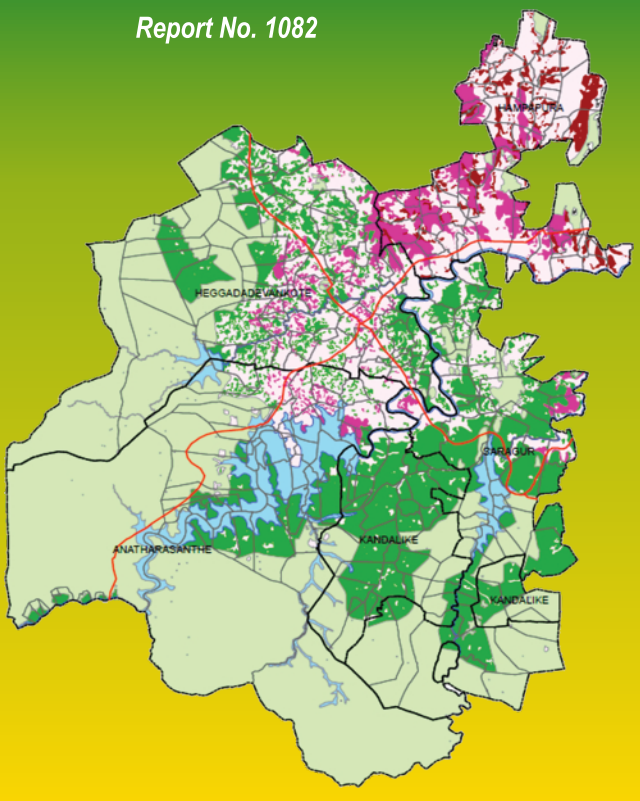
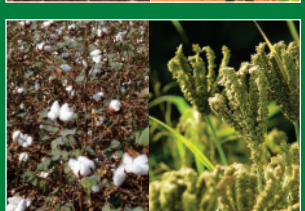
Report No. 1082



Land Use Planning for Enhancing Tribal Livelihood

A case study- H.D.Kote Taluk, Mysore District, Karnataka



ICAR-National Bureau of Soil Survey and Land Use Planning
Amravati Road, Nagpur – 440033, Maharashtra, India

Land Use Planning for Enhancing Tribal Livelihood

A case study- H.D.Kote Taluk, Mysore District, Karnataka

Ramamurthy V.
S. K. Singh
S. C. Ramesh Kumar
K. M. Nair
N. G. Patil
Shivappa Angadi

National Bureau of Soil Survey and Land Use Planning
Amravati Road,
Nagpur-440033

ABOUT THE NBSS&LUP

THE National Bureau of Soil Survey and Land Use planning (NBSS & LUP), Nagpur, a premiere institute of the Indian Council of Agricultural Research (ICAR), was established in 1976. Bureau is mandated for preparing soil resource maps at village, watershed, taluk, district, state and national level and to provide research inputs in soil resource mapping, soil correlation and classification, soil genesis, remote sensing applications, land evaluation, land use planning. It has grown significantly in its size and stature by building up adequate research infrastructure and well qualified human resources. NBSS&LUP is consistently carrying out resource inventorying for suggesting alternate land uses towards optimizing agricultural production.The Bureau's multidisciplinary approach comprising soil survey, establishment of databank, documentation, correlation, assessment of land for different land uses has won the recognition as a premier institute in India as well as in the world. The Bureau is implementing its mandate through five Regional centers and three divisions, all of which are well equipped with scientific capabilities. The Regional centers at Bangalore, Delhi, Kolkata, Jorhat and Udaipur are involved in soil resource mapping, soil correlation and classification, and undertaking research in land use planning. The divisions namely, Soil Resource Studies, Remote Sensing Applications and Land Use Planning are undertaking fundamental and applied research in National Agricultural Research System and provids needed support to the regional centers.

The Bureau in collaboration with Punjabrao Krishi Vidyapeeth, Akola and Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal is running post-graduate teaching and research programme in land resource management for awarding M.Sc and Ph.D degrees.

The publication on **"Land Use Planning for Enhancing Tribal Livelihood A case study-H.D.Kote Taluk, Mysore District, Karnataka"** is the significant outcome four years rigorous work under Tribal Sub-Plan (TSP). It will help the readers to broaden their understanding about livelihood improvement of tribals through land use planning in relation to prevailing soil and site characteristics and socio-economic status of the farmers.

Citation: Ramamurthy, V., S.K. Singh, S.C. Ramesh Kumar, K.M. Nair, N.G. Patil and Shivappa Angadi. 2015. Integrated Land Use Planning for Enhanced Tribal Livelihood in H.D.Kote Taluk of Mysore District, Karnataka. NBSS&LUP, Nagpur, 34p.

TO OBTAIN COPIES OF THIS BULLETIN
Please write to:

Director, National Bureau of Soil Survey and Land Use Planning (ICAR);
Amravati Road, Nagpur- 440 033, India.
Phone : (0712) 2500386, 2500478, 2500664
Telefax : + 91-0712-2500534
E-mail : director@nbsslup.ernet.in

January 2015

ACKNOWLEDGEMENTS

THE publication entitled **"Land Use Planning for Enhancing Tribal Livelihood, A case study- H.D.Kote Taluk Mysore District, Karnataka"** is an outcome of natural resource management and livelihood interventions implemented in tribal areas of H.D.Kote of Mysore district. This bulletin has documented livelihood situation of tribals, their problems and priorities and also highlights the appropriate participatory livelihood interventions and their impact. We express our sincere gratitude to the tribal farmers 15 hamlets of H.D.Kote for their wholehearted co-operation in resource inventory and their active participation in the successful implementation of the programme.

We are highly thankful to Dr. S. Ayyappan, Secretary, Department of Agricultural Research and Education (DARE), Government of India and Director General, Indian Council of Agricultural Research (ICAR), New Delhi for giving an opportunity to work in the tribal area. We are thankful to Dr. A.K. Sikka, Deputy Director General (NRM) and Dr. S.K. Choudhary, ADG (SWM) for their constant support and encouragement during this study. We are thankful to Dr. T.K. Sen, Nodal Officer (TSP), Dr. S. Chatterjee, In-charge PME cell, Ms. Akshata Srinivas, SRF and all the scientists, technical staffs, project staffs, RAs and SRFs, who have directly or indirectly contributed in the the project.

We believe that this publication will be useful for extension workers, policy makers, planners, researchers, academicians and students in offering valuable insight into the livelihood interventions in the tribal backward regions. Further, this publication will help policy makers in building framework, institutional mechanisms and support systems for scaling up of the successful livelihood approaches.

Authors

CONTRIBUTORS AND PROJECT STAFF

Partners
Tribal Self Help Groups Swami Vivekananda Youth Movement (SVYM), Sargur

Project Staff
Mrs. R.Vasundhara
Dr. K.V. Niranjana
Mrs. Archana
Dr. Chandra Kala
Dr. S. Maske
Mr. Somashekara
Dr. B. Dhanorkar
Mr. Paramesha
Mr. Jayaramaiah
Mr. Bhoora Prasad
Mr. Venkatesh Reddy

INTRODUCTION

TRIBAL are undeniably economically poor and under-developed. The process of their marginalization can be traced with the intrusion of British colonialism, which quickly detected the forest, home of tribals having great potential for appropriation of resources (Dixit, 2011). Exploitation of forest-lands by both the British and the zamindars resulted deforestation for commercial crops such as tea, coffee and rubber and other 'developmental' activities allowing contractors to cut trees in the very heart of the forest. These actions deprived the tribal people of their livelihoods.

Historically, tribal communities were characterized by a lifestyle distinct from agrarian communities. They subsisted on different combinations of shifting cultivation, hunting and gathering of forest products i.e. all types of activities closely linked with forests. Their culture and habitat has a close bondage with nature which also emphasis community ownership and consumption, closely-knit kinship structures, and minimal hierarchies (Palmer and Stanley 2012). Today, most of the tribal areas overlap with the major forest areas that are also the areas with the highest concentration of poverty (Anonymous 2009). Deforestation and felling of trees brought them closer to the outside world.

The tribal population of India constitutes around 7.23% of total population (Census, 2011) distributed over 94,000 tribal villages. Tribals are mainly concentrated in North-Eastern States, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Gujarat, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, West Bengal and North-Western Himalayan States. Many tribes still live in hilly and / or forested areas, somewhat remote from mainstream (Manjunatha and Bestur, 2014). The extent to which the tribals are able to meet their food requirements from agriculture is determined by the type of the land they own, the size of the holdings and the size of the household. FAO studies in Madhya Pradesh and Bihar state indicate a declining role of agriculture in household food security of tribals, which lasts for 2 to 6 months of the year for the majority of farming households (Anonymous, 2009). In the past, most tribals were able to cover the shortfall with natural food items gathered from the forests. Forest degradation and curtailed forest access has reduced the availability of natural foods on which they are dependent. This compels the tribals, especially those in the upland and mixed systems, to depend more and more on purchased foods to meet their minimum survival needs. Impoverished villagers have to choose

between migrating for wage work or resorting to unsustainable harvesting of firewood for survival income. Many tribals are under debt trap because of the precariousness of their food security situation.

The state of Karnataka has a total of 51 tribal communities that correspond to 5.2% of the total population of the state. The south west of Karnataka along the Western Ghat can be seen in two prominent tribal regions, one that includes Dakshin Kannada and Chikmagalur region and the other Kodagu and Mysore region. The Soliga, Kadu Kuruba, and Kaniyan are common in Mysore. The Jenu Kurubas are found in both Kodagu and Mysore region (Fig. 1).

Fig. 1 : Women folk of Jenu Kurubas

Apart from the Scheduled Tribes, there are 75 indigenous groups in India known as 'Primitive Tribal Groups'. The Tenth Plan of the Central Government observed that these vulnerable communities have experienced a 'decline in their sustenance base and the resultant food insecurity, malnutrition and ill-health has forced them to live in the most miserable living conditions and some of them are even under the threat of getting extinct'. In the state of Karnataka, the Koragas of Dakshina Kannada district and the 'Jenu Kurubas' who are concentrated in the districts of Mysore, Chamarajnagar and Kodagu are classified as 'primitive tribes'.

Various strategies are adopted to improve livelihoods including sustainable natural resource management, productivity and profitability enhancement, building support systems and institutions, and converging development agenda of different development agencies. Many other scheme have been launched through the schemes under "Tribal Sub Plan" for the upliftment of this section of people, the benefits accrued through such programmes were not sustainable

as they were not trained to improve the land base available at their disposal for integrated farming and allied income generating activities. Livelihood strategies in tribal areas can be classified into three categories: agricultural intensification and diversification, farm productivity and profitability and addressing migration. Agricultural production is only one subset of activities within the broader set of livelihood activities of the tribals. Probably a holistic approach consisting of agriculture and other related activities have not been attempted.

With this background, National Bureau of Soil Survey and Land Use Planning, Regional Centre, Bangalore initiated Tribal communities' livelihood improvement programme in 15 hamlets of HD Kote taluk, Mysore district, Karnataka for improving the livelihood of tribals (Table 1) by adopting a holistic approach covering on farm and off farm activities. This perhaps the key for sustainable livelihood which encompasses people's capabilities, assets, income and activities required to enable people to recover from shocks and stresses, enhances their well-being for future generations without undermining the natural resource base (Anonymous 2014).

Table 1 : Land details of adopted hamlets

S. No.	Name of the Hamlet	No. of Families	No. of Land Holders
1	Basavanagiri Hamlet A	84	72
2	Basavanagiri Hamlet B	84	82
3	Jaganakote hamlet	26	5
4	Devanadi hamlet	29	8
5	Chamanahalli hundi hamlet B	19	7
6	Kempanahaadi	46	25
7	Vadeyarahalli mala hamlet	24	10
8	Chennagundi hamlet	80	45
9	Aralahalli	39	20
10	M.G.halli	57	18
11	Anemala	79	*
12	Golur	72	*
13	Kerehadi	27	*
14	Annur	91	33
15	Bramhagiri	123	31

• Forest land is being cultivated

H.D. KOTE, A TALUK OF MYSORE DISTRICT

Location

H.D. Kote (Heggada Devana Kote) town is 52 kilometers away from Mysore city and is known as one of the backward taluks of Karnataka (Fig. 2). Along the boundaries of Kerala forests, H.D. Kote is an abode of tribal communities in good concentration. The various tribes found in H. D. Kote taluk are the Jenu Kurubas, the Kadu Kurubas, Soligas, Yeravas, etc. These tribes have built their settlements all along the fringes of forests of several hilly and mountainous areas. Total 112 hamlets of tribals comprising of 4228 families with total population of 17364 (Table 2) live in H.D. Kote Taluk of Mysore district.

Fig. 2 : Location map of H.D. Kote

Table 2 : Status of tribals in H.D. Kote (Census 2001)

No. of hamlets	No.of families	Population		
		Male	Female	Total
116	4228	8794	8570	17364

CLIMATE

Annual rainfall of H. D. Kote ranges from 611.7 to 1053.9 mm with an average of 832 mm received in 55 rainy days and the length of growing period is 150-180 days. The rainfall is well distributed (Fig. 3). Heavy rains during the monsoon cause heavy runoff which results in massive soil erosion. H.D. Kote is part of semi-malnad areas and experiences cool and moist climate during winter and rainy season. This part comes under Southern transition zone of Central Karnataka plateau, hot, moist semi-arid eco sub region (AESR 8.2).

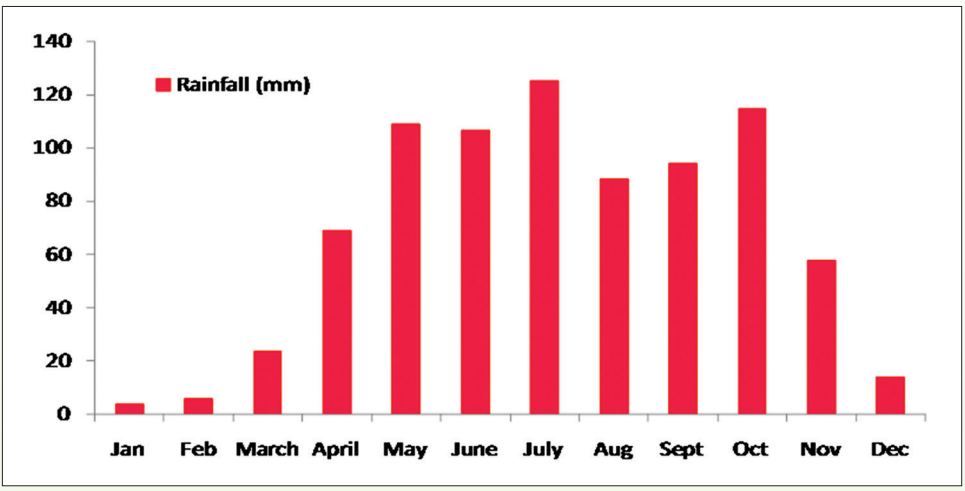


Fig. 3 : Rainfall distribution in H.D. Kote

LAND HOLDING, SOCIO - CULTURAL AND INFRASTRUCTURAL SCENARIO

The literacy rate of tribals in these hamlets is a cause for concern, as it has consistently been lower than that of the taluk. Only 54 per cent of the families own land and the holdings are around 1 ha. Since the tribal people treated land as a common resource, they rarely had land titles, and thus, lost their lands to outsiders when exploitation of forest resources began to take place on a significant scale. This ensured that a majority of tribal families ended up as marginal landholders. The meager holdings on marginal lands with low productivity further make their life measurable. Heavy rains during the monsoon cause intense runoff which results in massive soil erosion while during dry seasons there is acute shortage of water, even to meet the daily household needs. Adverse terrain conditions, inaccessibility of the areas, absence of good road network, and lack of infrastructural facilities, exploitation, unsteady agricultural economy and ignorance add to the backwardness of the tribal population in the region. Due to the practice of unscientific and inappropriate cultivation practices, land

degradation is accelerated through soil erosion and poor returns from agriculture result in poverty.

LIVELIHOOD ANALYSIS

Livelihood analysis indicate that one-third income of all the farmers comes from agriculture based activities including animal rearing, whereas the expenditure varies with the tribal group. Over two-third of the families were involved in migration. Among the migrating families, the average migration was for 180-200 days. Each migrating person earns an average income of Rs. 4500/-per month. Around 10 per cent of the income comes from selling of forest based products.

AGRICULTURAL SCENARIO

Agriculture is predominantly rainfed and mono-cropped. Cotton and finger millet are the dominant crops of tribal area (Fig. 4). Few farmers have irrigation facilities through Ganga Kalyana Yojana. However, water yield of bore wells is very poor. Horticulture is marginally developed and the current area under fruits, vegetables, and spices accounts for only 2.5 per cent of the cultivated area. Vegetable cultivation is picking up very fast. These are preferably grown on homestead land.

Fig. 4 : Dominant land use-cotton and finger millet (Finger millet)

CROPS AND THEIR PRODUCTIVITY

Mostly sole crop is being grown under rainfed condition during *kharif* (April-October). Dominant crops are: cotton (63%), cereals (18%), pulses (11%) and vegetables (8%) etc. (Table 3).

Table 3 : Productivity of major crops grown in tribal areas

Crop	Farmers field yields (q/ha)	Attainable yield (q/ha)
Cotton	6	12
Finger millet (*ragi*)	15	30
Chilli	50	75
Cowpea	3	10
Horsegram	3	8

YIELD GAP ANALYSIS IN TSP AREA

Yield gap analysis of major crops (Fig. 5) of the area indicated that there is scope to increase the productivity of crops to the tune of up to 50 per cent over present productivity. Yield gap is more in pulses and finger millet (*ragi*) than cotton and chilli crops.

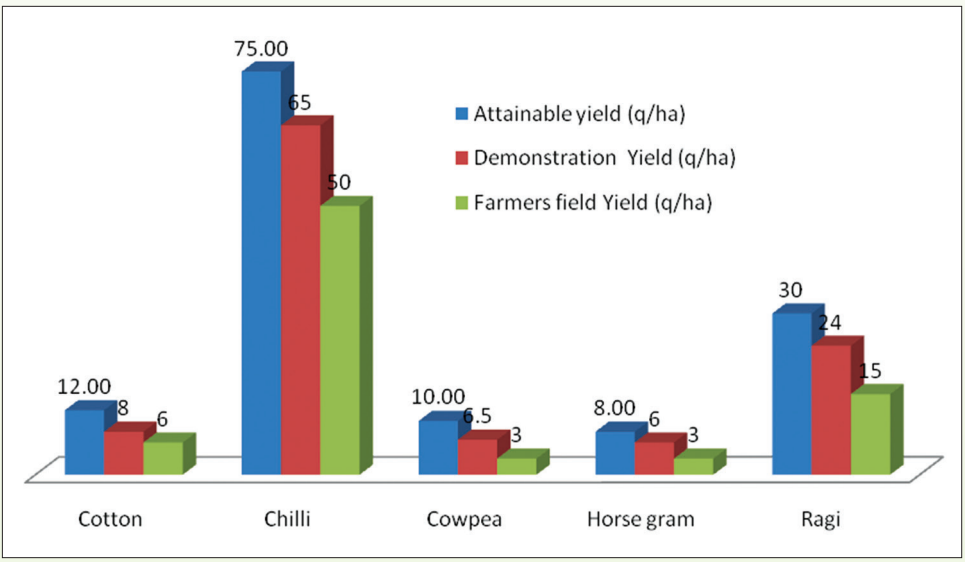


Fig. 5 : Yield gap analysis of different crops of tribal area

SOILS AND THEIR CONSTRAINTS

Soils are shallow to very deep (25 to >150 cm), gravelly, sandy clay loam to clay, dark red to dark reddish brown (Fig. 6) on 1 to 5 per cent slope (Fig. 7) over the basement of granite. Most of the cultivators are applying neither organic manures nor fertilizers in cotton resulting in multi-nutritional deficiencies. The

major soil related constraints are undulating terrain with moderate to steeply sloping landform, moderately deep to shallow depth, low water holding capacity, moderate to severe erosion and gravelliness / stoniness.

Fig. 6 : Soils of tribal hamlets

Fig. 7 : Landform of tribal hamlets

ACTIVITIES FOR ENHANCING LIVELIHOOD

Participatory Rural Appraisal (PRA)

The programme of enhancing tribal livelihood was undertaken in 15 hamlets of 116 hamlets of HD Kote. The techniques used are participatory observation,

resource mapping, interview with the farmers/stakeholders for gathering key information, individual and group discussions and sketching /diagramming of proposed development plan. It is conducted by establishing the rapport with the village community. It enables to analyze the living conditions of tribals and share our thoughts and opinion about the expected out outcomes of plan. This exercise has been done apart from data collected through secondary sources.

RAPPORT BUILDING

The informal contacts and several meetings were organized to build a rapport with the farming communities involving entire cross sections of the community (men and women). The problems related to village, agricultural and gender issues were discussed. The friendly relation was established with the people from all families and groups. The planting of MPTs saplings, general health check up, distribution of high range torches to scare away elephants (Fig. 8) etc. were carried out with the involvement of villagers so as to develop confidence in mind of the people. Sufficient time was allowed for the village entry so that relationship of trust was established with the local community.

Fig. 8 : Distribution of Torches to scare away Elephants

SOIL SURVEY, SOIL ANALYSIS AND MAPPING

Detailed soil survey of Basavanagiri hadi was carried out by using a base map of 1:10000 scale. In other hamlets detailed soil survey was carried out by using sketch map and google imagery. The base map shows field boundaries, location of farm roads, drainage network and other permanent feature of the farm area. Using this base map, a detailed traverse of the village was made to identify the different landform units. Based on the variations, 18 representative sites were selected in the village. At each selected site, profile was exposed up to 150 cm

or to the depth limited by rock or hard substratum and studied in detail for all their morphological characteristics (Soil Survey Staff, 1993). The soil and site characteristics were recorded.The horizon wise soil samples collected from representative master profiles were analyzed for physical and chemical properties following standard procedures (Jackson, 1973). Surface samples were also collected from farmers' field for fertility status (major & micro nutrients) analysis following standard procedures (Jackson, 1973; Page, 1991).

Based on the soil site characteristics, the soils were grouped into 4 soil series in Basavanagiri (Fig. 9), 2 soil series in Chamanhalli hundi (Fig. 10) and M.G.halli hadi (Fig. 11), one soil series in Kempanadi and Jagankote (Fig. 12) and one soil series in Vaderahalli mala (Fig. 13). Soil depth, texture, colour, gravel, nature of sub stratum and horizon sequence were the major identifying characteristics of soil series characterized in the area (Soil Survey Staff, 1993).

The area under each series was further divided into phases (a subdivision of the soil series based mostly on surface features that affect its use and management) and their boundaries were delineated on the field map based on the variations observed in the texture of the surface soil, slope, erosion and gravelliness etc.

GENERATION OF THEMATIC MAPS

The soil-site characteristics were interpreted for identifying the constraints and potentials like soil depth, erosion, gravelliness, salinity/sodicity, and land suitability maps for various crops generated. Fertility maps were generated using interpolation technique (Krigging) using GIS software (Arc Info version 10).

SOCIO-ECONOMIC SURVEY

During this survey, socio economic data were recorded pertaining to different hamlets based upon farmer's views and opinions regarding the constraints and potentials of the concerned village for profitable faming, soil and water conservation measures required etc.

LAND EVALUATION AND LAND USE PLANNING

Land use plan for each land owner was prepared based on the soil/land resources (soil survey data, land evaluation and subsequent negotiation with stakeholders (Fig. 9 to 13). Methodology followed in preparation of the land use plan is depicted in Fig. 14. Land parcels of each farmer were evaluated for their potential constraints and suitable crops were suggested (Fig. 15) (scientific land use plan) (Sys et al 1993; Naidu et al 2006)). Suggested land use plan of individual farmers

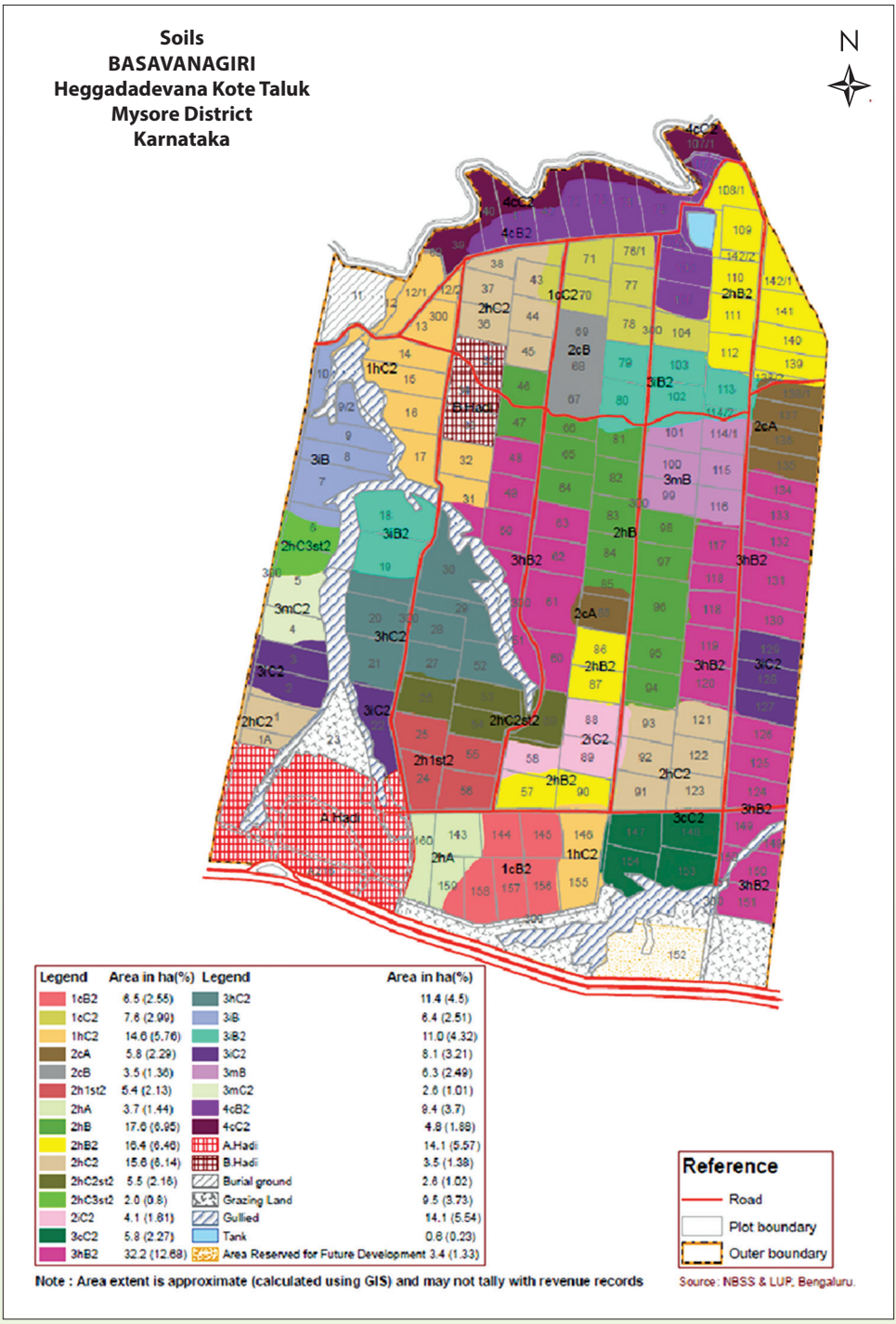


Fig. 9 : Soil map of Basavanagiri hamlet

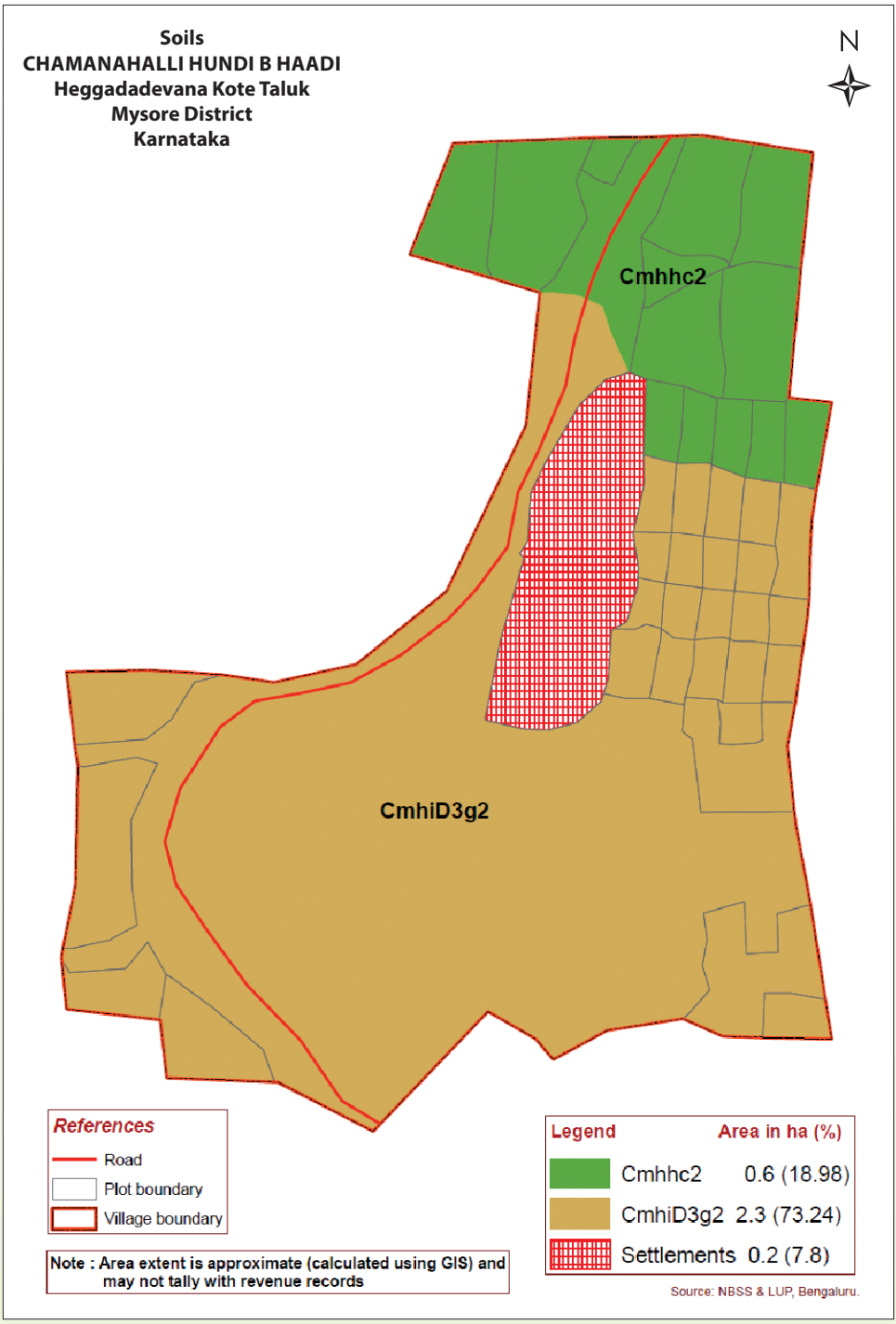


Fig. 10 : Soil map of Chamanahalli hundi B haadi

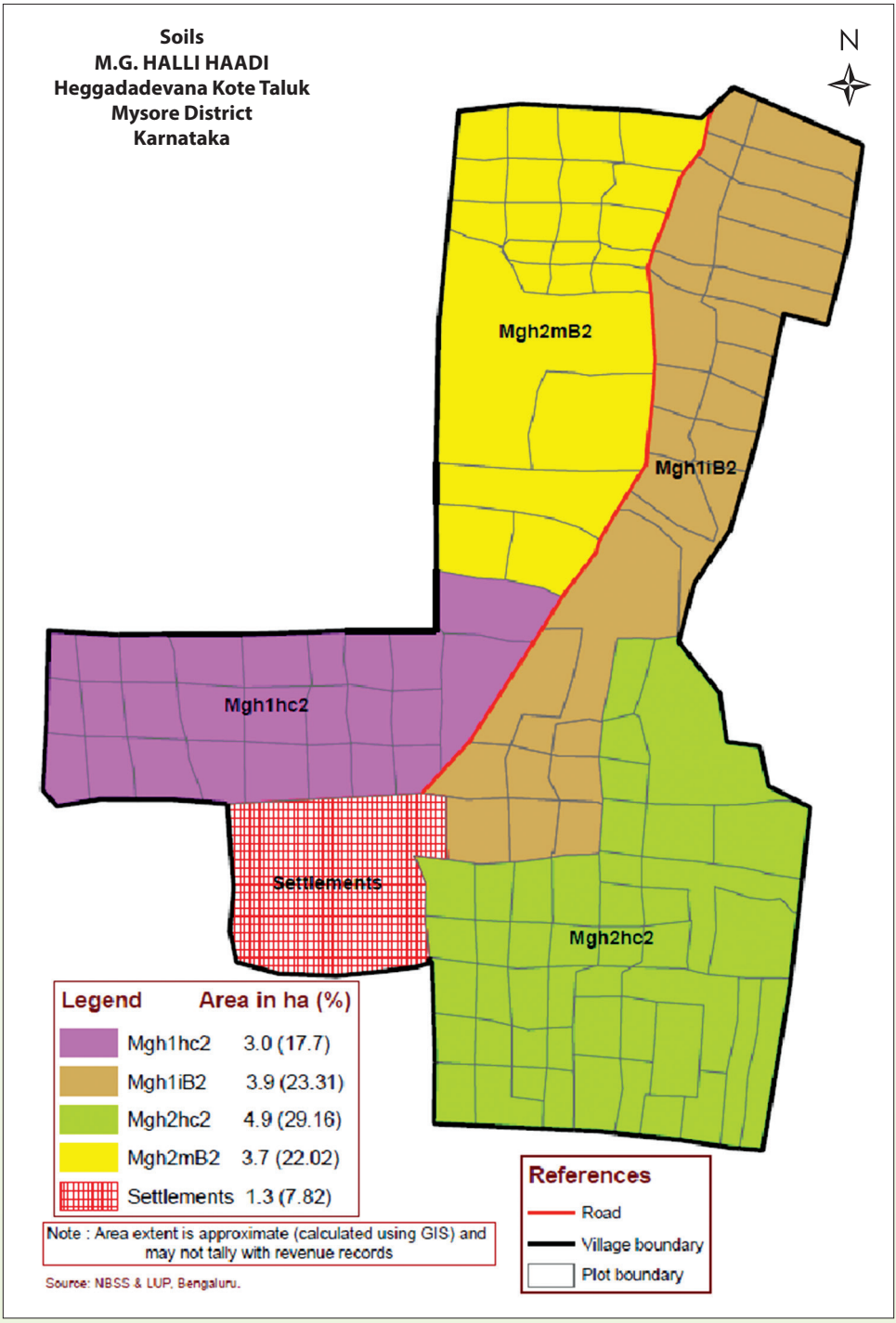


Fig. 11 : Soil map of M.G. Halli haadi

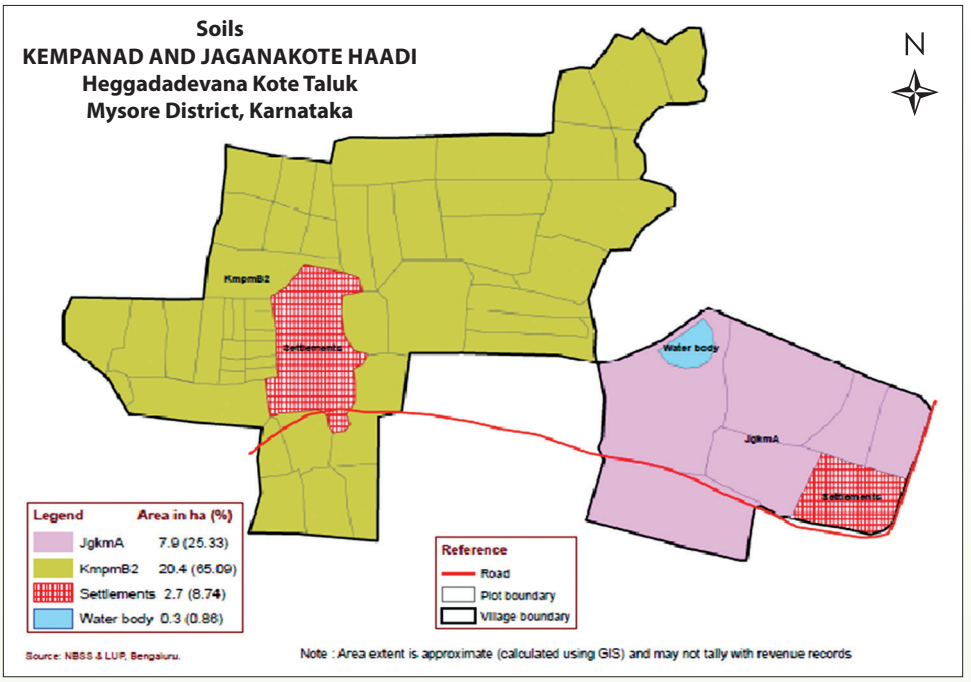


Fig. 12 : Soil map of Kempanad and Jaganakote haadi

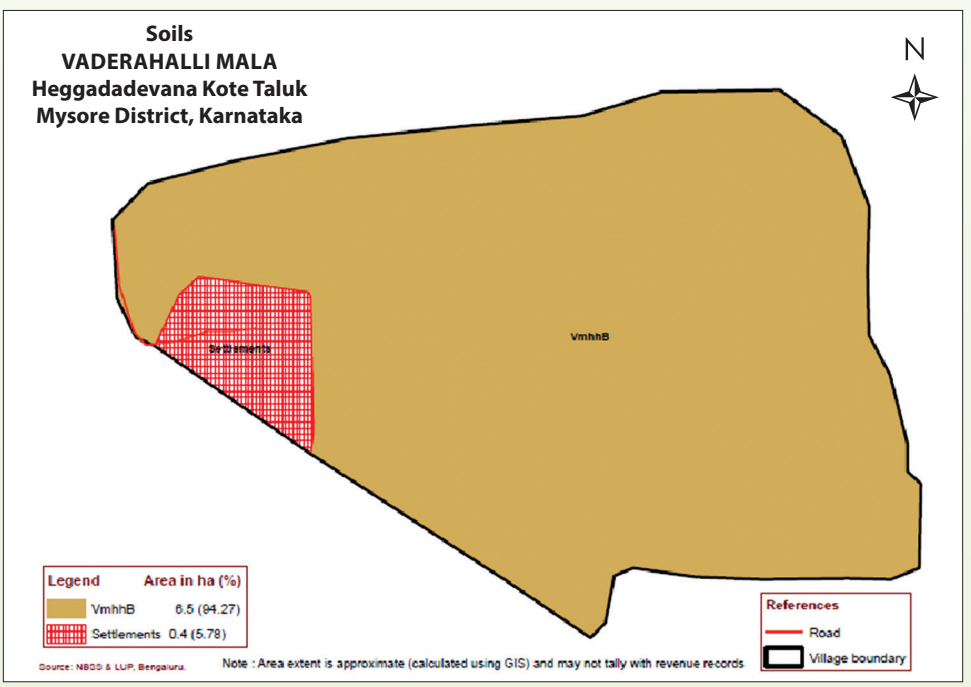


Fig. 13 : Soil map of Vaderahalli mala

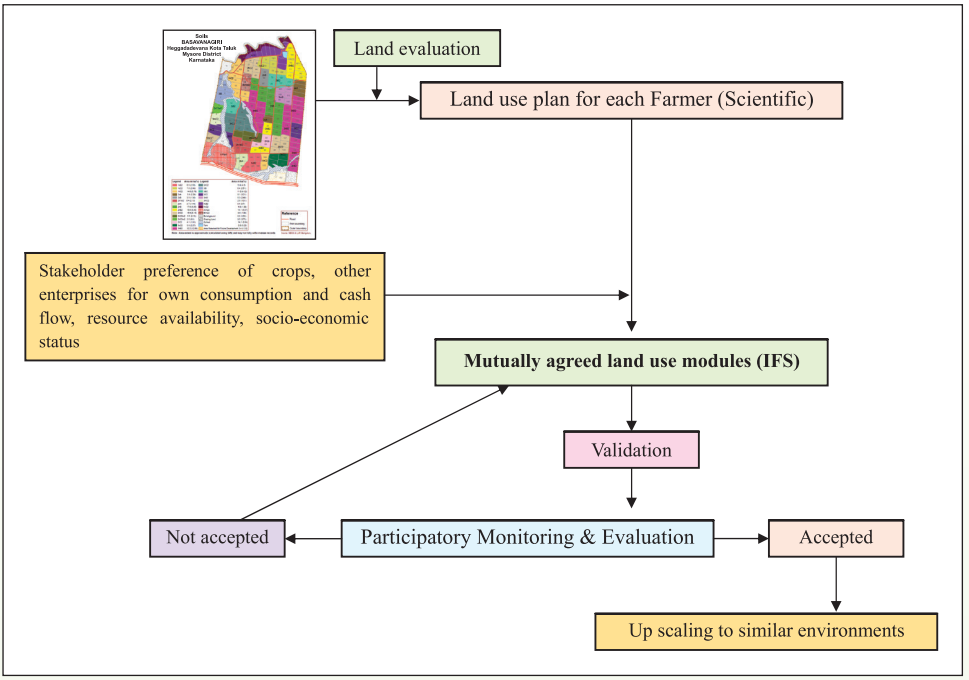


Fig. 14 : Methodology used for preparation of integrated land use planning

Fig. 15 : Participatory Appraisal of Natural Resource and Prioritization

was discussed and refined based on his/her needs and requirements and resources available with him/her (mutually agreed land use plan or integrated land use plan) (Table 4).

Table 4 : Mutually agreed Land Use Plan for 1 ha land holding (for different sites)

Farmer/plot No.	Soil suitability Assessment										Existing system	Mutually agreed LUP
	Cot-ton	FM	Ma-ize	RG	BG	FB	Chilli	Srb	Man-go	Am-la		
145 (shallow, well drained, gravelly loam soils)	S3	S2	S3	N	S2	S2	N	S2	N	N	Cotton	FM + FB(1Ac), BG -FB(1 Ac), FB (½ Ac), Simarouba
135 (Moderately deep, well drained, gravelly clay soils)	S3	S1	S2	S2	S1	S1	S2	S2	S3	S2	Cotton, Finger millet	FMt + FB(1Ac), Cotton (½ Ac), BG (½ Ac), Sapota+Sima-rouba, Cotton+ cowpea, Cotton + horsegram
50 (Deep, well drained, gravelly clay soils)	S2	S2	S2	S2	S1	S1	S1	S2	S2	S1	Cotton, Chilli, Mary-gold	Cotton (1Ac), FMt + FB (1 Ac), BG-FB (½ Ac), Cotton+chilli, Chilli+cowpea, Marigold+ cowpea
40 (Deep, moderately well drained crack-ing clay soils)	S1	S2	S2	S2	S1	S1	S1	S2	N	S3	Cotton	Cotton (1 ½ AC), FM + Fb (½ Ac), RG (½ Ac), cotton+chilli

Note : FM: Finger millet; RG: Red gram; BG: Black gram; FB: Field bean; Srb: Simarouba
S1: Highly suitable; S2: Moderately suitable; S3: Marginally suitable, N: Not suitable

EVALUATION OF SOIL BASED TECHNOLOGIES

Cotton as sole crop

Bt. cotton hybrids (Bahubali, Mahadev, Minerva and 6188) were tested during 2012 and 2013 on different soils of the tribal hamlets. Around 107 farmers were involved in on-farm testing of Bt. cotton. The crop choice was done in participatory mode and farmers took an informed decision to raise Bt cotton even in shallow soils even though bio-physical criteria suggest that cotton is not suitable in shallow soils. However, since most of the shallow soils are located far off from hamlets and near forest fringes, farmers prefer to go for safe crops

like cotton or tobacco, which are not eaten away by elephants. Farmers with only one land parcel also prefer to grow cotton because of the perceived higher returns as compared to Finger millet. Among the Bt hybrids tested, Bahubali recorded higher number of bolls per plant and lint yield followed by Minerva and Mahadev. Number of bolls per plant and lint yield was higher in deep soil as compared to medium deep and shallow soils (Table 5). Improved management performed better than farmer's practice (no fertilizer) across all the soils irrespective of the brand of the Bt. cotton.

Table 5 : Performance of Bt. Cotton hybrids on different soils (mean of 2013 and 2014)

Hybrids	No. of bolls per plant						Lint yield (q/ha)					
	Shallow soils		Medium deep soils		Deep soils		Shallow soils		Medium deep soils		Deep soils	
	IM	FP	IM	FP	IM	FP	IM	FP	IM	FP	IM	FP
Bahubali	30	22	34	27	48	38	7.3	5.6	9.4	8.0	13.7	10.6
Minerva	28	20	27	21	15	13	6.5	4.5	10.9	8.1	7.8	6.8
6188	25	19	30	21	33	27	6.0	5.0	8.0	5.4	10.3	7.8
Mahadev	23	20	31	25	28	25	6.4	5.5	9.0	7.3	7.8	7.0
Mean	26.5	20.2	30.5	23.5	31	25.7	6.6	5.1	9.3	7.2	9.9	5.8

Note : IM=Recommended dose of fertilizers (150:75:75 kg NPK/ha) & opening furrow at last inter cultivation; FP=Farmers practice

COTTON-PULSE INTERCROPPING

Cotton is a dominant crop in most of the hamlets. It is grown in all types of soils irrespective of depth and texture, therefore the productivity of cotton is low. Intercropping of cotton with cowpea and horse gram (Fig. 16) was tested in moderately deep soils in four hamlets covering 10 farmers during 2013 and 2014. Intercropping of cotton with cowpea and horse gram was found economically better system than cotton as sole crop (Table 6). Intercropping of cowpea/horse gram besides providing higher return from the system also helps in improving the soil fertility of these areas.

Fig. 16 : Intercropping of cotton + Horse gram

Table 6 : Performance of cotton with pulses in moderately deep soils (mean of 2 years 2013 and 2014)

	Yield (q/ha)			Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	BCR
	Cotton	Cowpea	Horse gram			
Cotton (FP)	6.0			8000	13000	1:1.62
Cotton (IM)	8.0			10000	18000	1:1.80
Cotton + Cowpea	8.0	5.5		12500	29250	1:2.34
Cotton + Horse Gram	8.0		6.0	12500	27500	1:2.20

Note : IM=Recommended dose of fertilizers (150:75:75 kg NPK/ha) & opening furrow at last inter cultivation; FP=Farmers practice; BCR: Benefit cost ratio

CHILLI AND COTTON INTERCROPPING

Chilli is not a major crop, however it is being grown mostly for home consumption and very little produce is sold to neighborhood farmers. Most of the farmers grow chilli and cotton in deep soils. Intercropping of chilli with cotton and cowpea (Fig. 17) was conducted in three hamlets covering four farmers during 2013 and 2014. In deep soils, growing of cotton as sole crop is more economical than growing chilli along with cotton. Growing of cowpea as an intercrop in chilli is better than chilli as sole crop as is evident from data presented in Table 7.

Table 7 : Performance of chilli and cotton intercropping system in deep soils (mean of 2 years)

	Yield (q/ha)			Cost of cultivation (Rs/ha)	Net return (Rs/ha)	BCR
	Cotton	Chilli	Cowpea			
Chilli (FP)		50.0		35000	7500	1:0.21
Chilli (IM)		65.0		40000	15250	1:0.38
Chilli + Cowpea		68.0	5.0	42500	27800	1:0.65
Cotton	7.5			10000	16250	1:1.62
Cotton + Chilli	7.0			15000	20750	1:1.38

BCR: Benefit cost ratio


Fig. 17 : Performance of chilli and chilli intercrop with cowpea in tribal farms

MARIGOLD AS SOLE AND AS INTERCROP WITH COWPEA

Marigold is a new crop being grown in this taluk for commercial purpose. Marigold is a short duration crop with higher profit compared to any other crops grown in this area. This trial was conducted in two farmers' fields during 2013 and 2014. Application of recommended dose of fertilizers (75:75:60 kg NPK/ha) and planting 20 days old seedlings recorded maximum flower yield. Farmers usually plant 30-40 days old seedlings and fertilizers are not applied. Therefore, plant population per unit area is usually less than optimum. To compensate for the poor crop stand of marigold, cowpea was introduced as intercrop (Fig. 18) and its performance was evaluated. It improved overall productivity of the system compared to farmers practice (Table 8). However, highest BCR was observed in sole marigold crop with improved management practice. It was also apparent that farmers could improve their returns from marigold by adopting cowpea as a filler crop.


Fig. 18 : Performance of marigold as sole and intercrop

Table 8 : Performance of Marigold (mean of 2013 and 2014)

	Yield (q/ha)		Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	BCR
	Marigold	Cowpea				
Marigold (FP)	300		74000	150000	76000	1:1.03
Marigold (IM)	500		100000	250000	150000	1:1.50
Marigold + Cowpea	300	5.0	75000	162500	87500	1:1.16

BT. COTTON HYBRIDS ON DIFFERENT SOILS

Hundred and seven (107) families were involved in on-farm testing (Fig. 19) of Bt cotton. Bahubali hybrid of Bt cotton produced the highest number of bolls per plant and lint yield in deep soils as compared to other hybrids. In medium deep and shallow soils Minerva Bt. Hybrid performed better than other hybrids tested. Other crops suggested for medium deep and shallow soils are finger millet, cowpea and field bean.

Fig. 19 : Cotton in medium deep soils

INTERVENTIONS FOR ENHANCING LIVELIHOOD

Bunding

Participatory bunding programme has been initiated at Basavanagiri hamlet (Fig. 20) for conserving soil and run-off water. Farmers showed innovativeness in utilization of bunds by growing vegetables on the bund. Total area bunded is 5 ha.

Fig. 20 : Vegetable crop on field bunds

OPENING OF FURROWS IN COTTON

Farmers used to sow cotton along the slope leading to soil erosion whenever a rainfall event occurred. They were informed about the loss of nutrients and productivity. Sowing was encouraged across the slope (Fig. 21) by opening the furrow for conserving soil moisture and arresting erosion. It improved cotton productivity by 15%.

Fig. 21 : Cotton cultivation with and without opening of furrow

DRINKING WATER AT DOOR STEP THROUGH MINI WATER SUPPLY

Lack of good quality drinking water was the primary problem listed by tribals during PRA. In most of the hamlets drinking water was used to be fetched from nearby non-tribal villages. The villagers have to walk 1-3 km daily for their water supply. Considering the severity of the problem this programme was initiated in Chanagundi, Aralahalli, Kere hadi, Devanadi, Chamanahalli B hamlet and Anemal hamlets. It helped to provide continuous and good quality water to 300 tribal families (Fig. 22).

Fig. 22 : Mini water supply facilities created to provide drinking water at door steps

COMMUNITY IRRIGATION PROJECT

In Chamanhalli hundi B, Jaganakote, Kempanadi and Basavanagiri A hamlets, community irrigation project has been launched. Water is distributed equally to the members of the water users association and the association in turn will take care of the maintenance of the system. The benefits accrued by farmers due to community irrigation are presented in Table 9.

Table 9 : Impact of community irrigation Project (CIP) on cropping pattern and net returns (2013)

Hamlet	Before CIP		After CIP	
	Crops/cropping system	Net returns (Rs/ha)	Crops/cropping system	Net returns (Rs/ha)
Basavanagiri (4)	Cotton or Finger millet	7500/3500	Cotton-Field bean	10,000
			Finger millet-Field bean	7,000
Chamanhalli hundi (5)	Cotton/Finger millet	8000/4500	Cotton-Finger millet	16,000
			Maize-field bean	23,000
			Banana	35,000
Jaganakote (3)	Cotton	10,000	Cotton-Finger millet	18,000
			Marigold-Finger millet	60,000
			Cotton-Marigold	65,000
			Cotton-Brinjal	60,000
Kempanahadi (4)	Cotton	8,000	Cotton-Finger millet	15,000
			Cotton-field bean	15,500

Note: Figures in parenthesis indicate number of farmers participated in the project

In Basavanagiri, quantity of available water is limited while in other locations land holdings near the irrigation source are limited. One year experience made farmers to go for high value crops like marigold, banana, sugarcane and vegetables (Fig. 23) instead of traditional crops if irrigation facilities are available.

Fig. 23 : Impact of Community irrigation facilities on banana plantation in Chamnahalli hundi hamlet

LIFT IRRIGATION

Vaderahalli hamlet is surrounded by Nugu river tributaries on three sides and water is available for irrigation up to March. Lift irrigation facility was created by installing 5HP diesel pump set (Fig. 24) and storage cum delivery tank was constructed in the elevated place. From this tank all the land holders get water for irrigation through gravitational water flow. Though there are 10 farmers with land holding of 1 ha., only four farmers could use water to grow finger millet after cotton and turmeric and cowpea in 0.4 ha each and average net profit per ha worked out to be Rs. 20,000/ ha due to lift irrigation facilities. This is an additional amount earned by the farmers besides that earned through working in the hamlet itself.

Fig. 24 : 5HP Disel pump set used to lift water from river tributory for irrigation purpose

SEED PRODUCTION OF COWPEA AND HORSE GRAM

During time line analysis of PRA, farmers pointed out that earlier they used to eat lot of pulses along with tapioca and other tubers. Now, pulses intake is very low and even if they want to grow they are not getting good quality improved varieties of pulses. Seed production of horse gram (PHG-9) and

cowpea (PKB-6 and AV-5) was initiated in collaboration with UAS, Bangalore and buy back agreement was made with Basavanagiri hamlet, where 25 farmers participated in this programme. Most of the seeds produced have been sold within the tribal hamlets. Seed production activity is taken up in 0.4 ha and farmers on an average are getting net profit of Rs.18,000/ha from seed production.

INTRODUCTION OF MULTI-PURPOSE TREE (MPTS) SPECIES

To ensure nutritional security of the tribal families, coconut, mango, sapota, jamun, amla and simarouba seedlings were distributed. Plantation of simuarouba was promoted on the field bunds, while fruit plants such as mango, sapota and amla were planted in spaces around village, house backyards and empty field spaces.

MULTI-STORIED CROPPING SYSTEM

Multi-storied cropping system consisting of coffee, drumstick, pepper, elephant yam, tapioca and turmeric was introduced in Anemal and Golur hamlet two years back (Fig. 25) along with teak and other forest trees. This system is being practiced by 5 farmers and an average Rs. 25,000/ha net returns were obtained from drumstick, yam, tapioca and turmeric.

Fig. 25 : Multi-storied cropping system of coffee, drumstick, pepper, yam and turmeric

VEGETABLE PRODUCTION SYSTEM

Vegetables like beans, vegetable cowpea, tomato as intercrop and bitter gourd as sole crop was grown in Anemala and Golur hamlets by 5 farmers (Fig. 26). Both these hamlets are in the middle of the Nagarhole forest and farmers used to grow vegetables for their home consumption only. The economics of these crops (Table 10) is as follows:


Fig. 26 : Beans, vegetable cowpea, tomato and bitter gourd fields

Table 10 : Economics of vegetable production system

Crop	Yield (t/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)
Veg. cowpea	4.0	40,000	88,000	48,000
Beans (as intercrop)	2.0	2,000	40,000	38,000
Tomato (as intercrop)	5.0	5,000	50,000	45,000
Bhendi (as intercrop)	2.0	5,000	30,000	25,000
System		52,000	2,08,000	1,56,000
Bitter gourd	5.0	40,000	90,000	50,000

DAIRY FARMING

Rearing of milch animals is a rare phenomenon among tribals as they don't use milk in any preparations. Few farmers were motivated to take up dairying and provided with milch animals. The economics of two lactations so far indicates that each family is earning net profit of Rs. 100 per day besides getting cow dung for fuel and organic manure (Table 11). Though initially farmers were reluctant to rear the milch animals, they are now changed and are willing to add 2-3 milch animals. Others are also expressing desire to take up dairying. This shows the impact of this intervention among the tribals (Fig. 27).

Table 11 : Impact of dairying on monthly income

Milk yield (l/day)	Cost of production (Rs/month)	Net returns (Rs/month)	BCR
4	1500	3000	1:2


Fig. 27 : Tribal women with milch cow

INTRODUCTION OF GIRIRAJ POULTRY BIRDS

A participatory action research was conducted with proven high producing backyard poultry breeds like Giriraj in different hamlets (Fig. 28). It was designed to create additional employment opportunities and income generation for empowerment of tribal women besides aiding family nutritional security. Interested land less villagers and land holders were identified as entrepreneurs for chick rearing in each hamlet and training program on chick rearing was conducted in the villages. Giriraja breed is dual purpose poultry bird, which gives nearly 250-280 eggs per year and also good meat. For landless tribal farmers 25 birds were distributed as backyard poultry enterprise and for land holders five birds were given as a component of integrated farming system to improve the livelihood security.

Fig. 28 : Giriraj birds

SKILL DEVELOPMENT FOR VALUE ADDITION OF FINGER MILLET AND SMALL SCALE BAKERY

45 tribal farm women were trained for value addition of finger millet, Bt cotton production and small scale bakery (Fig. 29, 30, 31). Value addition of finger millet and small scale bakery training was imparted through Bakery unit of University of Agricultural Sciences, Bangalore. Finger millet malt and other value added products being prepared by the tribal women have been supplied for consumption to patients of Swami Vivekananda Youth Movement Hospital

and Tribal Student hostel. Four value addition groups have been set up and given mini mill for processing the finger millet. Every month each group is supplying 50 kg finger millet malt at Rs.100/kg. Each group is earning Rs. 2000/month as profit after deducting cost of material, labour, packing *etc.*

Fig. 29 : Women Self-Help Group (SHG) members participating in skill development programme

Fig. 30 : Distribution of mini flour mill to SHG members

Fig. 31 : Tribal women members participating in hands on training in Bakery unit

NURSERY OF MPTS

A nursery is a place where plants are propagated and grown to usable size. Nursery activity remains highly labor-intensive and it can provide work to women folk of the hamlets during summer months. Usually during November to May tribal farmers migrate to Kodagu and Kerala in search of work. Nursery based interventions resulted in establishment of successful vegetable crops and other boundary plants (Fig. 32). The various types of nurseries established included social forest nursery and vegetable nursery. Among the various nurseries simarouba nursery is the predominant one. Simarouba is a multi-purpose tree species. It is a medium

sized evergreen tree. Simarouba wood is used as a substitute for white pine and there is a huge demand for timber pupose. Leaves and fruit pulp are used for preparation of vermicompost and other products like oil, oilcake are most important by-products of this tree. Nursery activity had a greater impact on farming community. They are earning Rs 8 for each simarouba plant.

Fig. 32 : Nursery of Simarouba plants

VERMICOMPOSTING: RECYCLING OF CROP RESIDUE AND KITCHEN WASTE INTO VALUABLE ORGANIC FERTILIZER

As such tribal farmers are not keen to use chemical fertilizers and even if they are using, it is not matching with crop requirement. Therefore, it leads to loss of soil fertility due to imbalanced use of fertilizers that has adversely impacted agricultural productivity and caused soil degradation. Now there is a growing realization that the adoption of ecological and sustainable farming practices can reverse the declining trend in the global productivity and environment protection. Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworms are used to enhance the process of crop residue and other farm and kitchen waste to produce a better end product. Composting with worms or vermicomposting, converts food waste to worm manure. Vermicompost plays a major role in improving growth and yield of different field crops, vegetables, flower and fruit crops (Nagavallemma *et al.* 2006). Three vermicompost units were constructed (Fig. 33) in the hamlets and another 22 units are under construction.

Fig. 33 : Visit to Vermicompost units in TSP area

PROTECTION FROM ANIMALS BY DISTRIBUTING HIGH RANGE TORCHES

Elephant menace is the second most critical problem faced by tribal cultivators. Most of the finger millet, horse gram and cowpea crops are eaten away or destroyed by the elephants. To scare away the elephants, high range torches were provided to cultivators whose fields are in fringes of forest. Torches were distributed in the beginning of the *kharif* season 2012, since then the intrusion has been less frequent with little or no damage to the crops.

UPSCALING

TSP project area can be classified into three land use systems (Fig. 34) based on soils and suitable land use. They are:

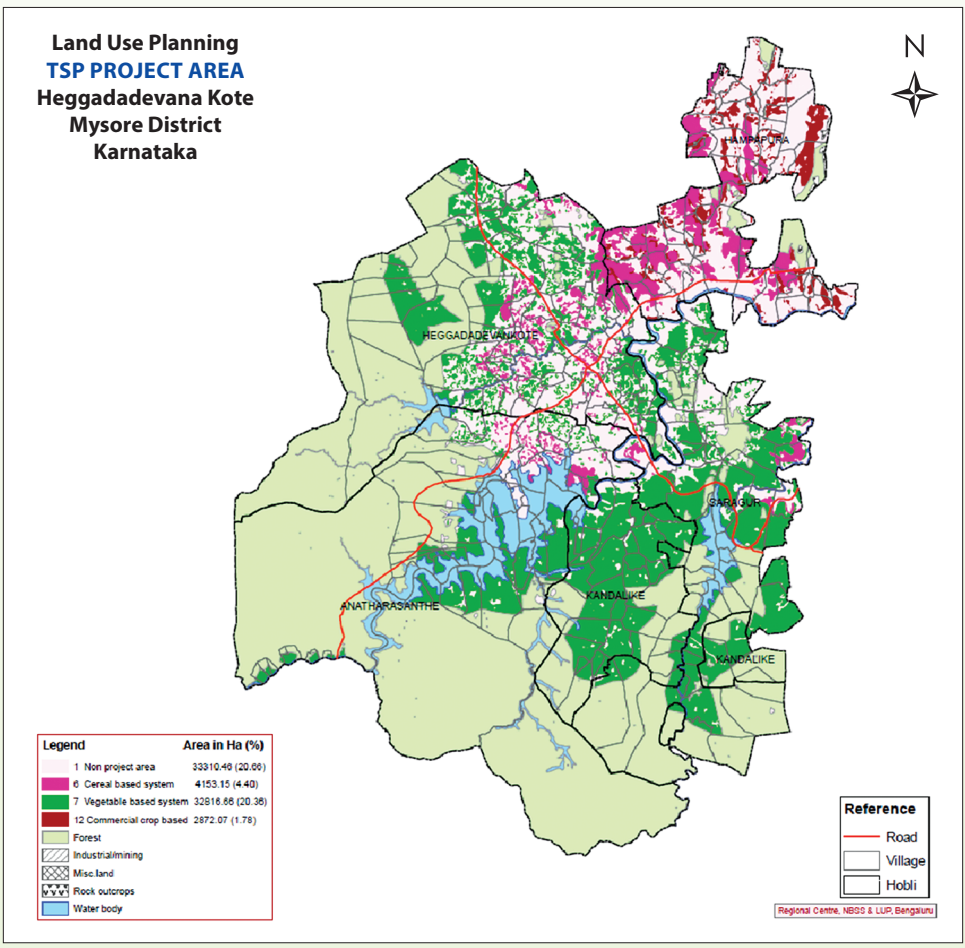


Fig. 34 : Land use systems of TSP area

1. Cereal based production systems in shallow red soils.

2. Commercial crops based production systems in moderately deep to deep black soils.

3. Vegetable and multistoried production systems in moderately deep to deep red soils.

Technological interventions tested in these land use systems could be up-scaled to similar soil and climatic conditions of H.D. Kote, where tribals are dominant.

ECONOMIC ANALYSIS OF DIFFERENT LAND USE SYSTEMS OF TRIBAL AREA

Economic analysis of different crops in different land use systems (Fig. 35) indicated that in all the crops, improved management practice recorded higher net return as compared to farmers' practice. Highest net returns were obtained in tobacco followed by field bean, tomato and cotton. Cotton, finger millet, maize, horse gram and field bean are being grown in all the three land use systems. Tobacco is concentrated in commercial and cereal crops based land use system.

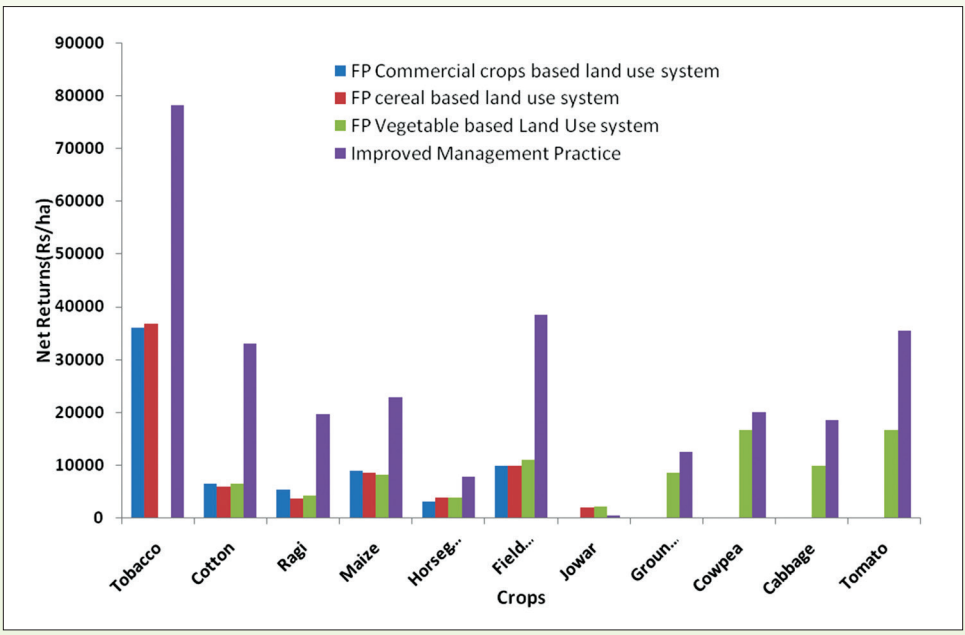


Fig. 35 : Economic analysis of different crops in different land use systems in TSP area (H.D. Kote Taluk)

CEREAL BASED LAND USE SYSTEM

Area of cereal based land use system is around 4153 ha and existing land use system of this area is mostly cotton and tobacco and less area is under finger millet and sorghum. Based on scientific evaluation, soils are not suitable for cotton and tobacco but suitable for minor millets, sorghum, maize (cob purpose) and intercropping of finger millet with field beans, amla *etc.* Besides these crops, dairying and goat farming are more remunerative enterprises with back yard poultry. After economic analysis the suggested land use was found to be more remunerative under improved management practices than the farmers' practice (Table 12). Impact of agro-silvi-horti-pasture with dairy, goatery, backyard poultry and vermi composting will be evaluated later as these are recent interventions.

Table 12 : Analysis of existing and suggested land use

Existing Land use systemt		Suggested Land Use Plan*	
Crops/cropping system	Net returns (Rs/ha)	Crops/cropping system	Projected net returns (Rs/ha)
Cotton	3000	Finger millet + Field	6500
Tobacco	8500	bean	3000
Finger millet	2000	Jowar	5000
Maize	3500	H.gram	15000
Jowar	1000	Tobacco-Horse gram/Field bean	6500
		cotton	10,000
		maize (green cob) Amla, Sapota, Pomegranate, Agro-silvi-horti-pasture, dairy, goatery, backyard poultry, vermicomposting	12,000

*with improved production technology

COMMERCIAL CROPS BASED LAND USE SYSTEM

The area of commercial crop based land use system is around 2872 ha. Existing land use cropping system in this area is mostly cotton based. Soils are moderately to highly suitable for most of the crops. Suggested land use plan includes cotton, chilli, marigold, maize, finger millet, sorghum, tobacco and intercropping of finger millet with field beans, tobacco-field bean and cotton with cowpea/ horse gram (Table 13). Besides these crops, dairying and goat farming are more remunerative enterprises with back yard poultry. Impact of agro-silvi-horti-pasture with dairy, goatery, backyard poultry and vermi composting will be evaluated later as these interventions are recent.

Table 13 : Existing and suggested land use systems analysis

Existing Land use system		Suggested Land Use System*	
Crops/cropping system	Net returns (Rs/ha)	Crops/cropping system	Projected net returns (Rs/ha)
Cotton Finger millet	10,000 5,000	Cotton Marigold Cotton+ chilli Chilli Cotton+field bean/horse gram Finger millet+field bean Maize Tobacco-Horse gram/Field bean Amla, Sapota, Pomegranate, Agro-silvi-horti-pasture, dairy, goatery, backyard poultry, vermicomposting	16,000 1,50,000 20,000 15,000 25,000 10,000 28,000 35,000 15,000

*with improved production technology

VEGETABLE CROPS BASED LAND USE SYSTEM

The area of vegetable based land use system is around 32816 ha, of which maximum area is held by non-tribals. Existing crop of this area is mostly paddy though tribals cultivate vegetables like yam, tapioca, tomato, cabbage, cotton and finger millet in forest fringe areas for own consumption and very little is sold to others . Soils are moderately to highly suitable for all the crops. Suggested land use plan includes cotton, field bean, vegetable, cowpea, beans, radish, greens, cabbage, tomato, bitter gourd, yam, turmeric and ginger (Table 14). Multi-storied system comprising of pepper, coffee, yam, drumstick, tapioca

Table 14 : Existing and suggested land use systems analysis

Existing Land use system		Suggested Land Use System*	
Crops/cropping system	Net returns (Rs/ha)	Crops/cropping system	Projected net returns (Rs/ha)
Cotton Finger millet Cowpea Cabbage Tomato	13,000 4500 3500 10000 15000	Field bean + Tomato + Beans + bhendi + veg. cowpea Bitter gourd Maize (green cob) Coffee+ pepper+ yam+turmeric, Goatery, backyard poultry, vermicomposting	1,50,000 50,000 30,000

*with improved production technology

comes up very well in these areas and there is good demand for these crops. Besides these crops, goat farming and back yard poultry are more remunerative enterprises. However, the performance and impact of these land use system needs to evaluated in later data. Multi-storied system was introduced in 2013 and its impact would be visible only after 3 or more years. Impact of goatery, backyard poultry and vermicomposting will be evaluated later as these interventions were introduced recently.

CONCLUSION

Livelihood of tribals is mainly based on agriculture related activities rather than cultivation of crops alone. Nearly 46 percent of tribals in H.D Kote are landless or own small holdings (< 1ha),. To improve the livelihood of these people, there is need to focus on integrated land use, where all the components of farming system are included to meet family's own requirement of food, cash and fodder for livestock. Integrated Land Use Planning methodology was developed by integrating all participatory tools with standard soil survey and land evaluation methods and subsequent negotiation with stakeholders. It was evident from the work done under TSP that cultivation of suitable crop/variety (based on soil type) by following improved management practices could help to produce sufficient for feeding the family and surplus food grains could be sold to generate income. Efficient use of land resources by intercropping, crop rotation and multi-storied cropping were demonstrated for its ability to generate more work for local people and maximize food production in limited land area. Besides this, major challenge of reducing migration of tribal was reduced through creation of jobs during lean period by introducing income generating activities like value addition of finger millet, nursery of MPTs, dairying, goat rearing and backyard poultry.

The findings of the study thus revealed that identification of bio-physical, socio-economic setup and need of the stakeholders certainly helps to design sustainable, acceptable and economically viable land use plans based upon participatory and integrated farming system approach, where soil specific agro-technologies form a basis to improve the livelihood of farming/tribal community as a whole.

REFERENCES

Anonymous (2009). Impact Assesment of Agricultural interventions in tribal areas in Madhya Pradesh. Catalyst management service Pvt. Ltd., pp-132.

Anonymous (2014). http://www.elipk.org/NRM.html Accessed on 9 Dec. 2014.

Dixit, S. (2011). Sustainable Rural Livelihoods: NAIP Experiences lecture notes of training on "Production and Farming System for Livelihood Improvement in Rainfed Areas" Sep. 5-9, 2011

Manjunatha, K.M. and Betsur, N. C. (2014). A Study on Mangana Kayile (Monkey Disease) of Malaikudi Tribal Students in Dakshina Kannada District of Karnataka. *Conflux Journal of Education. 2(2):35-39*

Palmer, M.D. and Stanley, M.B. (2012). Religion and Social Justice. Wiley Blackwell Publications.

Soil Survey Division Staff. (1993). Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.