornis</i>, <i>Casuarina equisetifolia</i>, <i>Tectona grandis</i>, <i>Melia dubia</i>, <i>Santalum album</i>, <i>Cocos nucifera</i>, <i>Areca catechu</i>, <i>Mangifera indica</i>,</p> <p>d) Silvihorti: <i>Melia dubia</i> + <i>Grevillea robusta</i> + <i>Santalum album</i> + Lemon + drumstick + <i>Murraya koenigii</i> + Banana</p>	<p><i>Pongamia pinnata</i>, <i>Santalum album</i>,</p> <p>a) Ficus based AFS in Mandya: <i>Ficus benghalensis</i>, <i>F. religiosa</i> <i>F. amplissima</i>, <i>F. virens</i>, <i>F. racemosa</i> <i>F. mysorensis</i> var. <i>pubescens</i>, <i>F. drupaceae</i></p> <p>b) Block plantations: <i>Casuarina equisetifolia</i>, <i>Tectona grandis</i>, <i>Melia dubia</i>, <i>Santalum album</i>, <i>Mangifera indica</i></p> <p>c) Mixtures of all the above species</p>	<p><i>pallida</i>, <i>Dodonaea viscosa</i>, <i>Cassia auriculata</i>, <i>Agave Americana</i>.</p> <p>b) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Stylosanthes hamate</i>, <i>Mucuna purpurea</i></p> <p>c) Preventing firewood collection from open scrub and protection against annual bushfire</p>
7	Southern transition zone	Hassan, Chikkamagaluru, Shivamogga, Mysuru, Davanagere	<p>a) Bund planting: <i>Tectona grandis</i>, <i>Azadirachta indica</i>, <i>Grevillea robusta</i>, <i>Melia dubia</i>,</p> <p>b) Arecanut block plantations: <i>Grevillea robusta</i>, <i>Tectona grandis</i> in border</p> <p>c) Block plantations: <i>Grevillea robusta</i>, <i>Tectona grandis</i>, <i>Santalum album</i>,</p> <p>d) Monoculture of <i>Areca catechu</i>, <i>Cocos nucifera</i>, <i>Mangifera indica</i></p> <p>d) Coffee + <i>Melia dubia</i>+ Black pepper</p>	<p>a) Blocks of <i>Tamarindus indica</i>, <i>Azadirachta indica</i>, <i>Hardivickia binata</i>, <i>Albizia lebbek</i>, <i>A. odoratissima</i>, <i>Ziziphus mauritiana</i>, <i>Azadirachta indica</i>, <i>Acacia nilotica</i>,</p> <p>b) Mixtures of <i>Ziziphus mauritiana</i>, <i>Annona squamosa</i>, <i>Azadirachta indica</i>, <i>Aegle marmelos</i>, <i>Prosopis cineraria</i>, <i>Pongamia pinnata</i>, <i>Santalum album</i>,</p>	<p>a) Mixtures of <i>Hardivickia binata</i>, <i>Bambusa arundinacea</i>, <i>Dendrocalamus stocksii</i>, <i>dendrocalamus strictus</i> <i>Albizia lebbek</i>, <i>Terminalia catappa</i>, <i>Butea monosperma</i>, <i>Balanites roxburghii</i>, <i>Pongamia pinnata</i>, <i>Madhuca indica</i>, <i>Pithecellobium dulce</i>, <i>Chloroxylon swietenia</i>, <i>Wrightia tinctoria</i> <i>Ficus drupaceae</i>, <i>Prosopis juliflora</i>, <i>Prosopis pallida</i>, <i>Dodonaea viscosa</i>, <i>Cassia auriculata</i>, <i>Agave Americana</i>.</p> <p>b) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Stylosanthes hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>c) Preventing firewood collection from open scrub and protection against annual bushfire</p>

8	Northern transition zone	Belagavi, Dharwad, Haveri, Gadag	<p>a) Babool based AFS: <i>Acacia nilotica</i>, <i>A. leucophloea</i>, <i>Azadirachta indica</i>, <i>Tectona grandis</i>, <i>Melia dubia</i>, <i>Azadirachta indica</i>, <i>Grevillea robusta</i>, <i>Melia dubia</i>, c) Block plantations: <i>Tectona grandis</i>, <i>Melia dubia</i>, <i>Santalum album</i>, <i>Mangifera indica</i>, d) Silviculture: <i>Melia dubia</i> + <i>Grevillea robusta</i> + <i>Santalum album</i> + Lemon + drumstick + <i>Murraya koenigii</i> + Banana e) <i>Melia dubia</i> + <i>Zizyphus mauritiana</i></p>	<p>a) Blocks of <i>Tamarindus indica</i>, <i>Azadirachta indica</i>, <i>Hardwickia indica</i>, <i>Albizia lebbek</i>, <i>A. odoratissima</i>, <i>Zizyphus mauritiana</i>, <i>Azadirachta indica</i>, <i>Acacia nilotica</i>, b) Mixtures of <i>Zizyphus mauritiana</i>, <i>Annona squamosa</i>, <i>Azadirachta indica</i>, <i>Aegle marmelos</i>, <i>Prosopis cineraria</i>, <i>Pongamia pinnata</i>, <i>Santalum album</i>,</p>	<p>a) Mixtures of <i>Hardwickia binata</i>, <i>Bambusa arundinacea</i>, <i>Dendrocalamus stocksii</i>, <i>dendrocalamus strictus</i>, <i>Albizia lebbek</i>, <i>Terminalia catappa</i>, <i>Butea monosperma</i>, <i>Balanites roxburghii</i>, <i>Pongamia pinnata</i>, <i>Madhuca indica</i>, <i>Pithecellobium dulce</i>, <i>Chloroxylon swietenia</i>, <i>Wrightia tinctoria</i>, <i>Ficus drupaceae</i>, <i>Prosopis juliflora</i>, <i>Prosopis pallida</i>, <i>Dodonaea viscosa</i>, <i>Cassia auriculata</i>, <i>Agave Americana</i>, b) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Stylosanthes hamate</i>, <i>Mucuna purpurea</i> c) Preventing firewood collection from open scrub and protection against annual bushfire</p>
9	Hill zone	Uttara Kannada, Belgaum, Dharwad, Haveri, Shivamoga, Chikkamagaluru, Kodagu, Hassan	<p>a) Coffee based agroforestry system: <i>Grevillea robusta</i>, <i>Acrocarpus fraxinifolius</i>, <i>Erythrina variegata</i>, <i>Tectona grandis</i> b) Tea based agroforestry system: <i>Grevillea robusta</i>, <i>Acrocarpus fraxinifolius</i>, <i>Erythrina variegata</i>, <i>Tectona grandis</i> in border c) Arecanut block plantations: <i>Grevillea robusta</i>, <i>Tectona grandis</i> in border d) Block plantations: <i>Grevillea robusta</i>, <i>Tectona grandis</i>, <i>Santalum album</i>, <i>Acacia magnum</i>, <i>Aquilaria malaccensis</i> e) Monoculture of <i>Anacardium occidentale</i> f) <i>Soppina Betta</i> AFS: <i>Terminalia tomentosa</i>, <i>T. pniculata</i>, <i>Carex arborea</i>, <i>Artocarpus heterophyllus</i></p>	<p>a) Monoculture of <i>Anacardium occidentale</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i> b) Mixtures of <i>Anacardium occidentale</i>, <i>gardenia</i>, <i>Casuarina gummifera</i>, <i>Casuarina equisetifolia</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i>, <i>Thespesia populnea</i>, <i>Terminalia arjuna</i>, <i>Terminalia tomentosa</i>, <i>Hopea wightiana</i></p>	<p>a) Monoculture of <i>Anacardium occidentale</i>, <i>Casuarina equisetifolia</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i>, <i>Melia dubia</i>, <i>Tectona grandis</i> b) Mixtures of <i>Anacardium occidentale</i>, <i>Gardenia gummifera</i>, <i>Casuarina equisetifolia</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i>, <i>Thespesia populnea</i>, <i>Terminalia arjuna</i>, <i>Terminalia tomentosa</i>, <i>Hopea wightiana</i> c) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Stylosanthes hamate</i>, <i>Mucuna purpurea</i> d) Preventing firewood collection from open scrub and protection against annual bushfire</p>

10	Coastal zone	Udupi, Dakshina Kannada, Uttara Kannada	<p>a) Arecanut block plantations: <i>Grevillea robusta</i>, <i>Tectona grandis</i> in border</p> <p>b) <i>Anacardium occidentale</i> based agroforestry system <i>Grevillea robusta</i>, <i>Acrocarpus fraxinifolius</i>, <i>Erythrina variegata</i>, <i>Tectona grandis</i></p> <p>c) Rubber plant based agroforestry system: <i>Hevea brasiliensis</i> with <i>Grevillea robusta</i>, <i>Acrocarpus fraxinifolius</i>, <i>Erythrina variegata</i>, <i>Tectona grandis</i></p> <p>d) Block plantations: <i>Tectona grandis</i>, <i>Santalum album</i>, <i>Acacia mangium</i>, <i>Aquilaria malaccensis</i>, <i>Acacia auriculiformis</i></p> <p>e) Monoculture of <i>Anacardium occidentale</i>, <i>Casuarina equisetifolia</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i>, <i>Vataria indica</i>, <i>Calophyllum inophyllum</i>.</p> <p>f) <i>Soppina Betta</i> AFS: <i>Terminalia tomentosa</i>, <i>T. priculata</i>, <i>Terminalia elliptica</i>, <i>Erythrina indica</i>, <i>Carex arborea</i>, <i>Artocarpus heterophyllus</i></p> <p>g) Home gardens: <i>Hopea parviflora</i>, <i>Hopea wightiana</i>, <i>Ailanthus triphysa</i>, <i>artocarpus heterophylli</i>, <i>artocarpus hirsuttus</i>, <i>Cocos nucifera</i>,</p>	<p>a) Monoculture of <i>Anacardium occidentale</i>, <i>Swietenia mahagoni</i></p> <p>b) Mixtures of <i>Anacardium occidentale</i>, <i>Grevillea robusta</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i>, <i>Terminalia tomentosa</i>, <i>Hopea wightiana</i></p> <p>c) Mangrove rehabilitation: <i>Rhizophora mucronata</i>, <i>Sonneratia caseolaris</i>, <i>Avicennia officinalis</i>, <i>Sonneratia alba</i>, <i>Bruguiera sexangula</i> and <i>Kandelia candel</i></p> <p>d) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Syloanthus hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>e) Preventing firewood collection from open scrub and protection against annual bushfire</p>	<p>a) Monoculture of <i>Anacardium occidentale</i>, <i>Casuarina equisetifolia</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i></p> <p>b) Mixtures of <i>Anacardium occidentale</i>, <i>Grevillea robusta</i>, <i>Acacia catechu</i>, <i>Swietenia mahagoni</i>, <i>Terminalia tomentosa</i>, <i>Hopea wightiana</i></p> <p>c) Mangrove rehabilitation: <i>Rhizophora mucronata</i>, <i>Sonneratia caseolaris</i>, <i>Avicennia officinalis</i>, <i>Sonneratia alba</i>, <i>Bruguiera sexangula</i> and <i>Kandelia candel</i></p> <p>d) Legume covers: <i>Desmanthus virgatus</i>, <i>Cassia tora</i>, <i>Syloanthus hamate</i>, <i>Mucuna pruriens</i>, <i>Mimosa pudica</i>, <i>Tephrosia purpurea</i></p> <p>e) Preventing firewood collection from open scrub and protection against annual bushfire</p>
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CONCLUSION

The state of Karnataka with four principal physiographic regions, namely South Deccan Plateau, Western Ghats, Eastern Ghats (south) and West Coast Plains has about 83% area in is the need of soil and water conservation indicating water erosion as a major problem of the state. With the climate varies from arid and semi-arid in the plateau region to humid tropical monsoonic type in the west coast plains the state is facing both water stress and excess soil erosion. In the Karnataka state the area of 413.8 thousand hectares, 1850.1 thousand hectares and 1650.7 thousand hectares are under severity risk category 1 (Very high risk), 2 (high risk) and 3 (medium risk), respectively. Belgavi, Uttar Kannada, Chamraj Nagar and Koppal are the dominant districts in terms of area under erosion risk.

The high erosion from high slope hilly region, forest destruction, open scrub, Mining, coastal erosion, floods, gullied land and water scarcity are the special problem of Karnataka. Almost all the possible bioengineering measures are to be applied in different part of Karnataka and has been suggested in the document. The proposed approach considered the soil erosion risk areas with production losses of major crops integrating. The wide range of agronomic and vegetative measures, engineering measures and agroforestry measures have been suggested with aim to bring down the erosion rate below the soil loss tolerance limit. The document will help prioritizing the area to be treated and the selection of specific SWC measures for execution of site-specific best management practices.

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Gokatte for capturing rain water for facilitating drinking water to livestock and ground water recharge in Tumkur district.



Trench-cum-bund for *in-situ* moisture conservation and erosion control in Tumkur district



Masonry check dam across nala with water ponding upstream side constructed for storing runoff and erosion control in Chamrajnagar district



Farm pond constructed in black soils to harvest rainwater for life saving irrigations in Koppal district



Farm pond in red soils constructed to harvest rainwater for life saving irrigations in Koppal district



Nala bund with upstream stone pitching for storing runoff, ground water recharge and supplemental irrigation in Tumkur district



Dugout farm pond constructed to harvest rainwater for life saving irrigations in Tumkur district



Trench-cum-Bund in hard rock soil for *in-situ* moisture conservation and erosion control in Bidar district



Farm pond constructed in red soils to harvest rainwater for life saving irrigations in Chamarajnar district



Waste weir in black soil for drainage of excess runoff in Koppal district



Trench-cum-bund in red soil for *in-situ* moisture conservation with Banana plantation in trenches in Tumkur district



Masonry check dam to store runoff, erosion control and providing supplemental irrigations to arecanut plantations in Tumkur district.



Agro-forestry (groundnut intercropping with *Melia dubia*) in Koppal district



Groundnut with jowar intercropping in Koppal district



Melia dubia based silvicultural plantations in Koppal district



Mango based dryland horticulture in Koppal district



Horti-silviculture (Lemon, mango intercropping *Melia Dubia* with drip irrigation) in Chamarajnagar district



Bund strengthening with fodder grass plantation in Koppal district



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