INDIGENOUS KNOWLEDGE FOR MANAGEMENT OF LAND AND WATER RESOURCES OF THE TRIBES OF SOUTH ODISHA AND ANDHRA PRADESH

(2015)

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SCHEDULED CASTE & SCHEDULED TRIBE RESEARCH
& TRAINING INSTITUTE (SCSTRTI)
ST & SC DEVELOPMENT DEPARTMENT, GOVERNMENT OF ODISHA
BHUBANESWAR - 751012

Submitted By
FOUNDATION FOR ECOLOGICAL SECURITY,
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ABBREVIATIONS USED IN THE REPORT

BBT	Broad Base Terraces
BT	Bench Terraces
CB	Contour Bund
CBO	Community Benefit Oriented Program
CCAFS	Climate Change, Agriculture and Food Security
CCT	Continuous Contour Trench
CD	Community Development
CoP	Conference of Parties
CT	Contour Trench
DDP	Desert Development Program
DFO	Divisional Forest Officer
DKDA	Dongaria Kondh Development Agency
DoLR	Department of Land Resources
DPAP	Drought Prone Area Program
FAO	Food and Agriculture Organization
FES	Foundation for Ecological Security
GIAHS	Globally Important Agricultural Heritage Systems
GMO	Genetically Modified Organization
GoI	Government of India
GoO	Government of Orissa (Odisha)
H&TW	Harijan and Tribal Welfare Department
IBO	Individual Benefit Oriented Program
IEK	Indigenous Ecological Knowledge
IIPFCC	International Indigenous Peoples Forum on Climate Change
IK	Indigenous Knowledge
IPCC	Intergovernmental Panel for Climate Change
IRDP	Integrated Rural Development Program
ITDA	Integrated Tribal Development Agency
IWDP	Integrated Wasteland Development Project

LBCD	Loose Boulder Check Dams
LI	Lift Irrigation
LSDA	Lanjia Saora Development Agency
MDG	Millennium Development Goal
NBT	Narrow Base Terraces
NGO	Non-Government Organization
NLCB	National Landuse and Conservation Board
NLP	National Landuse Policy
NRAA	National Rainfed Area Authority
NREP	National Rural Employment Program
NTFP	Non-Timber Forest Produce
PVTG	Particularly Vulnerable Tribal Groups
SC	Scheduled Caste
SCT	Staggered Contour Trench
ST	Scheduled Tribe
SCSTRTI	Scheduled Caste and Scheduled Tribes Research and Training Institute
THAS	Tribal Heritage Agriculture System
THRTI	Tribal and Harijan Research and Training Institute
TSP	Tribal Sub-Plan
UNDP	United Nations Development Program
UNFCC	United Nations Framework Convention on Climate Change

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EXECUTIVE SUMMARY

Efficient and sustainable use of natural resources is *sine qua non* for economic development, especially in the resource poor countries. More so in the agriculturally dominant economies like India more than 50 percent of the cropped area is dependent on rainfall without any alternative irrigation facilities. Rain fed regions, which account for more than 50% of cultivable land and 40% of population, house a large share of the poor, food insecure and vulnerable populations in the country. The tribal population and more specially, the Primitive and Vulnerable Tribal Groups (PVTGs) have become more vulnerable in this context.

The tribal areas constitute major chunk of the rain fed areas. The tribal communities are not much used to improved agricultural practices and hence, by and large, they have remained confined to their traditional agricultural and livelihoods practices for their imminent survival. The traditional agricultural practices of the tribal communities are scientific in their own accord and technically viable in their land use context. Their agriculture is rain fed, knowledge and skills acquired through years of interacting with their land use practices, less input intensive, land use decisions based on understanding local environment and shared perceptions, efficient land and water management technology, and the overall production system is sustainable in many respects. Their knowledge systems have not been mainstreamed for scientific validation and qualification. However, on the other hand, the intensity of resource degradation is reaching irreversible levels in some of the tribal regions calling for promotion of appropriate technologies and development strategies to result in multiple benefits such as (i) ensuring food security, (ii) enhancing the viability of farming, and (iii) restoring the ecological balance.

While efforts are on to restore the degraded resource base elsewhere, a pertinent question arises that in this quest for appropriate technologies shouldn't the traditional knowledge of the communities in the rain fed areas be given due priority on its merit? Should we not consider incorporating the age old indigenous knowledge of the tribal communities in bridging the gap between degraded resource base and the prescribed technological solutions? The indigenous knowledge systems, undoubtedly, matter in this context and scenario. The relevance of indigenous knowledge in a wider context and in the context of

food security, viability of farming and restoring natural resources remains to be justified through proper documentation, dissemination and authentic interpretation as appropriate knowledge systems. Their knowledge on wider natural environment, production conditions and resilience in coping and management strategies may be suitably employed in curbing the resource degradation.

In India, several policies and programs have been formulated and implemented over the years emphasizing upon the conservation and productive use of land and water resources. The Drought Prone Area Program (DPAP) in 1972-73, Desert Development Program (DDP), Integrated Wasteland Development Project (IWDP) in 1989-90 are some of the national level programs undertaken for comprehensive development and management in land and water resources. Certain empowered bodies like National Landuse and Conservation Board (NLCB) constituted in 1985, National Rainfed Area Authority (NRAA) constituted in 2006 are some of the leads at National level for strategizing conservation and management of land and water resources at a landscape and watershed level.

According to a report of National Rainfed Area Authority (NRAA, 2012), Rainfed areas currently constitute 55 per cent of the net sown area of the country and are home to two-thirds of livestock and 40 per cent of human population. The report presents characteristic contrasts among the various rainfed agriculture regions in India.

Tribal cultivators in India traditionally took recourse to numerous means of irrigation. In broken and undulating landscapes which are unsuitable for irrigation, the ingenuity of the tribal people could make irrigation possible to a limited scale. Embankments are constructed across the natural slopes of the land, and small streams are dammed and diverted to fill these crude reservoirs. Rice fields are laboriously constructed by terracing the land at suitable hollows; or the bed of the stream are banked and made into one long, narrow rice field.

The tribal way of management of land and water can be best studied at a landscape consideration. At a landscape level, ecologically significant areas and their spatial linkages are possible to be easily identified. Ecologically significant areas could be a wet land, grass land, patch of forest, farm lands, etc. Local tribal communities have rich perceptions on ecologically important areas within a landscape and they know from their experiences about

how a landscape becomes degraded and they also have the solutions about how to restore the landscape from point of view of ecological services. In landscapes the resources are concentrated in pockets creating mosaic of resource rich and poor patches of different sizes, shapes, contiguity, structure and composition. Hence, studying their land and water management systems at a landscape level provides a range of situations, problems, opportunities and innovated technologies to be studied comprehensively.

In the contemporary context the land and water management has become a prime concern towards restoring the natural resources and sustaining the primary production systems. General assessment of current status of land and water in tribal areas of Odisha indicate that there have been massive degradation in such natural resources that calls for critical interventions in a holistic approach. Interventions may range from bio-physical interventions for eco-restoration to interventions in livelihoods, social and cultural practices, and involving traditional technologies. In this context, the experience based indigenous or traditional knowledge of the tribal communities happen to be very instrumental.

In this context, the present study has attempted to document the indigenous knowledge of certain tribal communities in Odisha on Land and Water management. The tribal communities studied include the Dongaria Kondh and Lanjia Saora communities in Rayagada district of South Odisha and the Koda community in the Araku valleys of Andhra Pradesh as a neighboring community in a cross-cultural context. All the three tribal communities have been designated as Primitive and Vulnerable Tribal Groups. The study has attempted to understand their land and water management practices, technologies, understanding and perceptions, site-specific interventions in a rain-fed agriculture subsistence setting in the mountainous regions. All the three communities covered under the study exhibit significant variations in terms of land use technology although topographically they have close affinities.

Traditionally, tribal people across regions and landscapes in Odisha have evolved sound methods for conservation of land, water and forests. But the over increasing pressure to grow more has condemned this traditional wisdom. However, such rich traditions and skills have not been able to prove their merit due to lack of proper documentation and scientific validation. However, one cannot but appreciate the high engineering skills and need based responsive innovations showcased by many tribal communities in Odisha to restore their

production base by conserving soil and water in a rainfed agriculture context. In this context, the scope of the present study examined -

- Suitability of technologies and knowledge systems in relation to terrain and topography
- The understanding of land and water conservation measures taken on different land use units
- The knowledge of moisture management with physical and bio-physical interventions
- Land use unit wise cropping as a means for better soil and water management
- Coping with micro-climatic changes
- Understanding on ecological functioning and resilience in a forest-agriculture system
- Studying the social control mechanisms in favour of the soil and water conservation

Objectives

- To document traditional technologies in land and water management, soil and moisture conservation techniques, various bio-physical interventions, and the thumb rules relating to their traditional technology
- To examine the relevance of soil and water conservation technology in farmland and beyond over a landscape in relation to the production patterns, fertility restoration, arrangement of crops for water management and drought proofing
- To document the coded/uncoded rule systems existing within the communities towards maintenance and management of various structures and procedures taken towards soil and water conservation
- To make a precise documentation of various implements and artefacts made of metals and wood/bamboo that are used in various procedures adopted for soil and water conservation as well as for agriculture

Coverage of the Study

The present study covered two PVTG communities; Lanjia Saora and Dongaria Kondh of Odisha and another PVTG community called the Koda in neighboring Andhra Pradesh. The communities have been selected in consultation with experts at SCSTRTI after a round of general observation on various PVTGs in Odisha and Andhra Pradesh. The selected communities for this study are well known for their innovative land use on the hill slopes that underlies vast body of traditional wisdom and indigenous knowledge regarding soil and

water management on hill slopes and valleys that sustain agricultural production, and that is resilient with reference to the local environment and the perceptions of local climate change.

Methodology

The study followed an exploratory design to understand the indigenous knowledge systems embedded in traditional practices relating to land and water conservation. A broader framework for the study was designed after initial field visits that were broken down to checklists in order to cover the different aspects and dimensions of the study.

Convenient sampling method was followed for selection of study villages. After pilot visits the study villages were finalized. To cover the Lanjia Saora community, the villages under Lanjia Saora Development Agency (LSDA), Puttasing were selected. For studying the Dongaria Kondh, villages under Dongaria Kondh Development Agency (DKDA), Chatikona were selected. For study on the Koda in Andhra Pradesh villages under Paderu Mandal (Block) under Paderu ITDA were selected.

The draft report was prepared following descriptive design with narrations, tables, sketches and photographs following a chapter scheme. The draft report was further developed through peer review process by a panel suggested by SCSTRTI. Basing on the observations of the peer review the final report has been prepared.

Organization of Chapters

The report has been organized under six chapters including the introduction and the last chapter findings and conclusion. The introduction as Chapter -1 has been elaborate and covering contextual sub-heads like Historical policy perspective of Land and Water Management in India, landuse management policy formulation through various planning period, land and water management problem in India, land and water management in rainfed areas, ancient wisdom on land and water, traditional technology of water harvesting, land and water management in cultivation practice by tribals of Odisha, ecological importance of a landscape from land and water management point of view, relevance of local knowledge in context, understanding land use, ownership, and control, appropriate technologies in local context, universalization of local knowledge – THAS in context. The introduction covers by length and breadth a detailed contextual relevance of studying the indigenous knowledge of land and water conservation by tribes of Odisha.

The chapter - 2 presents conceptual framework and methodology for the study with an exhaustive review of literature. The relevant literature in the line of the study provided conceptual clarity on understanding indigenous knowledge and its applicability, dynamics of indigenous knowledge systems in the current scenario, indigenous knowledge and development, importance of local language, indigenous knowledge and tenurial security in the context of land and water conservation, initiatives taken by government to address land and water conservation in tribal areas, indigenous knowledge on land and water management in the context of Tribal Heritage Agriculture System (THAS), landuse and traditional agriculture in climate change context, etc. The secondary resources have been sourced from books, journals, reports and websites. It has been attempted to limit the review of literature within the purview of the objectives of the study.

The **Chapter-3** of the report has provided a detailed account of the area, people and their culture covered under the study. The chapter has provided brief descriptions on the society and culture of the three communities taken for study; such as Dongaria Kondh of Niyamgiri Hills, Lanjia Saora of Puttasingi hills and the Koda of the Araku valleys. It has been attempted to present briefly about the communities for a general understanding.

The **Chapter-4** details the perception and knowledge of the communities on denomination and classification of land and water resources in respective cultures. The land and water resources are considered cultural resources in cultures of all the tribes studied. The chapter presents the tribes' religious notions associated with land and water, rationale behind denomination and land use of landuse units, classification of soil in terms of their physical attributes and land use, institutional land governance and ownership pattern, etc in respect of the tribes. The understanding of terrain, the suitable land use in different zones of the terrain, the soil type existing in different zones provide good understanding of the ethno-ecological perception of the tribes. These perceptions led practices has within it embedded a vast body of indigenous knowledge of the communities on land and water, interaction of the resources in determining agricultural land use and accordingly guide the interaction of the communities with land and water resources. It is realized that an understanding of ethno-ecological perception opens up the arena of further understanding on land and water resources and their management in local context.

The **Chapter -5** details land and water conservation measures adopted and taken up by tribes specific to land use zones and the terrain. A range of such interventions specific to land type, slope, runoff velocity and quantity, extent of vegetation cover have been observed and documented in the chapter. The interventions have been grouped under upland interventions, interventions on the mid-ridges, and terraces. A detailed account of land and water management in shifting cultivation or swiddening practice has been provided which implicitly present the importance of vegetation in soil conservation. The detailed account brings into view the different situations under shifting cultivation practice and the practices undertaken by the tribes for land and water conservation. Fallow management provides the most important key to land management in a shifting cultivation context, is what the report has vividly presented. The importance of mixed cropping, intercropping, tuber crops, other crops, weeds, erosion controlling endemic vegetation, tools and implements have been particularly highlighted in land management context. The water management by Lanjia Saora, as a special case, has also been well covered in the chapter.

The **Chapter- 6** has been devoted to discussion on the data presented in the report and has comprehended the key findings from the study. It follows a glossary of cultural core terms used in the report. The photographs and bibliography follows have been placed as the last two sections of the report.

KEY FINDINGS OF THE STUDY

- Very inadequate work has been done on indigenous knowledge of land and water management in the context of Tribals in Odisha. At a time when the indigenous knowledge of local communities as potential for better natural resource management has got global relevance and so appreciations this study on indigenous knowledge on land and water resources in rainfed tribal areas bears paramount significance. Earlier workers, however, have tried to probe into this arena into bits and pieces, or as part of a larger objective, the literatures in this regard are very sparse and sporadic. Ethnographical accounts on the tribes of Odisha implicitly provide some hints and clues for studies in this direction.
- Land and water are cultural resources for the tribal communities. In the management aspects of land and water resources an overtone of culture is

reflected in case of each PVTG covered under the study. In certain cultures like that of Dongaria Kondh the land and water management is overtly attuned to culture whie in the case of Lanjia Saora and Koda it is relatively covert.

- The understanding of terrain, the suitable land use in different zones of the terrain, the soil type existing in different zones provide good understanding of the ethno-ecological perception of the tribes. These perceptions led practices has within it embedded a vast body of indigenous knowledge of the communities on land and water, interaction of the resources in determining agricultural land use and accordingly guide the interaction of the communities with land and water resources. It is realized that an understanding of ethno-ecological perception opens up the arena of further understanding on land and water resources and their management in local context.
- The facts presented in the report provide factual information and build the evidence in favour of the Dongaria Kondh community as having appreciable ethno-ecological knowledge on land and water resources and their interactions especially in a land based livelihoods context. The perceptions of Lanjia Saora community are also immense but the terrain and land use pattern of of Lanjia Saora community is less diverse in comparison with the Dongaria Kondh. However, the Lanjia Saora community is master-of-art in terrace cultivation and hence their knowledge has the potential to guide the management of land and water resources elsewhere on terrace agriculture systems. In the context of Koda community of Andhra Pradesh, the ethno-ecological perceptions are relatively less or it may appear so because not much of justice has been made in terms of dedicated time for study on the tribe.
- The Dongaria Kondh indigenous knowledge on understanding of land and water in their domain is very diverse compared to the other two tribes studied here. This may be accounted for their varieties of land use practices which are slope and terrain specific. Conscious efforts for managing cover

crops on upper slopes, restoring nutrient supply to the foothill plains, religious attributes warranting preservation of natural vegetation on hill tops are some of indicative practices for *in situ* conservation of land and water. The balance between natural vegetation on hill tops, the cover crops of horticultural species on the upper mid-ridges, shifting cultivation on mid-ridges and seasonal crops on foothills and valleys is so well managed as a practice that implicitly they contribute to effective management of land and water resources.

- The Lanjia Saora community may be considered one step lower to Dongaria Kondhs in respect of their knowledge on land and water management, for the latter has a major component of horticultural land use which the former is lacking. But, however, this does not, by any means, make the Lanjia Saora any less in terms of having the indigenous knowledge for land and water management. The Lanjia Saora depicts repositories of indigenous knowledge in terracing. The indigenous but ingenious engineering skill showcased by Lanjia Saora in terrace agriculture showcase their understanding on slope, soil, runoff and land use and the interaction of all in a subsistence based agriculture context. Such knowledge systems are no less scientific in comparison to modern knowledge systems and hence such knowledge systems qualify to be mainstreamed or practiced through a blending with modern knowledge systems.
- The Dongaria Kondhs and the Lanjia Saora have experience based knowledge in appropriating specific interventions at specific locations and slope conditions which are technically parallel to the sophisticated knowledge in soil and water engineering. They understand slopes typically in their own way, e.g. knee-chin slope i.e. very steep slope while walking on which the knee and chin come closer. The distance between knee and chin while walking on a slope gives an idea of the degree of slope. Accordingly they make idea for appropriate intervention for soil and water conservation structures applying thumb rules. Like the Lanjia Saora describe, the elevation of a bund between a downstream terrace and upstream terrace depends upon the soil depth, presence of bed rocks, etc. hence, each intervention

they undertake is very site specific and no generalization would be possible. For each intervention on each site their traditional knowledge and age old experience shows the way.

- Stone bunds, loose boulder checks, vegetation strips and contour terraces are said to be appropriate interventions on high slopes with justifiable technical logic. On the mid-hill region appropriate interventions count Contour Trench (CT), Continuous Contour Trench (CCT), Staggered Contour Trench (SCT), Contour Bund (CB), Bench Terraces (BT), Narrow Base Terraces (NBT), Broad Base Terraces (BBT), soil traps and barriers at horizontal rows, at regular intervals, soil trap drop structures, etc are feasible interventions which all the tribes are acquainted with. The drainage line treatment with Loose Boulder Check Dams (LBCD), Brush Wood Checks is most common.
- Enormous indigenous knowledge is embedded in the practice of shifting cultivation or swiddening. The three tribes studied here are at three different levels of practicing shifting cultivation. While the Dongaria Kondh practice of shifting cultivation is relatively less intensive, the practice of Koda is both extensive and intensive. The Lanjia Saora community has sort of abandoned shifting cultivation and has raised tree crops like cashew and mango. In the multiple cropping system, the variety of crops cultivated in swiddens is large compared to the Koda and Lanjia Saora. Further, the Dongaria Kondh have a very good knowledge of spacing of crops in unit area considering the root structure of crops, tubers, tree crops so as to maximize the production of different crops in unit area in a scientific manner. As long as the multiple cropping system continues to be there, the Dongaria Kondhs would be using such knowledge systems to multiply benefits from unit area of land. Dealing with a diversity of crops has made the Dongarias innovative which is scientific in their own accord. As such each tribe have typical experience and knowledge of managing the land and water resources at different stages of shifting cultivation which is by and large appreciable. The Dongaria Kondhs perceive that are of opinion that the rapidly declining resource of soil fertility is efficiently and effectively utilized by mixed cropping over time and space. Hence it is an advantage from perspective of land resource management

- The Dongaria Kondhs have probably the best understanding and explanations as regards to fallow land management. In villages where the land to man ratio in shifting cultivation is better, there the old traditions of fallowing the lands in consideration to vegetation can be better observed. A visual comparison of the regeneration in one-year cultivated, two-years cultivated, three-years, cultivated swiddens would suffice to such a perception regarding fallow management of Dongaria Kondhs. According to them an ideal fallow period should be conceived on the basis of observation on regeneration of plants and biomass increase in the fallowed swiddens.
- The tribes identify certain endemic species as erosion controlling vegetation. Knowledge of this is incredible about the Lanjia Saora although not less appreciable about the Dongaria Kondh and the Koda. This knowledge is of paramount importance from point of view of stabilizing the land and water conservation structures at various sites and locations. While the Dongaria Kondhs care banana, citrus, cashew, mango, pine apple, cinnamon, elaichi, pomegranate, turmeric, castor and lantana weeds as efficient soil binders on slopes; the Lanjia Saora care for date palm, cashew, ficus, mango, Indian privet, banana, bamboo, broom grass, sisal, grass as soil binders and as bund stabilizing agents. The Koda community care for sisal, vetiver, cashew, palm, mango, eucalyptus, silver oak, broom grass, lemon grass for purpose of arresting soil erosion. However, a close look at the plant species cared by the three communities provide to understand that while the Dongaria Kondhs have integrated crops and weeds for arresting soil erosion, the Koda is more used to the plantation species especially the exotic varieties for the same purpose. The Lanjia Saora community has well integrated the endemic vegetation and the plantation species for effectively preventing soil erosion. All the tribes, however, have reasonable agreement that the weeds are not bad, they are important from ecological point of view generally.
- A comparison that can be drawn between the three tribes in terms of farming systems approach which implicitly talk about the land and water management systems by them also puts the Dongaria Kondh at top of the

ladder. The Dongaria Kondh have integrated agriculture (on slopes and plains), horticulture (vegetables, fruits and tree crops), animal husbandry, forestry in their farming system approach, whereas the Lanjia Saora have agriculture (terraces and plains), horticulture (tree crops), animal husbandry and apparently no forestry in their farming system approach. The Koda have only shifting cultivation and forestry to sustain their livelihoods. What is emerging out of this is that the land based production systems of Dongaria Kondh is more stable compared with that of the other two tribes.

- The study has thrown light on the importance of indigenous tools and implements in the context of land and water management. It appears convincing to note that there has been least farm mechanization in the study areas and the tribal farmers have been using their indigenous farming crafts till date, which by default is preventing the soil erosion. Summer ploughing using the traditional bullock or buffalo driven ploughs is a very scientific practice the tribes do to retain moisture in soil by arresting each drop of rain in the summer.
- The Lanjia Saora community outshines the others in the area of water management. In their traditional norms the water management is considered a community responsibility. Their socio-political system about water governance was very organized, although, however, such management systems have become weak in the contemporary scenario though. They exhibit ingenious skill, expertise and understanding on water management which is exemplary and important learning.
- The Tribal Heritage Agriculture System (THAS) is gaining global recognition and relevance in the current scenario. The system of agriculture adopted and practiced by Dongaria Kondh and Lanjia Saora have justifiable merits for consideration under THAS. Further research in this direction would be a welcome step to add to the hypotheses and realization that THAS is more stable in a natural resources management context especially in the management of land and water resources. The management paradigms are inbuilt or ingrained in their work traditions and prevailing practices.

- The data presented in the report showcases multitudinal strategies adopted by the tribal communities over years for conservation and effective utilization of land and water resources to secure their livelihoods. In an exploratory study, the scientific aspects of their management practices can be better studied through participatory observations on practices than by using any other structured instruments. Each aspect opens up a new arena for in-depth study in future. Indigenous knowledge related to their land and water conservation is an embedded knowledge embodied in their socio-cultural interactions with such resources, community level ideals on governance of resources and above all in their work traditions in agriculture and livelihoods pursuits.

Limitations of the study

- The study could not cover all the seasons in a year. Field work with the communities through seasons and agricultural calendar of the communities could have generated more empirical information in the context of the study.
- Language barrier and the typical problems in articulation by the informants had its own limitations on the study
- The study could not generate adequate information to indicate the cross-cultural variation in understanding and perception among the three tribal communities studied.
- The study has limitations in consolidating the traditional norms and institutional procedures applicable in the specific context of land and water resource management because of wider variations across villages of the same community.
- Yield analysis: It was suggested by the experts at SCSTRTI during the first draft presentation to provide some input-output analysis in terms of yield from unit area of land under controlled condition of soil and water management and under general conditions. However, such yield analysis was found difficult within the scope of time and methodology of the study.

Chapter -1

INTRODUCTION

Historical policy perspective of Land and Water Management in India

Efficient and sustainable use of natural resources is *sine qua non* for economic development, especially in the resource poor countries. More so in the agriculturally dominant economies like India more than 50 percent of the cropped area is dependent on rainfall without any alternative irrigation facilities. Rain fed regions, which account for more than 50% of cultivable land and 40% of population, house a large share of the poor, food insecure and vulnerable populations in the country. The tribal population and more specially, the Primitive and Vulnerable Tribal Groups (PVTGs) have become more vulnerable in this context. As productivity growth in the more favoured green revolution areas is already showing signs of slowing down or stagnation (Pingali and Rosegrant, 2001), future growth in agricultural production and food security is likely to depend on improving the productivity in the semi-arid and arid rain fed areas (Reddy, *et. al*. 2010:1).

While the policy bias, resulting in intensive agricultural practices, has paid off in terms of meeting the country's food demand in the short run, it proved to be unsustainable economically as well as environmentally in the long run. This, coupled with the limited scope for expanding irrigation has prompted the policy shift towards rain fed agriculture. Though recent policies failed to address the problems of irrigated agriculture through improving the allocative efficiency of crucial inputs like water, concerted efforts are being made towards improving the conditions of rain fed farming. For, development of these regions, in terms of enhancing the crop yields, holds the key for future food security. Besides, these regions are increasingly being confronted with environmental problems such as soil erosion.

The tribal areas constitute major chunk of the rain fed areas. The tribal communities are not much used to improved agricultural practices and hence, by and large, they have remained confined to their traditional agricultural and livelihoods practices for their imminent survival. The traditional agricultural practices of the tribal communities are scientific in their own accord and technically viable in their land use context. Their agriculture is rain fed, knowledge and skills acquired through years of interacting with their land use practices, less

input intensive, land use decisions based on understanding local environment and shared perceptions, efficient land and water management technology, and the overall production system is sustainable in many respects. Their knowledge systems have not been mainstreamed for scientific validation and qualification. However, on the other hand, the intensity of resource degradation is reaching irreversible levels in some of the tribal regions calling for promotion of appropriate technologies and development strategies to result in multiple benefits such as (i) ensuring food security, (ii) enhancing the viability of farming, and (iii) restoring the ecological balance. In fact, about 15% of India's 329 million hectares of geographical area is already degraded (Reddy, 2000). While efforts are on to restore the degraded resource base elsewhere, a pertinent question arises that in this quest for appropriate technologies shouldn't the traditional knowledge of the communities in the rain fed areas be given due priority on its merit? Should we not consider incorporating the age old indigenous knowledge of the tribal communities in bridging the gap between degraded resource base and the prescribed technological solutions? The indigenous knowledge systems, undoubtedly, matter in this context and scenario. The relevance of indigenous knowledge in a wider context and in the context of food security, viability of farming and restoring natural resources remains to be justified through proper documentation, dissemination and authentic interpretation as appropriate knowledge systems. The local communities in a rain fed region have good knowledge of conserving and improving moisture *in-situ,* checking soil erosion and improvement of ground water resources, management of rainfall catchment area by building contour bunds, check dams, field bunds and bio-physical interventions. Their knowledge on wider natural environment, production conditions and resilience in coping and management strategies may be suitably employed in curbing the resource degradation.

In India, 60 per cent (apart from forest) of the land is the source for the livelihood through agriculture and related activities. Population growth and the consequent demand for land, water and biological resources has put tremendous pressure on land. The World Bank (2006) says that at present, land use practices in many developing countries are resulting in land, water, and forest degradation, with significant repercussions for the countries' agriculture sectors, natural resource bases, and eco environmental balances. Ministry of Agriculture estimated that about 174 million hectares of land (53%) suffers from different type and varying degrees of degradation. About 800 hectares of arable land are lost annually due to ingress of ravines. And also, it is estimated that more than 5000 million tonnes of topsoil are

eroded every year. All this has a direct bearing on food production and the livelihood of the people. (Umesh Babu & Nautiyal, 2013).

In India, several policies and programs have been formulated and implemented over the years emphasizing upon the conservation and productive use of land and water resources. During 1972-73, the Drought Prone Area Program (DPAP) was launched emphasizing upon minimizing adverse effects of droughts on the productivity of land, water and human resources. It also mandated to promote overall economic development and improve the socio-economic conditions of poor and disadvantaged sections inhabiting the program areas. During 1977-78, Desert Development Program (DDP) was initiated that addressed to mitigate adverse effects of desertification and adverse climatic conditions on crops, and human and livestock population, and towards that emphasized upon restoration of ecological balance by harnessing, conserving and developing natural resources, i.e. land, water, and vegetative cover, and raise land productivity. In the year 1985, the National Land Use and Conservation Board (NLCB) was constituted to formulate a national policy and perspective plan for conservation, management and development of land resources of the country; review of the progress of implementation of ongoing schemes and programs connected with conservation and development of land resources and soils; and to take measures to restrict the conversion of good agricultural land to non– agricultural uses. In the year 1988, National Land Use Policy (NLP) was formulated to install an efficient and effective administrative structure for prescribing and regulating land by all concerned and revitalize the land-use boards in this respect; prevent further deterioration of land resources; restore the productivity of degraded lands; allocate land for different uses based upon land capability, land productivity, and national production goals; and complete the inventory of land resources based on prescribed land-use. During 1989-90, Integrated Wastelands Development Project (IWDP) was commissioned emphasizing upon adopting soil and moisture conservation measures such as terracing, bunding, trenching, vegetative barriers, etc.; encourage natural regeneration; enhance people's participation in wasteland development programs at all stages resulting in equitable sharing of benefits. Since 1995-96, watershed development based approaches have been adopted.

The 73rd and 74th Amendment Acts (1992) of the Constitution brought the land use, conservation, management and related issues under the purview of local bodies in both

rural and urban areas. The initiatives taken by other ministries also had a bearing on the prevention of degradation of lands.

The National Rainfed Area Authority (NRAA) was established in 2006 to give focused attention to Rainfed areas of the country. This advisory body formulated some common guidelines for the Watershed Development Project and is in consultation with all the States for its implementation

Land use and management policy formulation through planning period

Table-1

Plan period	Major issue	Policy thrust
First Plan 1951 - 56	Area under cultivation to be increased. Community development (CD) networks to take care of the village commons.	Land reforms to bring in the fallow under cultivation and increase land use efficiency. Tenant to be given the rights to cultivate land.
Second Plan 1956 - 61	Concern about vast rainfed agriculture, low land productivity and thrust on irrigated agriculture.	Soil conservation as an important program. Irrigation development for the rainfed areas. Training and extension work for the technology through CD.
Third Plan 1961 - 66	Food security concern dominated. Cultivable waste land to be brought under cultivation.	Area development as an approach. Intensive area development program adopted for selected districts. An integrated land policy approach was inherent. Soil surveys were taken up.
Fourth Plan 1969 - 74	Emphasis on food security continued as minimum dietary requirements to be met. Incentives were created for diversion of land towards food crops and enhancing the capacity of such land.	Increased emphasis on irrigation and soil conservation in dry land regions and technological change introduced. Higher cropping intensity the main concern.

Fifth Plan 1974 - 79	Problems of degradation land management in irrigated command areas surfaced. Drought-prone areas attracted attention.	Drought-prone area development. Desert area development programs, and soil conservation started and further enhanced. New impetus to dry farming.
Sixth Plan 1980 - 85	Underutilization of land resources. Drought-prone areas continued to attract attention. Attention lagging areas on the background of green revolution required cultivation.	Land and water management program under drought-prone area program in selected areas.
Seventh Plan 1985 - 90	Soil erosion and land degradation surfaced as major issues. Deforestation and degradation of forest lands.	Soil and water conservation and averting land degradation. Specific attention to degraded lands. Wastelands Development programs. Long-term view of land management.
Eighth Plan 1992 - 97	Dry land and rain fed areas requiring attention. Degradation of land in irrigated command areas. Peoples' participation surfaced as major issue in land management at village level.	Emphasis on watershed approach. Soil conservation merged with watershed programs. Agro-climatic regional planning approach incorporated.
Ninth Plan 1997 - 2002	Land degradation increased significantly. Integrating Watershed Development Program across various components.	Bringing the underutilized land under cultivation. Management of wastelands. Maintenance of village commons. Decentralized land management system. Panchayati Raj institutions to manage the village lands. Rethinking on land legislation.

Source: R.S. Deshpande, www.fao.org/docrep/006/y5026e/y5026e0b.htm

Strategies for sustainable land management has been laying pronounced priorities on addressing weaknesses in land use policies as well as options that are available to deal with natural resource management and conservation issues. Establishing the horizontal linkages between various agencies that are involved in land resource management has become a very important objective in natural resources development programs. Implementing integrated land resources management programs and intensification of high-quality rain-fed lands are being considered as only viable options towards efficient management of land and its productivity.

Land and Water Management Problems in India

Land and water management comprises of two components soil conservation and water conservation. Both are regarded as important but soil conservation is of primary concern because in India, nearly 80 million hectare area is exposed to the threat of soil erosion, and 43 million hectares area is actually affected. In states like Madhya Pradesh, Rajasthan, Maharastra and Punjab, up to 15 percent of the total land suffers from soil erosion. It is reported that the annual loss of fertility by erosion is 20 times faster than, 10,000 hectares area is exposed to erosion. Nearly 147 million hectare area in India is in need of conservation measures.

Soil erosion causes undesirable change in physical characteristics of soils and damages plant and crops which directly cause less crop production in India. Data reveals that 130 million hectares of land, that is, 45% of total geographical surface area, is under erosion through gorge and gully, shifting cultivation, cultivated wastelands, sandy areas, deserts and water logging, severe landslides and floods, due to cutting of trees for firewood and timber; grazing by a large number of livestock over and above the carrying capacity of grasslands, traditional agricultural practices, construction of roads, indiscriminate quarrying and other activities. Excessive soil erosion, high rate of sedimentation in the reservoirs and decreasing soil fertility has become major environmental problems with disastrous economic consequences in India.

Soil erosion depends on physiographic conditions and geological formations. Northern and central zones have almost identical patterns in the soil degrading and bio-degrading forces. Eastern zone suffers from shifting cultivation and excessive rainfall. Western zone suffers due to aridity. Southern zone suffers from general problems related to aridity, low productivity and shallow soil depth.

Types of soil erosion in India

Various types of soil erosion in India is caused by natural factors, like wind and water which are main driving force and artificial factors like deforestation, mining, etc. soil erosion is a process of detachment and transportation of soil by natural agencies of water and wind.

Factors influencing soil erosion

Rainfall: Erosion is dependent on the amount, duration, intensity and frequency of rainfall. Short time period rainfall with high intensity cause more erosion.

Slope: Erosion increases with slope

Vegetation cover: Vegetative cover protects the soil from impact of and dispersing action of raindrops and act as a mechanical obstruction to flowing water structure, in addition to absorption and reduction of surface run-off.

Tillage: infiltration and permeability of soil is improved by the practice of proper tillage but excessive tillage expose soil to wind erosion.

Nature of the soil: Erodability of the soil depends on nature of the soil, particularly its texture, structure, organic matter, amounts and combination of salts present, presence of hard pan in the soil and presence of high water table.

Soil moisture: high water table means low infiltration and permeability, resulting in more surface run off, and more erosion, but on other part deficit rainfall cause loosening of soil enhancing rate of erosion by wind.

Wind velocity: Greater erosive potential, is due to strong wind with high velocity.

Causes of soil erosion

Main causes of soil erosion are directly related to improper land use, deforestation, faulty cultivation methods, shifting cultivation, overgrazing, diversion in natural drainage channels by railway embankments and roads, infrastructure development, over exploitation of land, more use of fertilizers, lack of proper surface drainage, denuding forest fires.

Effects of soil erosion

Loss of top soil which is most important for crop production, harmful effects of erosion on organic matter and soil structure, decline in soil capacity, increase in salinity and alkalinity of soil, siltation and sedimentation in dams and water storage reservoirs, deposition of sand and gravel on agricultural lands, flooding of streams.

Land and Water management in Rain fed areas

According to a report of National Rainfed Area Authority (NRAA, 2012), Rainfed areas currently constitute 55 per cent of the net sown area of the country and are home to two-thirds of livestock and 40 per cent of human population. Even after realizing the full irrigation potential, about 50 per cent of the cultivated area will remain rainfed. The business as usual approach of taking major interventions uniformly across all the regions of the country has not paid much dividend. Therefore, regionally differentiated interventions befitting natural resource endowment, social capital, infrastructure and economic conditions are need of the hour to meet the local challenges and enhance livelihoods. Earlier efforts of characterization of rainfed areas mainly focused on a few bio-physical indicators without giving importance to socio-economic aspects related to livelihoods issues.

The report presents characteristic contrasts among the various rainfed agriculture regions in India. Rainfed areas in India are highly diverse, ranging from resource rich areas with good agricultural potential to resource-constrained areas with much more restricted potential. Some resource rich areas (normally under temperate climate) are highly productive and already have experienced widespread adoption of modern technology. On the other hand traditional farming systems in drier and less favored areas is more of a survival mechanism rather than a growth oriented activity. Earlier, the rainfed farming systems, because of its risky nature was dependent upon locally available inputs (seeds, manures, animal draft) and used to grow a number of crops, which were able to withstand drought-like situation.

The study provides that Planning Commission has identified 15 agro-climatic regions in the country. Under the classification Odisha is categorized under Eastern Plateau and Hills, and East Coast Plains and Hills. National Bureau of Soil Survey and Land Use Planning (NBSS & LUP), Nagpur has, on the basis of rainfall, climate and soils, divided Odisha into 10 agro-climate zones.

The ecological health of rain fed agriculture regions is by and large dependent on the status of the surrounding watershed areas, especially in mountainous regions. Watershed degradation threatens the livelihood of millions of people and constraints the ability to develop a healthy agricultural and natural resource base. Management of watershed entails the rational utilisation of land and water resources for optimum production but with minimum hazard to natural and human resources. The main objectives of watershed

management are to protect the natural resources such as soil, water and vegetation from degradation. In the broader sense, it is an undertaking to maintain the equilibrium between elements of natural ecosystem of vegetation, land or water on the one hand and man's activities on the other hand. The Ministry of Rural Development, Government of India, has recently created a Department of Land Resources to act as a nodal department in the field of watershed management and development. This has the mandate of developing the valuable land resources of India, which are presently under various stages of degradation and it also endeavors to prevent further degradation of these resources through appropriate management and necessary measures. The real issue is management that includes dynamic conservation, sustainable development and equitable access to the benefits of intervention.

Many parts of India that are characterized by rain fed agriculture and mixed farming systems have been facing decreased returns from agriculture. Ecologically, rain fed areas is the most fragile even though they sustain substantial populations. In these areas, where as much as 70% of the population depends on agriculture for their livelihoods, the sustenance of rain fed agriculture assumes critical importance. The key to the sustainability of agriculture lies in reviving the linkages among components of the natural resource base in the area, revitalizing ecosystem services, adopting an integrated farming systems approach and managing the commons in a way so that resources reinforce resources.

No significant improvement can be expected without the people being brought to centre-stage. It is well realized now that unless local people are brought to the centre stage of management and their traditional adaptation and indigenous knowledge are duly respected the problem of land and water management in rain fed agriculture regions would remain to be there. Indigenous knowledge refers to how indigenous people use their knowledge for their relationship with local environment. It is a pluralistic approach to conserve and manage the resources of a particular region. Local indigenous knowledge includes experiences on fundamental understanding of processes of ecological change, slope dynamics and biological conservation and hence assumes importance in the context of land and water management. Improvement from one generation to another generation takes place in the traditional practices considering previous experiences (good or bad). Indigenous management of land and water resources is considered to have built-in eco-friendly system of conservation, preservation and utilization of natural resources. Time has come when the need has been well expressed to make a critical appraisal of the traditional knowledge system and how the

modern technological advances can be blended for better scientific management of water in traditional agriculture of a region. It is a fact that both indigenous and scientific knowledge are always imperfect; therefore using one does not necessarily reject other. It needs mutual respect and involves an interactive learning process.

Ancient Wisdom on Land and Water

Kautilya's *Arthasastra* is replete with ancient values on land and water in India. It is a treatise on government and economics in ancient India. There is enough evidence in the book to indicate that the people knew about rainfall regimes, soil types and appropriate irrigation techniques in specific micro-ecological contexts. The *Arthasastra* divides the country between the Himalaya and the ocean into various kinds of regions – forest region *(aranya),* village areas *(gramya),* mountainous areas *(parvata),* wet or humid areas *(audaka),* dry lands *(bhauma),* plains *(sama),* and uneven lands *(visawa).*

Classification of land level

Cultivated areas not dependent on rainfall or water, called *adevamatrika,* were valued more than areas dependent on rain. Rainfed agricultural areas which received 16 *drona* of annual rainfall were called *jangala* (dry) and those with 24 *drona* of rainfall called *anupa* (wet). A further grading of cultivable lands was made from the point of view of their suitability to different crops and their humidity and water content – *sthala* (dry lands), *kedara* (marshy lands), *sanda* (vegetable gardens), and *vata* (flower gardens and fruit orchards). *Anupa* means booth a wet field and an area with heavy rainfall. Another kind of division was made between *sthala* and *audaka* (land abounding in water). A small tract of *audaka* land was thought better than large *sthala* land because of the certainty of the produce. *Audaka* land, therefore, seems to have been the same as *adevamatrika* land. *Sthala* was suitable for crops that needed a small amount of rainfall for ripening and if the proper crop was sown, it could yield a large harvest. *Kedara,* however, did not mean only land which got abundant rain, it probably meant a tract that could get sufficient water through irrigation, for *kedara* is mentioned in the list of revenue items classified under the head *setu* (irrigation work). *Auduka, anupa* or *kedara* lands were suitable for grains *(dhanya).* Probably it was in these lands that crops like Sali *and* orihi *were grown.* (Kangle, 1963 cf. Agarwal & Narain, 1999:15). One of the primary ways of making land valuable for agriculture, according to *Arthasastra,* was to make proper arrangements for irrigation. Land provided with irrigation facilities was,

therefore, prized more than rainfed land. The construction of embankments to collect rainwater was a popular irrigation device. Both natural resources like rivers, springs and lakes, and human made systems like tanks, reservoirs and wells were tapped for irrigation. It was considered necessary to build irrigation works both in waterless regions *(anudaka)* as well as those blessed with a good supply of water *(sahodaka).* In waterless regions government superintendents were asked to construct wells and waterworks. The *anudaka* areas may be identified with *sthala* lands, which, according to the contemporary, *Naya-Candrika,* had no flowing river and received sparse rainfall. Kautilya was well aware that in such areas the most practical means of getting water supply was to dig wells with underground springs as their feeders. It is believed that the expression *anudake kupasetubandhasthan sthapayet* indicates that wells are the mainstay of irrigation in *anudaka* areas.

A clear reference to canal irrigation is to be found in a passage which refers to water set into motion by digging *(khatapravartim)* from river dam *(nandinibandhayatana).* Channels for diverting water from a reservoir or river were also dug and were perhaps known as *adhara parivaha* or *udakamarga*. There were both state and private irrigation works. The state rendered help for the construction of irrigation works initiated and managed by the inhabitants of a newly settled village. Some usufructory rights continued to be vested on the King on account of the help given. A water cess *(udakabhagam)* over and above normal land revenue was levied by the state on all users of irrigation facilities. Even those using their own water works had to pay. Temporary exemptions were granted for constructing a new irrigation work or improving an existing one. Private owners used to give water to farmers from their tanks and wells against payment of a part of the produce. However, keeping a private water work in disuse led to a lapse of ownership to the state.

The *Arthasastra* states that those who cultivate land irrigated by manual labour shall pay one-fifth of the produce as water rates; by water carried on the shoulders, one-fourth of the produce; by water lifts, one-third; and by water raised from rivers, lakes, tanks and wells, one-third or one-fourth. *(ibid:15)*

Traditional Technology of water harvesting

Depending on the resources available to them, Indians, over centuries developed a range of techniques to harvest every possible form of water – from rain water to ground water, stream to river water, and flood water. Wherever there were streams, especially in the hill

and mountain regions of India, people develop techniques to divert its water, with the help of simple engineering structures, into artificial channels that would take the water directly to the agricultural fields. When streams became bigger and turn into rivers, engineering also became more sophisticated and diversion systems became bigger and larger.

In areas with a good ground water aquifer, Indians harvested rain water with the help of dug-wells and developed various technologies using local materials to lift the water to irrigate the fields. Wells were an important source of irrigation in the ground water-rich region of the Indo Gangetic plains, for instance. But people learnt to harvest ground water in other ingenious ways too, especially where water in general, and ground water in particular, was scarce. In the hills and mountains of the Eastern Ghats, people learnt the middle eastern technology of *qanats* to build subterranean structures, or rather horizontal wells called *surangams* to tap the water sipping down the hill sides for use as drinking water.

When no options were available, people learnt to rely on rain water for survival. For irrigation purposes they would build rain-fed tanks to provide irrigation water for a downstream command area ore for cultivating the tank bed itself. In the *haveli* system of Madhya Pradesh the soils and traditional crops were such that the farmers found it useful to store rainwater in the agricultural fields itself. In several places people would construct embankments to catch the monsoon run off from a catchment area so as to collect water in the bed of the storage structure itself. This would allow the collected water to sip down into the soil and give it enough moisture to take a good crop in the following dry period. Thus, people did whatever they could – and they did a bewildering variety of things – within the constraints that the local ecology imposed upon them.

In Odisha, there are references to Gonds as a Dravidian Tribe in their autochthonous country called Gondwana for their ingenious skills in water conservation and management (Chhotroy in Agarwal and Narain, 1999; 182, 183). The striking features of Gond settlements are that the land is well cultivated and the fields are carefully terraced and irrigated. The Gonds have classifications of irrigation structures (*katas, mundas, bandhs, chahal*) and also classification of lands on the basis of its topography (*aat,* the highland; *mal,* the slope land; *berna,* the medium land; and *bahal,* the low land). The Gonds have traditional norms of water and irrigation management and structures of institutional governance for land and water management that ensured production from all kinds of lands even under critical situations and adverse climatic conditions.

Land and water management in cultivation practice by tribals in Odisha

Tribal cultivators traditionally took recourse to numerous means of irrigation. In broken and undulating landscapes which are unsuitable for irrigation, the ingenuity of the tribal people could make irrigation possible to a limited scale. Embankments are constructed across the natural slopes of the land, and small streams are dammed and diverted to fill these crude reservoirs. Rice fields are laboriously constructed by terracing the land at suitable hollows; or the bed of the stream are banked and made into one long, narrow rice field.

In the mountainous areas, extensive canal systems are not practical because the main streams are below the level of the land to be irrigated. The only method of irrigation was to tap each tributary near its source, and make it serve the land below. Enormous energy and skills are used to carry out these works. Many structures are not even really storage reservoirs but acted practically as weirs which allowed water to percolate into the lower land, and keep it moist while the reservoir bed was sown with crops as soon as it became dry.

Land and water management: Ecological importance of a landscape

The tribal way of management of land and water can be best studied at a landscape consideration. At a landscape level, ecologically significant areas and their spatial linkages are possible to be easily identified. Ecologically significant areas could be a wet land, grass land, patch of forest, farm lands, etc. Local tribal communities have rich perceptions on ecologically important areas within a landscape and they know from their experiences about how a landscape becomes degraded and they also have the solutions about how to restore the landscape from point of view of ecological services. In landscapes the resources are concentrated in pockets creating mosaic of resource rich and poor patches of different sizes, shapes, contiguity, structure and composition. Hence, studying their land and water management systems at a landscape level provides a range of situations, problems, opportunities and innovated technologies to be studied comprehensively.

The tribal landscapes in and around Odisha offers affinities and variations in terms of land use practices, understanding of the ecosystem components and their interactions, in the

context of tribal livelihoods and culture. Most of the tribal communities in Odisha are regarded as forest dwelling communities in view of their choice of habitats and their means and modes of livelihoods earning. There are semi-nomadic tribal communities earning a livelihood out of hunting and gathering; there are tribal communities who have been practicing shifting cultivation on the hill slopes; there are tribal communities who have been identified with horticulture and fruit growing in practice; and also there are tribal communities who have integrated all these subsistence modes i.e. hunting and gathering, shifting cultivation, horticulture, fruits growing, settled agriculture. These modes of subsistence and such practices over the years, however, have made the tribal people experienced and knowledgeable about their landscape, the various primary production pursuits, ecological and environmental perceptions and thereby have enriched their domain of traditional wisdom. The tribal communities have also developed traditional technologies suitable for their subsistence based production systems through which they have understood the ecological interactions among land, water and forests. Their traditional management systems regarding the ecological resources and food production have been founded on the understanding of the interactions among land, water and forests. The traditional technologies employed in their natural resources management have been borne out of their rich experiences over the generations, and innovations are also there looking at the contexts and situations.

In the contemporary context the land and water management has become a prime concern towards restoring the natural resources and sustaining the primary production systems. General assessment of current status of land and water in tribal areas of Odisha indicate that there have been massive degradation in such natural resources that calls for critical interventions in a holistic approach. Interventions may range from bio-physical interventions for eco-restoration to interventions in livelihoods, social and cultural practices, and involving traditional technologies. In this context, the experience based indigenous or traditional knowledge of the tribal communities happen to be very instrumental.

Relevance of local knowledge in context

For any scientific analysis of the situation of land and water management in tribal areas of Odisha, local knowledge of the situation is a crucial input and is mostly sought with the same seriousness and expert advice. A thorough look at and critical observation of traditional and/or local practices in relation to natural resource management would substantially

contribute to the understanding of critical gaps in land and water management in tribal areas. In this connection the traditional ecological knowledge of the tribal communities would be of enormous importance. Although there have been univocal appreciation for local and traditional knowledge systems in integrated natural resources management, yet in absence of a precise documentation of the knowledge systems hinder integration of the traditional knowledge in sophisticated scientific management knowledge, especially in the context of land and water management in tribal areas.

Indigenous or traditional knowledge is invaluable in managing a changing and fragile landscape and it may also happen to be a tool to ascertain the direction and rate of changes. Especially for better comprehension and effective planning it is important to improve understanding of historical changes in the landscape during past 100-200 years. It is only the local people who can share the ethno-history of the area in respect of ecosystems and habitats, and relate the degradation of resources under grazing land, water sources, agricultural fields, etc and other common issues which in a historical time scale.

Understanding on land capability class from the perspective of tribal land use practices is an important aspect of studying the indigenous knowledge and technology of the tribal communities. Their perception of land quality, observations on soil and moisture regime, and experiences in yields and productivity are important variables and parameters to understand their land and land use classification. Land capability[1], or in other words, the capacity of the land to sustain a particular land use, and estimation of its productivity potential and specific management requirements is understood by the tribes in their own context. Traditionally, they have shaped a range of situations providing the possibility to make the land use succeed and to minimize the risk of land degradation between the extremes of very high and very low land capability class. The land cover[2] in a given landscape is an important consideration from point of view of land and water management.

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[1] *Land capability defines the physical attributes of land, which are relevant to a particular use and is usually described by a class number indicating the degree of physical limitations. Under the classification systems used in India, land is divided into 8 capability classes (i to viii).*

[2] *The land-cover is what exactly occupies a given geographical location, e.g. water body, grassland, agriculture, forest, etc. This is a technical category and what one can see from air or how a satellite sees it. These categories are not determined by administrative limits and ownership pattern. A land parcel under one form of ownership or official land use category may have more than one kind of land cover pattern on it (e.g a land classified in land use category as agriculture may have agriculture and tree cover). The actual and land cover pattern depends on seasons and rainfall pattern.*

Understanding land use, ownership and control

The land use (not land cover) implies the purpose for which a particular land unit, usually defined in ownership or administrative terms is used by human communities (e.g. used as pasture, farm, conservation reserve, playground, etc). Similarly a water body may be used as reservoir or strictly used for irrigation or used as conservation reserve for animals and birds. Essentially, a particular land cover type could be under different uses for various purposes and thus has different implications for planning and management. The census operations and the central statistical organization uses nine administrative categories of land use while reporting the land use data.

Table-2 Category wise extent of wasteland in Orissa (in sq km)

Category of wasteland	Extent sq km
Gullied and/or ravinous land (shallow)	600.62
Gullied and/or ravinous land (medium)	0.92
Gullied and/or ravinous land (deep)	8.01
Land with scrub	7544.91
Land without scrub	618.05
Waterlogged and marshy land (permanent)	239.72
Waterlogged and marshy land (seasonal)	208.26
Land affected by salinity/ alkalinity (strong)	0
Land affected by salinity/ alkalinity (moderate)	8.69
Land affected by salinity/ alkalinity (slight)	32.27
Shifting cultivation area (abandoned *jhum)*	541.03
Shifting cultivation area (current *jhum)*	636.26
Underutilized/ degraded notified forest land	5241.98
Underutilized/ degraded notified agricultural land	2335.09
Degraded pastures/ grazing land	0
Degraded land under plantation crop	137.31
Sands (Flood plain)	4.78
Sands (Levees)	0.03
Sands (Coastal sand)	92
Sands (Semi stab.- stab > 40m)	0
Sands (Semi stab.- stab Moder-High 15-40m)	0
Sands (Semi stab.- stab Moder-Low < 15m)	0
Sands (Closely spaced inter-dune area)	0
Mining wastelands	29.23
Industrial wastelands	1.83
Barren rocky/ stone waste/ sheet rock area	668.91
Steep sloping area	150.38
Snow covered and/or glacial area	0

The revenue department and the local authorities responsible for maintaining land records of each land units under the 'survey numbers'. The fact that a certain land parcel (with a certain survey number) is under a particular category (say, agriculture or forest) does not imply that in a given season there is agriculture or forest cover present on that land. Many of the village pastures (village commons, grazing land, etc) – a legal category that ensures that a certain portion of each village is available as common land – may have been

encroached upon and may not in real terms be available as common lands. The legal category under which a land unit falls, who the legal owner is and who effectively controls it are crucial to the design of interventions. Therefore, it is important to understand the land ownership pattern and hierarchies of control over the land in the context of land management. Some of the land will be under overlapping jurisdictions with regard to the management rights. Land under various local and legal denominations is also important subject to understand which categories of land is used, controlled, managed and owned by whom.

The major land-use categories in Odisha include: Forest Area, Area under Miscellaneous Trees & Groves, Permanent Pasture, Culturable Waste, Land Put to Non-Agricultural Use, Barren and Uncultivable Fallow, Current Fallow, Other Fallow and Net Sown Area. The State has experienced significant changes in land-use patterns over the last five decades. Although in the above categories the government wastelands are not included yet they are the areas where people have common access irrespective of whether they are brought under some kind of land use or not. These wastelands are often used meaningfully in local contexts and are important in the land and water management context. Leaving apart the other categories, the wastelands (in government denomination) occupies significant land area and significant percentage of it is under cultivation.

According to Wasteland Map 2003 of Orissa prepared by Orissa Remote Sensing Application Centre (www.dolr.nic.in/WatershedAtlas2005/orissa) out of the total geographical area of 1,55,707 sq km the total wasteland area is 18952.74 sq km that makes 12.17%. According to the Atlas there are 28 categories of wastelands. Wastelands are the most commonly known commons in village context. The wastelands occupy about 12% of the State's geographical area. The wastelands recorded by the government are known with different official and local names and each name depicts the location and characteristic features of the categories of wastelands. However, part of the wastelands is under government ownership and part of them is regarded as communal lands. These lands form important inextricable link with local agriculture through nutrient provisioning, moisture retention and in-situ conservation of water. The various categories of wastelands available in the state have been distinguished by location, soil type, land use, soil chemistry, land cover and such which play important ecological functions in conserving land and water regime over an area.

Table-3 Common lands in Odisha over years (in 000 ha.)

Year/ Land Type	Forest	Non agricultural uses	Barren & unculturable	Grazing land	Mis. Tree crops & groves	Culturable waste	Fallow	Current fallow
2002-03	5813	999	843	443	482	392	434	485
2003-04	5813	999	843	443	482	392	434	370
2004-05	5813	999	843	443	482	392	434	426
2005-06	5813	999	843	443	482	392	434	474
2006-07	5813	1298	840	494	342	375	229	526
2007-08	5813	1298	840	494	342	375	229	556
2008-09	5813	1298	840	494	342	375	229	576
2009-10	5814	1230	1076	518	218	487	573	859
2010-11	5814	1247	1032	513	220	520	567	877
2011-12	5814	1234	1063	508	200	536	622	997

Source: http://eands.dacnet.nic.in/

The common lands which happen to be important from land and water conservation in a rain fed agriculture context is showing some negative trends over different years in a time series. For example, the extent of culturable waste, fallow and current fallow categories which are otherwise cultivated is in increasing trend because of the problems in land and water management. The primary production in these lands fostered the subsistence requirement of many local ultra poor families.

Ecologically, the Commons play a vital role in ecological balance while providing important resources that sustain life – maintenance of hydrological cycle, conservation of bio diversity, serving as sinks for greenhouse gases. Some benefits are perceived locally, as in the availability of water supplies and nutrients to local agriculture while others, such as biodiversity benefits are perceived at a global level. In many parts of the country, Commons functions as 'buffer' zones catering to the natural resource needs of the community. This has insulated many reserve forests from pressures of acute use.

Appropriate technologies in local context

In subsistence based livelihoods setting the tribal people have showcased many eco-technologies that are very feasible in local context for land and water management. The availability and use of local materials, preference for labour based approaches are intrinsic to the local management practices. The local technologies have provided a sound cost-effective alternative to the conventional engineering solutions through the smart mix of traditional knowledge, modern science, technology and innovative use of local materials. There is a large basket of such eco-technologies and skills in the tribal areas in relation to landscape characteristics which also creates additional labour opportunities for stabilizing soil, installing lasting soil erosion control measures, etc. The local approaches, over the years, have not only minimized the use of conventional structural works but also have ensured resource management based on local skills, traditional knowledge and locally available materials.

Technical solutions required to solve problems will be increasingly location-specific and matched to the huge agro-ecological/climatic diversity. Detailed indigenous knowledge and greater skills in blending modern and traditional technologies to enhance productive efficiency will be more than ever before, key to the farming success and sectoral growth. Most technological solutions will have to be generated and adapted locally to make them compatible with socio-economic conditions of farming community

In this context, the present study has attempted to document the indigenous knowledge of certain tribal communities in Odisha on Land and Water management. The tribal communities studied include the Dongaria Kondh and Lanjia Saora communities in Rayagada district of South Odisha and the Koda community in the Araku valleys of Andhra Pradesh as a neighboring community in a cross-cultural context. All the three tribal communities have been designated as Primitive and Vulnerable Tribal Groups. The study has attempted to understand their land and water management practices, technologies, understanding and perceptions, site-specific interventions in a rain-fed agriculture subsistence setting in the mountainous regions. All the three communities covered under the study exhibit significant variations in terms of land use technology although topographically they have close affinities.

Universalization of Local Knowledge: THAS in context

Tribal Heritage Agricultural System (THAS) is a sort of evolving documentation process to recognize exclusive zones and traditional practices that approve of the merit to be called heritage agriculture. THAS is a concept that falls under the initiative towards GIAHS (Globally Important Agricultural Heritage Systems) that was started in the year 2002 by Food and Agriculture Organization (FAO) intended to create public awareness and safeguard world agricultural heritage sites. The objectives of GIAHS has been

- To understand and appreciate the nature friendly agricultural practices of local and tribal populations around the world.
- To document indigenous knowledge.
- To conserve and promote these knowledge at global scale to promote food security, sustainable development.
- Providing incentives for local population by measures like eco-labeling, eco-tourism.

Documentation and studies on GIAHs have become increasingly important in the present day context because of the following main reasons

- Globalization, increasing population pressure, environment degradation putting food production under stress.
- Loss of Biodiversity, loss of livelihood and economic returns for marginalized and poor-major impacts.
- To overcome all these, combat climate change, move towards MDGs, eradicate poverty this initiative was undertaken.

A criteria evaluation process has been set in for selection of GIAHS that by and large emphasize upon the provision of local food security; high levels of agricultural biodiversity and associated biological diversity; store of indigenous knowledge and; ingenuity of management systems. If a site has above characteristics, and is under threat of degradation, then GIHAs begins its projects.

In India two sites have been recognized as GIAHS while six sites have been assessed potential for GIAHS certification. Koraput in Odisha on the Eastern Ghats has the pride to have got the status and recognition as GIAHS for rice cultivation while the other is Pampoore region of Kashmir valley for saffron cultivation.

The Koraput region has been accorded GIAHS status because of its rich biodiversity, growing several varieties of paddy, millets, pulses, oilseeds, vegetables by ethnic communities including PTGs like Bondo, Didayi, Kondhs in a slash and burn or swidden agriculture system. However, such agriculture systems have been condemned as disastrous to environment because of the loss of forest cover, habitat loss, soil loss and soil degradation that are obvious with the practices. Disturbances in the bio-physical factors not only influence the production and yield but also negatively influence the ecological services for sustaining the multiple cropping systems. However, the demographic and socio-economic indicators especially the land holding are very poor for which the ethnic communities have little other options left for abandoning the old practices like swiddening for food production.

The current study on indigenous knowledge for management of land and water resources of the tribes in south Odisha and Andhra Pradesh draws relevance in the context of GIAHS which, presumably, could provide platform for universalization of the local knowledge systems in favour of traditional practices and traditional technologies. Although the traditional agriculture patterns of the Lanjia Saora in Odisha and tribes in the Paderu area of Andhra Pradesh have been in discussion in the wider context of THAS or GIAHS, the same about the Dongaria Kondhs in the Niyamgiri hills may also be brought into such discussions on merit. The present study may also throw some light in this direction.

Chapter -2

REVIEW OF LITERATURE, CONCEPTUAL FRAMEWORK AND METHODOLOGY

Understanding Indigenous Knowledge and its applicability

Indigenous knowledge means that something is originating locally and performed by a community or society in this specific place. It emerges as peoples' perceptions and experience in an environment at a given time and is a continuous process of observation and interpretation in relation to the locally-acknowledged everyday rationalities and transcendental powers (Seeland, 2000). Although 'indigenous knowledge' and 'traditional knowledge' are used as synonyms, yet they vary conceptually and contextually in certain respects. Knowledge is to be said indigenous, if it is bound to local experiences and takes its local world perhaps not as the only existing, but as the most relevant of all. In other words, indigenous knowledge is location and culture-specific knowledge. Local knowledge in this connection may be understood as knowledge that is unique to a given culture or society. Indigenous knowledge contrasts with the international knowledge system generated by universities and research institutions. Being influenced by global or western knowledge, one tends to forget that over the centuries human beings have been producing knowledge to live a balanced relationship with their natural and social environment in order to survive. Indigenous knowledge refers to a large body of accumulated knowledge with which the people are able to manage their natural resources in order to subsist on a long-term basis. Some other relevant definitions of indigenous knowledge are:

> … is a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Further, traditional ecological knowledge is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them indigenous or tribal (Grenier 1998).

> … the unique, traditional, local knowledge existing within and developed around the specific conditions of men and women indigenous to a particular geographic area (Johnson 1992).
>
> … a body of knowledge built by a group of people through generations living in close contact with nature. It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use (Studley 1998).
>
> … there is consensus amongst scientists using various terms that such knowledge: i) is linked to a specific place, culture or society; ii) is dynamic in nature; iii) belongs to groups of people who live in close contact with natural systems; and iv) contrasts with "modern" or "western formal scientific" knowledge." (Warren, 1991)

Indigenous knowledge systems got a face-lift when International policy regime on nature and biodiversity conservation considered it as an instrument to achieve sustainability in biodiversity and bio-resources conservation, utilization and management. A major impetus was given to an international understanding on Indigenous Knowledge through the conference on 'Building Bridges with Traditional Knowledge – International Summit Meeting on Issues Involving Indigenous Peoples, Conservation, Sustainable Development and Ethnoscience' that was held in Honolulu, Hawai'i in June 2001.

Misra and Basa (2007) have presented a framework for studying indigenous knowledge in contemporary societies with emphasis on their rationalization and utilization in the current development context. At the outset they hold that indigenous knowledge not only refers to the knowledge of indigenous people, but also to that of any other defined community. Quite often IK is local, but it needs not to be traditional as knowledge is always in the making. True tradition comprises proven ancient, original and distinctive customs, conventions and routine. Invented tradition means 'a set of practices, which seek to inculcate certain values and norms of behaviour by repetition, which automatically implies continuity with the past'. Indigenous knowledge is a mix of both which is hard to be segregated.

Indigenous knowledge is human life experience in this distinct natural and social compound, within this local and contemporary setting. In a traditional society the local context is taken as the universal frame in which knowledge matters. This context is constituted out of physical facts, social interactions among people in the surroundings they perceive as their

world and spiritual beliefs. Knowledge is to be called indigenous, if it is bound to local experiences and takes its local world perhaps not as the only one existing, but as the most relevant of all. Local knowledge, as we may call it, is an encompassing whole of what has been revealed to human perceptions in a particular place or region. There will always be local knowledge even if modern scientific knowledge invades a socio-cultural setting and challenges its local knowledge more or less effectively. Global knowledge, once it has settled down in local's minds and is disconnected from the international setting it refers to, becomes a local variety of what was once global knowledge. A local setting transforms outside knowledge in a continuous process of adaptation and appropriation.

After decades of extension activities, now there has evolved awareness that modern global expertise has always to cope with autochthonous knowledge that is deeply woven into the social fabric of a local and particularly rural community within a transitional developing society. The wisdom and experience of generations reflect the way of life of their ancestors before one's own generation and oneself took over. Indigenous knowledge is a matter of continuity, although one's surrounding may change at a slower or quicker pace. It is a matter of social and cultural evolution in the background of an ancestral tradition.

Indigenous knowledge cannot be displaced because it is autochthonous empirical experience and only valid as a world in its place of origin. Authenticity means to know things from personal experience in places where they originate and thus experiencing them in their proper context. What can be transferred is the *rationale*, how indigenous people deal with nature and cope with times of scarcity of resources and social competition to gain access to other means of livelihood. What else is comparable is the way of looking at natural, social and spiritual phenomenon in an ultimately inseparable way. The modality, how tribal forest dwellers perceive things live with them and use them is a mode of appropriation that they may share with many other tribal all over the world.

Dynamics of Indigenous Knowledge System

The dynamics of IK Systems thus takes place on two different levels and the empirical level. At the cognitive heritage of local people, IK has rarely been recorded or validated by the scientific method. Moreover, most of such knowledge has been localized and transmitted orally and typically has been uncodified. Its recording and validation may serve two purposes: (a) the pure scientific purpose of documenting and understanding the logic of the

human mind; and (b) the applied scientific purpose of recording, analyzing and incorporating of all knowledge in a scientific corpus with the aim of local development. The recording of Indigenous Knowledge as Indigenous Traditional Knowledge or Indigenous Knowledge System has its own difficulties. It is putting on record the facts or data without analysis.

The validation of IK is generally perceived as one by global Scientific Knowledge. Any IK can be cross culturally validated. It may also be considered scientific or global knowledge if it is disconnected from locale specific notions of Space and Time.

Importance of local Language

Language is very instrumental in studying Indigenous Knowledge. Indigenous knowledge lies hidden in the language and vocabulary of the common folks. The occupational groups use specific vocabulary that covers the concepts hidden in the art and science of the occupation. The same language may be used commonly, but the use by an expert or a person from specific occupation carries a different meaning and concept. The meaning and concepts are to be understood in specific contexts. Examples in this regard may go endless. The artisans, fishermen, herdsman, medicine man, women food gatherers, carpenters, swiddener all carries different sets of expert knowledge to explore which one can better understand when their language is used as the most important tool for data collection.

The study of IK Systems brings the localistic data from farmers, artisans and others back to the semantics of the participants' own discourse away from folklore. Ignoring the IK system, in design and implementation of development projects, is an impediment for sustainability of development.

Indigenous Knowledge and Development

Time has come to realize the relevance of indigenous knowledge for development. Indigenous knowledge is gaining favour as an alternative to gear resource management activities in a sustainable manner by learning from the resource use rationale of indigenous peoples. On the background of the concept of the nature-man-encompassing spirituality complex, indigenous peoples have developed an intricate relationship with nature and as far as socio-politic circumstances permit and maintain a holistic mode of resource use. While making a living out of his natural environment, man is compelled to perceive everything in

nature critically, gather experience through trial and error methods and store knowledge necessary for his survival. In the process of interaction with nature, man identifies useful species and develops patterns of indigenous classification of different varieties of resource use (Jena, et.al. 2002).

Jena (2007) makes a mention of the displacement of tribals in the eastern corridor of India due to development projects resulting in the erosion of traditional knowledge held by the communities since generations. The author examines how the tribals of this region suffer and how they lose their traditional knowledge base ill conceived government policies. She presents evidences of loss of food reserves by the destruction of forest, loss of medicinal plants, loss of agricultural and water harvesting knowledge, loss of livelihoods of other kind and loss of traditional biodiversity management practices due to the modern forces of industrialization and urbanization. She strongly believes that for our civilization to survive, it is imperative that the indigenous communities and their knowledge also survive.

Box-1: World Bank's emphasis on Indigenous Knowledge

In the emerging global knowledge economy a country's ability to build and mobilize knowledge capital, is equally essential for sustainable development as the availability of physical and financial capital. (World Bank, 1997) The basic component of any country's knowledge system is its indigenous knowledge. It encompasses the skills, experiences and insights of people, applied to maintain or improve their livelihood. Indigenous knowledge is developed and adapted continuously to gradually changing environments and passed down from generation to generation and closely interwoven with people's cultural values. Indigenous knowledge is also the social capital of the poor, their main asset to invest in the struggle for survival, to produce food, to provide for shelter or to achieve control of their own lives.

Today, many **indigenous knowledge systems are at risk of becoming extinct** because of rapidly changing natural environments and fast pacing economic, political, and cultural changes on a global scale.

Indigenous knowledge is part of the lives of the rural poor; their livelihood depends almost entirely on specific skills and knowledge essential for their survival. Accordingly, for the **development process**, indigenous knowledge is of particular relevance for the **sectors like agriculture, animal husbandry and ethnic veterinary medicine, use and management of natural resources, community development, poverty alleviation, etc.**

Indigenous knowledge is **not yet fully utilized in the development process**. Conventional approaches imply that development processes always require technology transfers from locations that are perceived as more advanced. This has led often to overlooking the potential in local experiences and practices.

Indigenous knowledge is **relevant** on **three levels for the development process**: it is, obviously, most important for the **local community** in which the bearers of such knowledge live and produce; development agents need to **recognize** it, **value** it and **appreciate** it in their interaction with the local communities; lastly, indigenous knowledge forms part of the **global knowledge**. In this context, it has a value and relevance in itself. **Indigenous knowledge can be preserved, transferred, or adopted and adapted elsewhere**.

The **development process interacts with indigenous knowledge.**When designing or implementing development programs or projects, three scenarios can be observed. The development strategy either · relies entirely or substantially on indigenous knowledge; or, overrides indigenous knowledge; or, incorporates indigenous knowledge. **(http://www.worldbank.org/afr/ik/basic.htm)**

Ratha (2007) discusses the most important relevance of traditional knowledge in securing food production and food collection for combating hunger with his extensive empirical data from two tribal habitats of Orissa covering the Lanjia Saora and Durua communities. Ratha observes that the IK of Lanjia Saora, Durua and many other communities with limited cross-cultural contacts remain as treasure house of knowledge that need immediate documentation, as such geo-culturally insulated knowledge is prone to quick degeneration. He suggests that proper and cross cultural documentation can transform local knowledge into regional and regional knowledge into global knowledge, which can motivate people to preserve their knowledge.

Misra and Basa (2007) interprets that Indigenous Ecological Knowledge (IEK) has paramount importance in local development, particularly of the poor and marginalized. This is because of the fact that IEK ensures food security, protects human and animal health, regulates natural resource management and conserves biodiversity as a part of cultural practice, and importantly, it has the tremendous capacity to blend with other kinds of knowledge. Its nature of cultural embeddedness and context specificity gives legitimacy to its application in local development.

Mohapatra (1997) makes a note that the tribals have been much maligned for soil erosion in mountainous region and flooding down the hills. Recent researches in the most fragile mountain regions of North India have led scholars to assert that: 'there is no evidence of a direct effective linkage between overexploitation of resources in the mountains and flooding in the fore lands… Neither can forest prevent floods after torrential rains… Considering the overall system, erosion caused by anthropogenic factors exerts only an insignificant influence under processed like flood, danger and sedimentation in the fore land, when compared to erosion caused by natural forces… change in annual run off are the result of climatic processes (Mohaptra, 1997 *cf.* Kreutzmann, 1993 52-53). It may be interesting to note that Jack. D. Ives and Bruno Messerli have critically examined the so called 'Himalayan Dilemma', which focuses on the environmental degradation, erosion and flooding of the foreland as mainly due to over population and deforestation on the high mountains. Kruetzmann points to the conclusion reached by the authors of the book: The Himalayan Dilemma: Reconciling Development and Conservation (1989, London/New York) in the following paraphrased words: 'population growth and deforestation alone do not present sufficient parameters for the explanation of the "Himalayan Dilemma", physical phenomena

rather find their explanation more in the 'normal' surface processes of a mountain range of recent uplift…(*ibid:*53). P- 31

Thakur (1997) sourcing information from Harinath, 1990 on area affected in different districts of Orissa under shifting cultivation is of the view that the area affected under *podu* is maximum in Koraput (undivided) district. Referring to Shivaraman, Chaturvedi, the author builds the argument that shifting cultivation is not always harmful to the forest and the land as it can very well be improved and evil effects minimized by introducing leguminous crops and nitrogen fixing plantations as well as planting fruit-bearing trees by restricting *podu.*

Table: 4

Total area and number of Tribes Engaged in Shifting Cultivation in Orissa

Year	Source of estimation	No. of tribals depending on shifting cultivation and their percentage to total population	Total area of forest land affected and their percentage to total forests in acres
1951	F. M. Mooney	9,33,500 (53.5%)	81,72,800 (53.6%)
1956	Indian Council of Agricultural Research	10,00,000 (33.7%)	4,00,000 (2.6%)
1960-61	Commissioner for SC&ST	9,35,700	4,00,000
1971-72	DFO, Forest Research Survey, Orissa	10,00,000 (19.7%)	34,59,400 (20.8%)
1972-73	THRTI, Orissa	2,40,000 (4.7%)	46,500 (0.3%)
1975	Director of Agriculture, Orissa, Erts-I, Satellite Imagery	-	81,72,800 (49.7%)

Harinath, 1990

The rehabilitation of *podu* cultivators was launched during 1984-85 out of Special Grants of Central Government through ITDAs. In the year 1987-88 the Government of India introduced another scheme for control of shifting cultivation. Under the scheme, the development works undertaken included sisal plantation, cashew plantation, coffee plantation, horticulture, tree plantation, central nursery, field bunding, bench terrace, WHS, orchards, gully control, land development, tube wells, LI Points, etc. The author critically observed that except land colonization and resettlement programs all other programs were oriented for the economic upliftment of shifting cultivators. The land colonization and resettlement was the only program wherein the shifting cultivators were brought to specially built colonies for their resettlement.

Table: 5

Area affected in different districts of Orissa under shifting cultivation

Sl. No	Districts (undivided)	Area under shifting cultivation in sq.km.
1	Ganjam	2,980
2	Kalahandi	1,324
3	Keonjhar	2,528
4	Koraput	11,528
5	Phulbani	8,435
6	Sambalpur	1,913
7	Sundargarh	2,270

Patnaik (1997) argues that indiscriminate loss of forest area is causing severe soil erosion. In absence of adequate plant cover erosion of top soil is possible by wind action, floods and run-off water. Enormous

spread of wastelands have been created in the district due to excessive soil erosion, caused by unscientific agricultural practices, wood felling and shifting cultivation within forest lands (cf. Rout, et.al. 1994). The author attributes deforestation and soil erosion because of developmental projects also.

However, in the context of land and water management, appreciation or incorporation of indigenous knowledge has hardly been promoted during such interventions. Physical displacement and resettlement in colonies, rather indirectly, depreciated their traditional wisdom on land and water management that has been ascribed from specific land use practices of the communities.

Reddy, *et. al.* (2010) views that over the decades watershed development in India has transformed from a purely soil and water conservation technology to a comprehensive rural development program. In the backdrop of Andhra Pradesh, the authors looks at the watershed development program in a historical perspective and covers a number of important issues such as policies, implementation, livelihood impacts, sustainability and political economy of the program. At the policy level, the authors identify some of the lacunae like property rights and the linkages between property rights and collective action. As far as the implementation of the program is concerned, the authors emphasizes that the core philosophy of the policy makers dealing with natural resources has not changed despite numerous changes at the macro level. The livelihoods analysis brings out the fact that watershed management is a necessary but not a sufficient condition to sustain rural livelihoods in a wider context. But, it holds the potential for enhanced livelihood security even in the given geo-climatic conditions where watershed cannot bring direct irrigation benefits on a large scale. The institutional framework stresses the importance of policy and political environments for institutional innovation and sustainability.

Indigenous knowledge with tenurial security is important for land and water conservation

The observations of Mohapatra (1997) further adds to the fact that indigenous knowledge does matter in the context of tribals who still practice a primitive mode of subsistence. Tribal swiddeners have realized that they have to change their technology and diversify their economy in order to live and thrive in the modern world. Even the Hill Bondo, a primitive tribe in southern Orissa, and the Paudi Bhuiyan and the Juang, other primitive tribes of

northern Orissa, have always tried to construct terraces in the bed of the hill streams, where feasible. But such locations are scarce and terrace making is not only arduous, but also costly in time and in lost opportunities to earn their daily bread, while they work on several operations connected with terrace construction, often extending over to two generations.

Further, tenurial security is to be considered an important aspect of land and water conservation. In this connection Mohapatra (1997) holds that, much as the Hill Bondo and Hill Saora are masters in such terrace construction both in the hill stream bed, as also on dry upland, they find to their horror and distress, that the terrace land cannot be recorded as their private property, not because it is their clan or lineage land. Either the land is above 10% slope, and the land settlement officials are not empowered to get these lands recorded as privately cultivated lands with royotwari rights, or the forest development claims the land as under some category of forest and thus cannot be diverted to non-forest use and recorded as land under cultivation, as per the Forest Conservation Act of 1980. Fortunately, the then Chief Minister of Orissa has decreed that in Kashipur Block/ Tehsil of Rayagada sub-division the tribal people be given property rights in cultivated land – as terraces, swiddens or upland upto 30% slope. When the tribal people are in actual possession of land for cultivation even above 30% slope, either in the form of swidden or otherwise, they shall be regarded as ryots for this land, provided the land beyond 30% slope is utilized for raising perennial crops in the form of plantations, etc. this conditional grant of rights will be entered in the *patta,* so that in case of violation of the condition the rights of the ryots may be revoked. That means, the tribal swiddeners in Kashipur can either grow perennial tree crops or raise a forest on hill slopes beyond 30% and the fruits and the yield from the trees will be theirs, and not of the forest department. In this way, the Chief Minister has stuck down at one stroke all the restrictions imposed by the revenue and forest departments on the tribal ryots to own trees as exclusive possession above 30% slopes.

In this way, ecological considerations have been met, economic well-being of the tribal people has been ensured and the age old process of depriving the tribal people of the hard owned fruits of their back breaking labour, i.e., the terraces and the cultivated fields beyond 10% slope has been reversed. Under this dispensation, the poorest landless tribal families, who do not have any permanent fields may at least 'own the swiddens and trees and get adequate compensation as ryots and tree owners even above 30^0 slope, in the event of displacement. As the departments of revenue and forest have accepted this trend setting

decision in respect of Kashipur tribal groups, it is expected that this will be agreed to in respect of other swidden cultivation areas in Orissa. Once Orissa shows the way, the other states with swidden cultivation and exclusive rights over trees among tribal groups, namely, Madhya Pradesh, Andhra Pradesh, Karnatak and Assam, and other North-eastern states are also expected to grant such rights to their tribal people. (Mohapatra,1994 cf. Mohapatra, 1997). Mohapatra (1997) cites Roy Burman Committee (1982) who recommended that 'the Government should grant the *rayati* rights to swidden cultivators up to 30^0 slope, if these lands are under cultivation as terraces, upland permanent dry fields or as swiddens, and beyond 30^0 slope, if these lands are under permanent tree crops as orchards or forest on the model of Orissa's Status Rule for Survey and Settlement Operation in Kashipur Tahsil of Koraput (now Rayagada) district as revised in Letter No. 20321 dated 10.04.1992 from the Revenue and Excise Department addressed to the Director of Land Records and Surveys, Board of Revenue, Orissa. (Mohapatra, 1997:40). However, irony is that, property rights over upland up to 30% slope have not been extended in respect of any other swiddeners beyond Kashipur.

In support of above mentioned decision of the Government of Orissa we may take into consideration one important ecological situation for appreciating the significance of agricultural practices in checking soil erosion on mountain slopes. Modern research on the mountainous regions of North India has established that 'forest clearance on steep slopes… can have the effect of a reduction in soil erosion, if terracing for agricultural purposes takes place, which is a characteristic of many region of the mountain arc. The human factor is, therefore, by no means only a negative one, land slide zones, too, are stabilized by the very fact of terracing…' (Kruetzmann, 1993:53, Cf. Mohapatra, 1997:38).

Patnaik (2005), in his 'Primitive Tribes of Orissa and their Development Strategies' while prescribing an agenda for future action has suggested that 'land ownership and provision of irrigation are must for those who carry on agriculture. Provision of these facilities in large measures would certainly encourage the people to adopt settled cultivation in place of shifting cultivation (p. 236). Such initiatives would undoubtedly strengthen the land and water management regime in the PTG areas.

Initiatives taken by Government to address land and water conservation in tribal areas

Buchi (1997) has made a mention of the initiatives taken by Government of Orissa, towards implementation of large number of schemes and programs as measured to control shifting cultivation. During the Fifth Five Year Plan, the State Government formulated a special scheme for rehabilitation of 20 thousand *podu* families. Under the scheme, the Government proposed to provide one hectare of land for horticulture and one unit of animal husbandry per *podu* family residing in higher slopes, and 2 acres of reclaimed land, input assistance and animal husbandry component for each such family residing in lower slopes (Also see Mohapatra, 1987:146). As soil erosion is an acute problem, the Soil Conservation Department of the State has implemented different programs like bunding and terracing, plantation of quick growing trees on hill slopes, construction of check dams and water harvesting structures to prevent gully erosion (Tribal Sub-Plan for Eighth Plan, p. 146).

During 1984-85, the State Government launched a program for rehabilitation of *podu* cultivators out of the special grant to the State under Article 275(1) of the Constitution of India. Accordingly, the Forest Department of the State drew a Five Year Perspective Plan to be implemented in the State through the ITDAs of sub-plan areas.

Samal (1997) argues on the basis of available evaluation reports on land colonization scheme formulated by the H&TW Department of Government of Orissa during the First Plan period that, the scheme has failed to achieve its objectives properly. The author has quoted proceedings of Shilu A.O. Committee that “the basic weakness in many of these programs lies in the assumption of the planners that the grant of land, provision of houses and supply of bullocks, enough has been done to enable a tribal to earn a living. What is not recognized is that building up of fertility of virgin land takes time and that its productivity after reclamation is not always enough to maintain a tribal family” (GoI, 1969). The author pointed out, out of findings from a micro level study conducted by him that many families deserted the colonies organized under the land colonization scheme because of land quality in terms of productivity.

This indicates that the choice of communities in organizing their production processes is by and large made out of their observation and understanding of land type, quality and production estimates. In this context their traditional knowledge and adaptive practices over the years matters much. It seems that while planning development programs such aspects have been grossly ignored.

Nayak (2002-2003) presents a comprehensive note on the special programs drawn and implemented by Government of India with utmost attention to the Particularly Vulnerable Tribal Groups (PVTGs). During the sixth five year plan Integrated Rural Development Program (IRDP), National Rural Employment Program (NREP) and the new twenty-point program were added to the package of anti-poverty programs under the sub-plan. Programs of agriculture, animal husbandry, fishing, agriculture, etc were extensively implemented and the same objectives were persuaded in the seventh five year plan too. Additionally, it laid emphasis on vulnerable groups like nomads, shifting cultivators, forest villagers, displaced families, migrant labourers and tribal women. For the improvement of quality of tribal environment and up-gradation of resources, plans and programs were drawn on the basis of scientific survey.

Nayak further notes that orange, lemon, ginger, banana plantations in addition to high yielding rice cultivation in Ramagiri-Udayagiri area of Lanjia Saora concentration and additing to other crops as above the pine apple plantations made in Niyamgiri areas of Dongaria concentration were very successful schemes. Cultivation of vegetables in the hills was equally successful. People earned cash in addition to pursuing their traditional subsistence agriculture in the hill slopes. Cash crop and vegetables were also encouraged among tribal villagers adept at plough cultivation in the plateaus, plains and terraced fields. This note indicates that for socio-economic development of the tribals initiatives under agricultural extension has been widely carried out in PTG areas that include crop introduction, intensification and diversification. However, it does not seem likely that adequate attention was given towards land and water conservation measures before planning agricultural extensions. Implicitly, it is an appreciation to the communities' practices towards land and water conservation and management on the base of which the livelihoods portfolio has been expanded.

Mohanty & Nayak (2002-2003), in their article on Lanjia Saora Mode of Subsistence: Change and Development have emphasized the Lanjia Saora community as traditionally shifting cultivators with expertise on terrace cultivation. According to the authors, the Lanjia Saora exhibit a high degree of indigenous skill, ingenuity and technological outfit for preparing the terraces with in-built water management systems. The remarkable features of their socio-economic life includes their traditional system of labour cooperatives called *Ansir,* which ensures them supply of labour for labour-intensive operations like swidden cultivation,

house construction, terrace making and terrace cultivation, and a host of other activities in the village (p.83). The authors further note in the context of LSDA Serango, that some tangible results out of Community Benefit Oriented (CBO) programs (drinking water, irrigation) and Individual Benefit Oriented (IBO) Income Generation Programs (settled agriculture, horticulture, agro-forestry) could be well achieved in limiting shifting cultivation on one hand and development of farm lands on the other. Further, the implementation of soil conservation and land development programs has led to expansion of farm land area that could change the equation of average landholding size at household level. The authors make a mention that the Lanjia Saora is already endowed with the indigenous skill of water management associated with land terracing in their difficult terrain. As they are aware of the value of water for settled agriculture, the irrigation facilities created by development agencies have gained a high level of popularity. In most cases, the Saora farmers have come forward to demand construction of irrigation structures, presenting definite proposals suggesting the location, source and type of structure feasible (p. 87). The presentation of the authors indicate that, at least, the Lanjia Saora have ever tried to use their indigenous knowledge in terms of identifying strategic locations and suggesting for definite structures within which is embedded their experience based knowledge on land and water management.

Tribal Heritage Agriculture Systems: Indigenous knowledge on land and water management

Traditional agricultural systems in India has its own significance both ecologically and socio economically. The age-old environmental knowledge and community management in the tribes shows their rich heritage and how important it is to preserve and record this indigenous knowledge to frame up sustainable agriculture practices in the modern times. The diverse traditional agricultural systems of the different tribal communities all over India has been seen to be standing on the same principle of conservation of natural resources in a holistic perspective. Therefore, in order to develop sustainability in agriculture, it is necessary to understand the intrinsic social cultures and values of these communities.

The 'Inventory and Documentation of Tribal GIAHs in India' (*www.fao.org/giahs*) by Schumacher Centre (*www.schumachercentre.org*) presents a comprehensive account on the Tribal Agricultural Heritage Systems. The report presents that a salient feature of traditional farming systems is their degree of plant diversity in the form of polycultures and/or

agroforestry patterns (Chang, 1977; Clawson, 1985). This is a strategy of minimizing risk by planting several species and varieties of crops which stabilizes yields over the long term, promotes diet diversity, and maximizes returns even with low levels of technology and limited resources (Harwood, 1979). Such bio diverse farming are endowed with nutrient enriching plants, insect predators, pollinators, nitrogen fixing and decomposing bacteria, and a variety of other organisms performing various beneficial ecological functions. Traditional multiple cropping systems provide as much as 15-20 per cent of the world food supply (Francis, 1986). Polycultures are very common in Asia where upland rice, sorghum, millet, maize, and irrigated wheat are the staple crops. Lowland (flooded) rice is generally grown as a monoculture, but in some areas of Southeast Asia farmers build raised beds to produce dryland crops amid strips of rice (Beets, 1982). Tropical agro ecosystems composed of agricultural and fallow fields, complex home gardens, and agroforestry plots, commonly contain plant species per field which are used as construction materials, firewood, tools, medicines, livestock feed, and human food (p3).

Depending on the level of biodiversity of closely adjacent ecosystems, farmers accrue a variety of ecological services from surrounding natural vegetation. Clearly, traditional agricultural production commonly reflects a total multiple-use system of both natural and artificial ecosystems, where crop production units and adjacent habitats are often integrated into a single agro ecosystem. (P4)

The inventory prepared under the aegis of Globally Important Agricultural Heritage Sites (GIAHS) summarized 16 GIAHS in India out of which five sites have been recognized from Odisha and Andhra Pradesh. The study, implicitly, indicates the importance of the traditional agriculture and subsistence based livelihood systems of the two states in a global context. The excerpts from the inventory on GIAHS are presented here in a tabular form.

Table- 6: Globally Important Agricultural Heritage Sites in India

GIAHS	Ecological zone	Climatic type	Ethnicity	Main source of livelihood
1. Benwar Farming System of Baigas; **Bilaspur District** of **Chhatisgarh**	The Chhattisgarh / Mahanadi Basin Agro-eco-region; hot, moist / dry, sub-humid transitional ecological sub region with deep	Sub-tropical, semi-arid, continental, and monsoon type	Baigas and sub-families Binjhwar, Bharotia, Raibhaina, Kathbaina, Narotia or Nahr,	Shifting cultivation named as Bewar

	loamy to clayey red and yellow soils		Kondwan or Kundi and Gondwaina	
2. Chilka Fishing System; spread over part of districts Khordha, Puri, Ganjam of **Odisha**	Eastern Coastal Plain, hot sub-humid to semiarid eco-region. The Agro-Ecological Sub-Region (AESR) is the Utkal Plain and East Godavari Delta.	Sub-humid (moist) climatic type. It receives 1200 to 1600 mm of rainfall, 80 per cent of which is during June to September	Keuta, Noliya, Tiara, Kandara, and Khatia	Fishing
3. Animal husbandry system of the Raikas; Pali district of **Rajasthan**	Northern Plain (and Central Highlands) including Aravallis, hot-arid eco-region	Hot and dry summer and cool winter, annual precipitation ranges from 500 to 1000 mm with an increasing trend from west to east	Raikas (nomadic)	Animal Husbandry (Camel, sheep, goat, buffalo) and cultivation
4. Paddy fish cultivation of the Apatanis; Apatani Plateau of **Arunachal Pradesh**	Eastern Himalayas, warm perhumid eco-region, with brown and red hill soil	The climate in the region is characterized by warm summer and cool winter	Lhoba ethnic group; spread across China, Myanmar, Bhutan, and North-East India	Agriculture and fish cultivation
5. Bamboo Drip Irrigation, Meghalaya; Jaintia and Khasi hills of **Meghalaya**	North-Eastern Hills (Purvachal), warm per humid eco region with red and lateritic soils	The agro-climate of the region is characterized by warm summer and cool winter	Jaintia and Khasi tribes	Agriculture
6. Three tier agriculture system of Kondha Savara tribe of Seethampeta; Srikakulam District of **Andhra Pradesh**	Eastern Ghat, hot moist sub-humid ecosystem with Red and Lateritic soils	The climate is characterized by hot and moist summer and mild and dry winter	Dravidian	Agriculture and horticulture
7. Zabo indigenous farming system, Nagaland; Phek District, Kikruma village of **Nagaland**	Eastern range (Meghalaya Plateau and Nagaland hill), warm to hot per humid ecosystem with red and lateritic soils	The agro-climate of the region is characterized by warm summer and cool winter	Chakhesang	Agriculture, fishery, animal husbandry

8. Alder-based jhum system, Nagland; Khonoma village, **Nagaland**	Eastern Range (Meghalaya Plateau and Nagaland hill), warm to hot perhumid ecosystem with red and lateritic soils	Warm to hot moist humid to perhumid ESR	Ang**a**mi tribe	Agriculture
9. Hunting and gathering system of Horsley hill; Madinapalli District of **Andhra Pradesh**	Eastern Coastal Plains, Andhra Plain, deep, clayey Coastal and Deltaic alluvium-derived soils	Hot dry sub-humid ESR	Chenchu Tribes	Agriculture
10. Sikkim Himalayan traditional agriculture; Sikkim	Eastern Himalayas, warm perhumid eco-region with shallow to medium deep loamy Brown and Red Hill soils	The climate of the region is characterized by warm summer and cool winter	Nepali ethnic group – Bhutias and Sherpas	Agriculture, MFP, agro-product, carpet weaving
11. Saffron Cultivation, Kashmir; Pampore district of **Jammu & Kashmir**	Western Himalayas, cold arid eco-region	Cold to cool, typic-arid ESR with shallow, loamy-skeletal soils	Kashmiri	Agriculture
12. Paderu Agricultural System of Andhra Pradesh; **Visakhapatnam District, Andhra Pradesh**	Deccan Plateau (Telangana) and Eastern Ghats, hot semi-arid ecoregion	South Telangana Plateau (Rayalseema) and Eastern Ghat, hot dry semi-arid ESR with deep loamy to clayey mixed red and black soils	Primitive Tribal Groups	Agriculture (shifting cultivation)
13. Traditional Sugarcane Cultivation in West Bengal; Purulia District, West Bengal	Assam and Bengal Plain, hot sub-humid to humid eco-region	Bengal basin and North Bihar plain, hot moist sub-humid ESR with deep loamy to clayey alluvium-derived soils	B**h**umij and Santhal tribes	Sugarcane cultivation
14. The Traditional agriculture of Muthuvans, Kerala; Idukki District, Kerala	Western Ghats and Coastal Plains, hot humid-perhumid eco-region	Hot humid to per humid transitional ESR with deep, loamy to clayey Red and lateritic soils	Muthuvan tribe	Gathering food and forest products, and agriculture

15. Traditional Rice-Fish Farming, Assam	Assam and Bengal Plain, hot sub-humid to humid eco-region	Teesta, lower Brahmaputra Plain and Barak Valley, hot moist humid to per humid ESR with deep, loamy to clayey alluvium derived soils	25 Scheduled tribes of Assam	Agriculture
16. Terrace cultivation of Lanja Saora, Orissa; Gajapati District, Odisha	Eastern Coastal Plain, hot sub-humid to semiarid ecoregion	Coastal and deltaic alluvium-derived soils	Lanjia Saora tribe, belonging to the proto-Astraloid stock	Agriculture

It is worth mentioning here that the traditional heritage agriculture especially in the tribal regions have within them the local indigenous knowledge applied to the management of the resources like land, water, biodiversity and in a larger context of the ecosystem services. Of the 16 GIAHs referred here the inventory presents some salient features of Tribal Heritage Agriculture Systems in Odisha and Andhra, such as Terrace cultivation of Lanja Saora in Odisha, Paderu Agricultural System of Andhra Pradesh, and Three tier agriculture system of Kondha Savara tribe of Seethampeta of Andhra Pradesh. The current study has covered the Lanjia Saora and the PTGs in Paderu, and Dongaria Kondhs in Odisha which has affinities with the other tribes referred here in respect of terrain, topography, land use, ecosystem and local culture.

With reference to the inventory, the characteristics of three tier agriculture system of Kondha Savara tribe of Seethampeta is that the ethnic communities there have evolved an indigenous agricultural system for subsistence livelihood, which maintains ecological balance, and ensures food security, and economic returns. This system is a three-tier agriculture system: where the hills are divided into different land use classes based on the elevation, slope and ecological considerations. In this system the upland retains as forests, the mid elevation lands are used for slash and burn agriculture, and in the plains, the tribal farmers grow the more economically viable varieties of crops. The tribal people cultivate their local varieties for their own consumption and also agriculture and horticulture varieties for the market and the agriculture almost entirely organic. Crop varieties and, landraces, of over 19 species of vegetables and around 150 varieties of paddy, sorghum, small millets and pigeon pea are grown. More than 95 wild relatives of crop plants are recorded in this area. Over 75 species of plants are endemic to this region out of the 359 endemic species

recorded in the Eastern Ghats. This region is a unique representative of traditional agriculture and land use, practiced in harmony with nature since many generations Mixed Cropping: Crops are mixed to maximize production and hedge risks. The crops are rain-fed and moisture stress tolerant. Crops grown are cashew (*Anacardium occidontale*), Mango (*Mangifera indica*), Turmeric (*Curcuma longa*), Pineapple (*Ananas comosus*), Banana (*Musa paradisiaca*), Coconut (*Cocos nucifera*), Custard apple (*Annona squamosa*), Paddy (*Oryza sativa*), Pulses – red gram (*Cajanus cajan*), Green gram (*Vigna radiate*) and black gram (*Vigna mungo*), oilseeds – Sunflower (*Helianthus annuus*) and ground nut (*Arachis hypogaea L.),* millets – Jowar (*Sorghum vulgare*), Bajra or pearl millet (*Pennisetum glaucum*), and Ragi or finger millet (*Eleusine Coracana*), spices, medicinal plants, and vegetables.

The documentation on Paderu Agricultural System of Andhra Pradesh summarize that the tribal groups raise mixed crops, ensuring minimum food security. This is the main feature of the traditional system of agriculture – maintenance of bio-diversity. Different local varieties are grown suiting the climate conditions and depending on their needs. The area is pest and disease free. - The local varieties are not high yielding but are rich in nutrient content, are grown organically with no use of chemical fertilizers or pesticides, organic food increases the resistance power of the tribal people. The traditional cash crops cultivated like turmeric and ginger give them a secured income and these products possess great medicinal value.

In the context of Terrace cultivation of Lanja Saora in Odisha the inventory provides that, Terrace cultivation of Lanjia Saora represents an agricultural heritage system. The tribes' lives are based on forests, animals and crops which are interdependent. The terrace is also divided into 3 slopes – (1) the upper slope - 60^{o}, where they cultivate forest plants and cashew nuts, Bageda/Swidden (mixed cropping of pulses and serials), (2) 40^{o} to 60^{o} are the upper terraces with millets and orchards; in the slope between 20 to 40^{o}, there are terrace fields of paddy, and (3) on the foothills at 20^{o}, in the plain area, there are kitchen gardens, backyard plantation and paddy cultivation.

They also grow small millets, pulses, and beans, horticultural crops like mango, jackfruit, coconuts, papaya, bananas, pineapples, cashew nuts, and peat palms. The system is indigenous for the features including rich agri-biodiversity, stone bunding in rice terraces, complete check of soil and water erosion through sound soil and water management

practices, resilient livelihoods system and labour co-operatives based on “lead and lag” approach.

The bio-diversity in the area consists of forest plants that include *Azardirachtaa indica, Pongamia pinnata, Madhuca indica, Annana squmosa, Shorea robusta, Terminalla glate, Caryota urens, Annona reticulata, Phaseolus humilis, Argemona mexicana, Coculus hisutus, Cassia seamea* and *Anacardium occidentale* etc.

The heritage value comes from its 200 year old culture, during which no drought has occurred, and rich bio-diversity reflects the traditions and culture. The rituals and festivities deeply linked with agriculture. Indigenous knowledge is preserved and used in maintaining the system which continued to deliver environmental services – barren lands converted into cultivable ones, local resources are conserved, soil erosion checked through stone bunding, and water management through pits and fences, bio-diversity in agriculture maintains social integrity. The threats facing the system are diminishing land sizes, climate change and onslaught of so-called high yielding mono-cropping agriculture, and disrupting traditional sustainable agriculture.

What is important to note here that many tribal agriculture systems are there which are unique and qualifies for thorough documentation and stands the merit to be recognized under GIAHS. The Dongaria Kondh community in the Niyamgiri hills in the Rayagada-Kalahandi complex of Odisha has many unique features in their traditional agriculture systems. The communities represent a repository of related knowledge and wisdom in respect of land and water management, management of biodiversity in crops and wilderness. This is a community which is much regarded as a shifting cultivation and horticulture based community although in course of time they have developed integrated agriculture and agro-horti-forestry systems. In this approach an attempt has been made to document the traditional agriculture systems of Dongaria Kondhs in an indigenous knowledge perspective.

Land Use, Traditional Agriculture and Climate Change

Land and water management is a default practice in agriculture. The traditional agriculture and land use patterns in tribal areas have come under direct influence of climate change. Various natural resource management models especially for land, water and forests have been in place and many are in implementation process. However, all the models appear as context specific although most of them have a direct relation with agriculture. The innovations in agriculture popular as improved and scientific models are by and large oriented towards maximizing productivity and yield from unit area of land and also a clear shift from subsistence agriculture to cash crops or a mix of the two often with inappropriate proportions. However, a close look at all these models reveals, or convincingly raises the argument that, the innovations in agriculture is borrowed from traditional agriculture and repackaged. What we called a perception in the context of tribals has come out as new knowledge systems. While setting in place the agricultural innovations in the current times often the traditional knowledge is ignored, in most cases looked down upon. However, in the context of climate change impacting agricultural patterns, when a case is in consideration, the farmers and practitioners are consulted for their observations, interpretations and effective coping mechanisms. In recent years the tribal agriculture and traditional systems of natural resources management has posed to be an important subject to be studied. Although literature in this regard, especially in the context of traditional tribal agriculture and climate change impacts, are very sporadic, yet what is emerging that the local practitioners know better and have reflexive coping mechanisms. This reaffirms the notion that the traditional management systems in sustaining production systems is still relevant today and continue to justify its relevance in future. Land and water management remains as an integral component of traditional agriculture.

Perceptions of tribal communities are being increasingly recognized as tools for climate change studies. Organizations like CCAFS South Asia, with their partner organizations in India have been working to understand how climate change and climate variability is affecting tribal communities and how they can cope by adapting their farming practices to future climate scenarios. In Maharastra, the research team organised discussions with men and women farmers to understand how these climatically challenged tribal hamlets are witnessing increasing climatic risks. The study team was fed to realize that, changes in temperature and rainfall pattern have affected the crop yields and their livelihoods, but due to lack of crop advisories and technical and financial resources coping with such events is

beyond their reach. The study provides to understand that the tribals now have a renewed interest in adopting climate-smart-agriculture, especially, conservation agriculture practices, seeds, on farm water management structures and water-saving devices like drip and sprinklers. (https://ccafs.cgiar.org)

At an International level trends are emerging indicating efforts for reestablishing trust on traditional agriculture and natural resources management practices in the context of current climate change impacts worldwide. The Colorado Plateau Inter Tribal Gathering is fighting climate change by preserving its ancient dry farming practices. A new exhibit "Preserving Our Seeds and Farmer Knowledge" showcases efforts by elders and leaders from 12 tribes to preserve dry farming practices that have allowed native peoples to flourish for thousands of years and protect ancient crops. The exhibit honors six years of work by a coalition of elders and cultural leaders from 12 Colorado Plateau tribes to ensure that traditional farming and ancient food preparation practices, as well as tribal teachings and stories key to adapting to climate change, are passed on to the next generation. The group also works to restore springs, create farmers markets, protect heirloom seeds, keep out GMOs, and protect sacred sites by revitalizing traditional intertribal networks. Many Intertribal Gathering members are farmers and have witnessed changes in temperature, wind, rain, soil moisture levels and encroachment of genetically modified seeds. (http://indiancountrytodaymedianetwork.com) In the context of land use, climate change adaptation and indigenous peoples, McLean (2012) is of the view that 'for indigenous peoples, resilience is rooted in traditional knowledge, as their capacity to adapt to environmental change is based first and foremost on in-depth understanding of the land. As climate change increasingly impacts indigenous landscapes, communities are responding and adapting in unique ways'. This is further affirmed in a recent statement to the Conference of Parties (CoP) to the UN Framework Convention on Climate Change (UNFCC), the International Indigenous Peoples Forum on Climate Change (IIPFCC) that observed '…[W]e reiterate the need for recognition of our traditional knowledge, which we have sustainably used and practiced for generations; and the need to integrate such knowledge in global, national and sub-national efforts. This knowledge is our vital contribution to climate change adaptation and mitigation."

Worldwide realization is emerging that the connection of indigenous communities to their land is an important source of resilience, but this resilience depends on an ability to nurture and manage this relationship. Indigenous knowledge is locally fine-tuned, which is essential

for climate change adaptation and long-term community resilience. Indigenous and local communities make careful observations about their lands, exchange information and experiences, and plan for the future. New ideas spring up, based on centuries-old knowledge, and partnerships between indigenous peoples and scientists are producing new knowledge to address the challenges of climate change. In the face of increasing climate instability, recognition of indigenous rights and respectful two-way collaboration is the path forward to build better early warning systems and support local efforts towards building resilience (http://voices.nationalgeographic.com).

The ensuing community-based and collectively-held knowledge offers valuable insights, complementing scientific data with chronological and landscape-specific precision and detail that is critical for verifying climate models and evaluating climate change scenarios developed by scientists at much broader spatial and temporal scale. Raygorodetsky in his note holds that the very identity of indigenous peoples is inextricably linked with their lands, which are located predominantly at the social-ecological margins of human habitation — such as small islands, tropical forests, high-altitude zones where the consequences of climate change include effects on agriculture, pastoralism, fishing, hunting and gathering and other subsistence activities, including access to water. With collective knowledge of the land … these peoples are excellent observers and interpreters of change in the environment. Moreover, indigenous knowledge provides a crucial foundation for community-based adaptation and mitigation actions that sustain resilience of social-ecological systems at the interconnected local, regional and global scales. Quoting last IPCC Assessment (AR4, published in 2007, - IPCC- XXXII/ Doc 7) the author argues that indigenous knowledge is "an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change". This was reaffirmed at the 32nd Session of the IPCC in 2010: "indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost-effective, participatory and sustainable". (http://unu.edu).

The Mexico workshop in 2011 on Indigenous Peoples, Marginalized Populations and Climatic Change participated by indigenous people from around the world observed that when considering climate change, indigenous peoples and marginalized populations warrant particular attention. Climate change poses a direct threat to many indigenous and marginalized societies due to their continuing reliance upon resource-based livelihoods. The workshop proceeding genuinely appreciates their accumulated knowledge and wisdom that

makes them excellent observers of environmental change and related impacts. Attentiveness to environmental variability, shifts and trends is an integral part of their ways of life. Community-based and local knowledge may thus offer valuable insights into environmental change due to climate change, and complement broader-scale scientific research with local precision and nuance. Finally, indigenous societies and marginalized populations have elaborated diverse coping strategies to deal with the change. While the environmental transformations caused by climate change are expected to be unprecedented, indigenous and local knowledge and coping strategies may nonetheless provide a crucial foundation for community-based adaptation measures. Thus, there has been an increasing realization that the observations and assessments of indigenous peoples and marginalized populations prove valuable regional in-situ information, offer regional verification of global scientific models and satellite data sets, and provide the basis for successful adaptation and mitigation strategies (http://www.unutki.org).

Tribal agriculture is in a dynamic situation in tribal Odisha and tribal farmers are with all efforts to rediscover their sustainable agriculture with mixed cropping systems. Series of case studies, documented by Living Farms and published by IPS news, clearly indicate that the tribals in and around Niyamgiri hills are taking recourse to their 'grandfather's practice'. A survey conducted in village Munda of Rayagada district has brought out the climatic situations under which the tribal farmers feel that their traditional pattern of land use and agricultural practices has the inbuilt mechanisms to cope with climate fluctuations such as erosion, dryness, soil acidity and falling ground table. The survey reveals that subsistence farmers in 70 Niyamgiri villages in Rayagada, adapting to changing conditions meant reverting to traditional farming methods such as mixed cropping, the use of organic fertilisers and trusted seed varieties. Many farmers held that under the drying condition of soil due to less rainfall and inadequate infiltration only their traditional seed varieties can germinate and produce better compared to any other improved methods of agriculture and seeds. The case studies indicate that by dint of their generations of interaction with local environment the farmers are equipped with the knowledge to cope with climatic fluctuations and manage their land and water resources in a way to secure their subsistence crops of traditional varieties. There are varieties of millets and other traditional crops that can withstand climatic fluctuations and can secure the subsistence of the communities in traditional agriculture under rainfed conditions. Perceptions like this puts the traditional practices and indigenous knowledge acquired out of such practices at the centre stage of identifying climate change adaptation strategies. (www.ipsnews.net)

Studies and documentation on tribes in Odisha in relation to climate change and agriculture in the state indicate that the State is reeling under impacts of climate change impacts. Basing on documentation and observations on Dongaria Kondh, Living Farms (NGO) advocates that there is a need to look for solutions dependent upon the climatic and agricultural conditions in the different areas. Not all crops and farming methods are suitable for all areas as the situation is becoming more extreme. In the case of the Dongria Kondh this means a reintroduction of millet based farming system. Traditionally, tribals and adivasi have had access to less fertile, rainfed agricultural land in mostly uphill areas. On these lands they grew crops like millets, sorghum, oil seeds and a few varieties of paddy that could grow in rainfed hill slopes. This farming system based on millets has gone lost due to the recent over-emphasis on rice and wheat. Goverment data shows a 25% decline in millets. In this context, the studies explicitly raise that the traditional practices has resulted out of generations of experience based knowledge and the multiple cropping system thrives well in the terrain. Land and water management remains an embedded practice in the traditional agriculture on slopes. Hence, the traditional practice is vetted as to be the scientific and relevant in local context (http://www.living-farms.org).

There are better instances of how tribal people in central India have developed coping mechanisms to combat climate change impacts. An article published in Down To Earth describes how shifting cultivation, according to tribals, play an important role in providing food security to the Baiga tribals living in the Mandla and Dindori districts of Madhya Pradesh. A similar form of cultivation called *penda* is practised by the primitive Madia tribe in the hills of Bhamragadh in Gadchiroli district of Maharashtra. Despite their illegal status on land ownership over hill slopes, *bewar* and *penda* cultivation practices continue to thrive among these tribes because they involve no cost or loan, are less laborious, give an assured crop from land considered inferior, and yield more nutritious and varied food than conventional cultivation. *Bewar* cultivation is also practised by a significant proportion of the tribal population in Chhattisgarh. In recent years, the findings indicate, tribal farmers who had converted to conventional agriculture are returning to *bewar* and *penda* cultivation in the face of increasingly erratic rainfall patterns and crop losses as climate change makes its presence felt. This cultivation is much more resilient to environmental stress, and gives an assured yield in both low and excess rainfall conditions. (www.downtoearth.org.in)

The Status Report on Land Rights and Ownership in Orissa has indicated that the Land utilisation pattern in the State is fast changing in favour of cash and non-food crops. The irony is that such diversion of species is taking place in food scarce areas of western and southwestern Orissa. The most affected populace are the Scheduled Tribes and Castes. Cash crop cultivation in tribal pockets is intruding the traditionally grown highland cereals (black gram, horse gram) and minor millets (Arhar, Janha, Suan) area leading to constant decrease in the production and non-availability of cereals and millets. This contributes to the growing food scarcity and nutritional imbalance in the tribal areas of the state (UNDP, 2008 p.63). The report implicitly comments upon the expansion of cash crops under agricultural extensions that take away the communities away from their traditional agriculture and thereby discouraging traditional skills, knowledge and resource management practices in remote pockets (http://www.undp.org).

SCOPE OF STUDY, OBJECTIVE AND METHODOLOGY

The natural resource usage systems in the tribal areas, including pattern and pace of their change, manifest the social adaptation to the constraints and opportunities associated with specific features of resource base. However, land and water are the two most important components that require adequate attention if rainfed agriculture has to contribute significantly for food and environment security in tribal areas in a long term perspective. The tribal have enriched perceptions of sound ecological principles relating to land, water and forest management as part of their indigenous knowledge systems and techno-economic pursuits which can hardly be ignored. Tribal cultures represent a vast assortment of local ecological and biological knowledge, as an invaluable library that is being destroyed every year due to lack of appreciation and usage. But such knowledge systems are very relevant to the context of studying changing man-nature relationship and its hegemony.

Traditionally, tribal people across regions and landscapes in Odisha have evolved sound methods for conservation of land, water and forests. But the over increasing pressure to grow more has condemned this traditional wisdom. However, such rich traditions and skills have not been able to prove their merit due to lack of proper documentation and scientific validation. However, one cannot but appreciate the high engineering skills and need based responsive innovations showcased by many tribal communities in Odisha to restore their production base by conserving soil and water in a rainfed agriculture context. In this context, the scope of the present study examined -

- Suitability of technologies and knowledge systems in relation to terrain and topography
- The understanding of land and water conservation measures taken on different land use units
- The knowledge of moisture management with physical and bio-physical interventions
- Land use unit wise cropping as a means for better soil and water management
- Coping with micro-climatic changes
- Understanding on ecological functioning and resilience in a forest-agriculture system
- Studying the social control mechanisms in favour of the soil and water conservation

Objectives

- To document traditional technologies in land and water management, soil and moisture conservation techniques, various bio-physical interventions, and the thumb rules relating to their traditional technology
- To examine the relevance of soil and water conservation technology in farmland and beyond over a landscape in relation to the production patterns, fertility restoration, arrangement of crops for water management and drought proofing
- To document the coded/uncoded rule systems existing within the communities towards maintenance and management of various structures and procedures taken towards soil and water conservation
- To make a precise documentation of various implements and artefacts made of metals and wood/bamboo that are used in various procedures adopted for soil and water conservation as well as for agriculture

Coverage of the Study and rationale for selection

The present study covered two PVTG communities; Lanjia Saora and Dongaria Kondh of Odisha and another PVTG community called the Koda in neighboring Andhra Pradesh. The communities have been selected in consultation with experts at SCSTRTI after a round of general observation on various PVTGs in Odisha and Andhra Pradesh. The selected communities for this study are well known for their innovative land use on the hill slopes that underlies vast body of traditional wisdom and indigenous knowledge regarding soil and water management on hill slopes and valleys that sustain agricultural production, and that is resilient with reference to the local environment and the perceptions of local climate change.

Secondary sources have also contributed to the rationale of covering the above three PVTG communities in the context of the study. The Lanjia Saoras have, over the years, integrated modes of production on hill slopes, i.e. they have been practicing slash and burn agriculture on hill slopes, plain land paddy on terraces formed on wider slopes, and horticulture-cash crops on the degraded slopes. That apart, they also see the primary forests as sources of NTFPs for which they also manage the land, water, vegetation in the forests for sustaining supplies of NTFPs. Hence, the indigenous knowledge is diverse with respect to each production space as referred here. The diverse form of knowledge provides a broader spectrum and dimensions of studying the indigenous knowledge related to land, water and forest management. At the same time it offers wider scope to understand, document and discuss the traditional technology employed in management of these resources. The land ownership pattern and management responsibilities within *Birinda* or extended families would also add to the understanding of various designs that are employed to arrest soil erosion, nutrient management and water management.

The Dongaria Kondh are one of the best known PVTG for water management, intercropping on lands previously under slash and burn agriculture. The indigenous knowledge systems of the Dongaria Kondhs, in many ways, are very distinct from any other tribal communities. The Dongaria Kondhs have denomination and classification of land use units which represent different types of production zones within their ancestral domain. The diverse denomination builds the hypothesis that the community members have grandeur of indigenous knowledge specific to land units and the terrain. Hence the community is very relevant from the perspective of the present study.

On the basis of survey of secondary resources and physical verification of tribal locations in the bordering areas of Odisha and Andhra Pradesh and further consultation with SCSTRTI the Koda tribal community in Andhra Pradesh has been taken up for the study. The Koda community, regarded as PVTG, resides on high mountainous regions in Araku landscape and is adept to shifting cultivation as their mainstay of livelihoods. They have their traditional systems of resource management which is important in the context of this study.

Methodology

Study design: The study followed an exploratory design to understand the indigenous knowledge systems embedded in traditional practices relating to land and water conservation. A broader framework for the study was designed after initial field visits that were broken down to checklists in order to cover the different aspects and dimensions of the study.

Sampling: Convenient sampling method was followed for selection of study villages. After pilot visits the study villages were finalized. To cover the Lanjia Saora community, the villages under Lanjia Saora Development Agency (LSDA), Puttasing were selected. For studying the Dongaria Kondh, villages under Dongaria Kondh Development Agency (DKDA), Chatikona were selected. For study on the Koda in Andhra Pradesh villages under Paderu Mandal (Block) under Paderu ITDA were selected.

Fieldwork: The primary sources of information were gathered through extensive fieldwork in the study villages. The data collection was done through interviewing the farmers, small and large group discussions, focus group discussions (men/ women/ agriculture dependent/wage dependent families) with reference to a checklist prepared for the purpose. The PRA tools were used to understand the landscape, resource pockets and community interactions with resources. Transact walk with community members were conducted to understand site-specific interventions in the context of land and water resource management. Walking along farmers through the farm lands and direct observation on work practices elicited enormous information on the ecological understanding and environmental perceptions of the communities.

Secondary sources: Secondary sources were consulted to supplement the primary information and help interpretation of the study findings. Available books and journals, research reports, news clips, web sources were referred and reviewed to build a wider outlook on relevance of the study and identify suggested literature in the lines of the study.

Case studies: Case studies covering the visually interpreted and verbally articulated explanations relating to various types of bio-physical interventions including crop planning and vegetation management have been collected with reference to each tribe covered under the study. Photographs and sketches suffice to explain the relevance and appropriateness of the interventions in relation to the location of land, the purpose of utilization and the ecological functions in a landscape.

Draft Report, Peer review and final report: The draft report has been prepared following descriptive design with narrations, case studies and photographs following a chapter scheme. The draft report shall be further developed after peer review by a panel suggested by SCSTRTI. Basing on the observations of the peer review the final report shall be prepared and presented to the SCSTRTI.

Limitations of the study

- The study could not cover all the seasons in a year. Field work with the communities through seasons and agricultural calendar of the communities could have generated more empirical information in the context of the study.
- Language barrier and the typical problems in articulation by the informants had its own limitations on the study
- The study could not generate adequate information to indicate the cross-cultural variation in understanding and perception among the three tribal communities studied.
- The study has limitations in consolidating the traditional norms and institutional procedures applicable in the specific context of land and water resource management because of wider variations across villages of the same community.

Chapter -3

AREA, PEOPLE AND CULTURE

Distribution of tribal communities

In Odisha, broadly there are four distinct geographical zones in which the tribes of Odisha have been distributed in uneven proportions. They are: The Northern Plateau, The Central Table Land, the Eastern Ghat Region and the Coastal Region. The Eastern Ghat Region is further sub-divided into Northern Section, Central Section, Rayagada Section, 3000 ft plateau, 2000 ft plateau, and 1000 ft plateau. The PTG communities Dongaria Kondh and Lanjia Saora covered under the study are distributed in the Rayagada section of Eastern Ghat Region.

Dongaria Kondh of Niyamgiri hills

Dongria Kandha Development Agency, Kurli, operating from Chatikona of Rayagada district covers 1475 Households in 62 villages with a total population of 6264 (2656 male & 3608 female). Their growth rate is (from 2007-10) 4.47% and the sex ratio is 1358 per 1000 male. The density of population of the area is 54 per sq.kms and the average household size is 4. The total literacy rate of the Dongria Kandha of the Micro Project is 33.68%. The literacy rate for male is 46.57% and the female literacy is 23.42%.

Figure 6 Dongaria Kondh Settlement

Dongarias are one of the primitive sections of Kondh numerically the largest among the 62 tribal communities in Odisha. They are called Dongarias as they live on mountain tops or highlands. They relate to the proto-australoid stock with a considerable mongoloid admixture. *Kuvi*-a Dravidian Language is their mother tongue. The Dongaria Kondh villages are

located on the hill slopes or valleys in a tangle of thickly wooded hill ranges. At the village entrance within mango and jackfruit trees the shrine of the village deity – *Jatrakudi Penu* is installed in a thatched shed. Its walls are painted with beautiful coloured geometric designs. At the other end, close to the hill streams lies the girls' dormitory. It is a preparatory home for the unmarried girls to learn about their life ways before entering into the family life. In the middle of the village street another thatched shrine (*kudi)* accommodates the Earth Goddess *(Dharni Penu)*, the supreme deity. Close to the Kudi there stands beautifully designed and carved wooden posts representing the consort (*Jhankar or Kateivali Penu)* of Darni Penu.

The typical Dongaria houses have low thatched roofs. Built upon a rectangular plan, it consists of a spacious rectangular room and another small room *(Dhapa)* at the back with verandahs in front and back. The living room is used for sleeping and dining. Often a ceiling like platform is built inside to store food grains and other sundry articles. A small partition wall separates the kitchen from the main room and keeps it out of sight of outsiders. Cattle are tethered to the wooden posts in the cowshed (*Hada sala)*, built near the house.

Mostly, Dongaria family is nuclear, monogamous and patrilineal consisting of parents and their unmarried children. When a son grows up and gets married he sets up his own house and lives there with his wife and children.

The family acts as an economic unit. All the capable adults and children above 8 years of age toil in the field and contribute to the economic pool of the family. Men do the hard works and women, besides their routine housekeeping and child care engage themselves in farming and other subsistence activities. In swiddening practice they clean the bush, thorns and thickets, and do the sowing, weeding and harvesting. Property is inherited to sons only.

Seasonal cereals, pulses and vegetables viz.maize, millet, *kandul, kating, balia and jhudang,* etc, roots like *Rani Kanda* and *Langal Kanda*, fruits, green leaves and mushrooms are cooked and eaten. They relish non vegetarian items prepared out of fish, chicken, meat, buffalo meat, pork and beef. Dry fish baked on fire makes the evening meal delicious for them. They are very fond of distilled liquor out of mahua (*irpi kalu)*, and sago palm toddy *(mada kalu)*. Besides they also brew and drink banana liquor *(tade kalu)* and molasses liquor *(guda kalu).* Liquor is used as medicine, as ritual offering to appease deities and ancestors, to entertain

friends and relatives. They consume various narcotics and stimulants like *kara, dhungia, kundeli* and *chunga. Kara* is prepared out of tobacco leaf and fine ash for chewing. *Dhungia* is chewing of raw tobacco.

Paucity of plain and wet land and natural conditions has made them shifting cultivators. In the swiddens they grow a variety of crops comprising cereals, pulses, legumes, fruits and vegetables, roots and tubers. A swidden owned individually is cultivated for three to four years continuously before fallowing for about two to three years.

Dongarias are skilled horticulturists. Taking advantage of favourable climatic conditions they raise jackfruit, mango, citrus, banana, pineapple, turmeric and arrowroot plantations on vast stretches of hill slopes right from valley bottom to the hill top. In their kitchen gardens they also grow mango, jackfruit and vegetables like gourd, pumpkin, beans, brinjal, tomato, chilly, etc.

Traditionally, Dongarias enjoy indisputable rights to plant fruit trees anywhere besides his own land and enjoy the fruits of his trees. The favourable environmental factors in Niyamgiri hills favour horticulture very much. Collection of NTFPs, small scale animal husbandry, wage earning supplement their income from farming.

Traditional village council is composed of household heads and village leaders. The council handles matters like inter-personal conflicts and feuds, breach of taboos and customs, offences committed by anybody, property sharing in case of a family partition, property inheritance cases, irksome love affairs, adultery, etc.

At the village level, a set of traditional leaders and village council exercise control. Jani, the priest, is formal secular and ritual head of the village and village council. He presides over the village council meetings. He is the custodian of norms, customs and social sanctions. He fixes dates for various meetings, rituals, ceremonies, feasts and participates in all events in family, lineage and village levels. His post is hereditary. He does not demand any remuneration for his services but the villagers offer him the head and good share of meat of sacrificed animals in communal rituals and hunts. *Bismajhi* is the revenue collector and village fund manager whose secular position comes next to Jani. He collects land and forest revenue from the household of the village and impose penalty on offenders declared by the

village council. He presides over the village meetings in absence of Jani. He fixes up the share contributions in communal feasts and festivals in consultation with Jani. *Barika* is the village messanger who belongs to Domb community. He circulates news in the village about important events such as birth, death, serves summons to people and leaders for the village meetings, collects cash or grains from the villagers on the headman's instructions.

Mutha is an important feature of social and political organization of the Dongaria Kondhs. It consists of a group of adjoining villages and is treated as an administrative-cum-social unit. It is led by a head designated as Mandal. The entire Dongaria area has been divided into 21 muthas. This organization has received recognition from the ex-feudatory set up.

The Dongaria Kondhs believe in the existence of a large number of supernatural beings who exercise control on various aspects of their mundane life. Their pantheon is composed of Gods, deities and spirits – both benevolent and malevolent. Goddess mother earth called Dharni Penu or Jhankar is the benevolent supreme goddesss. In every village she is represented by three elevated stones. Her consort Kateivali Penu represented by a vertical stone with crossed wooden pole (Munda) at its back lie by the Kudi. He watches the village and protects its inhabitants from any odds and evils. He is worshipped with Dharni Penu. Jatrakudi Penu, Hira Penu, Niyamraja Penu, Dongar Penu, Lada Penu are the other village deities. At the household level various ancestral spirits, Lai Penu, Sita Penu, Danda Penu, Chhatar Penu, Bhairo Penu are worshipped and propitiated. Among the malevolent spirits Maunli Penu, Buru Penu, Suku Penu inflicts diseases who are satisfied by Shamans and Bejunis. Ghanta Parab,Salangi, Mandia Rani, Dhan Nuakhia, Pidika, Punapadi, Dongar Puja, Meria Puja, Bihan Puja or Sadrangi Laka are important regular festivals and rituals in their agricultural and ritual calendar. Meria festival is the biggest and most important festival observed communally in any one of the villages of a Mutha for 8 days during January-February in which people of other Muthas participate too. Their dance forms are Kedu Dance, Bali Parab, Dhap Dance and Meria Parab dance.

Lanjia Saora of Puttasingi hills

Figure 7 Lanjia Saora woman

Lanjia Saora Development Agency, Puttasing is about 20 km away from Gunupur Block headquarters in Rayagada district. It covers 1012 households in 20 villages with a total population of 6267 (2927 male & 3440 female). Their growth rate is (from 2007-10) 3.22% and the sex ratio is 1141 per 1000 male. The density of population of the area is 179 per sq.kms and the average household size is 6. The total literacy rate of the Lanjia Saora is 51.81%. Literacy rate for male is 63.26% and the female literacy rate is 41.52%.

The Saora legendary view of ethnicity gives that the etymological meaning of Saora goes with two words *so* meaning hidden and *ara* meaning wood. It means, as described in myth, that the Saora emerged from a hollow wooden trunk and later lived amidst woods. Tracing the root of the term Saora, Patnaik (1989) holds that 'the term Saora appear to have two connotations one derived from *Sagories,* the Scythian word for axe and the other from *Saba Roye*, the Sanskrit term for carrying a dead body. Both of them fit well with their habit of carrying an axe on their shoulders with their primitive occupation of hunting and living on spoils of chase.

Figure 8 Lanjia Saora landscape

Sitapati (1938) has made 25 subdivisions of Saora. According to Thurston's classification, the Saora community is divided into two main divisions: Hills Saora and Plain land Saora, the former being large in number showing affinity with proto-austroloid group. Saora are cosmopolitan in distribution (Vitebsky,1993).

Linguists identify the Saora language as belonging to the Munda group. G. V.Ramamurti an authority on Saora language says 'it varies considerably not only between villages but also between individuals' (Patnaik, 1989). According to Elwin (1955) 'the Saoras who give the impression of being rather matter of fact and prosaic are surprisingly picturesque and metaphorical in their speech'. They speak their language at home among themselves and within their community. But to the outsiders they speak in Oriya or Hindi.

Hill is the elementary unit of settlement for Saoras. The first man lived on the hill top called *Ajingbur*. Then gradually they came down and started their settlement on the foot hills (*Baseng*). While selecting a site, importance is given to water resources, availability of plain lands for making terrace cultivation. The first house holders in a new place allowed only people from their *Birinda* to stay with them and the settlement became dominated by people of specific *Birinda*. At that time due to irregular arrangement of houses the settlement looked disorganized and scattered. With growth and influx of population to the areas new houses were built with a common wall. After few years by continuous addition of new houses the settlement site looked like rows of houses. Gradually, an area gets filled in with houses with front yards and back yards. When space becomes very scanty for any new house in the same area, some people shift the place for a new habitation elsewhere.

The houses in which Saora lives is called *Nyalsing* type, which shows similarity with that of local Telugu people. People who had been to Assam and Arunachal Pradesh have built houses with non-traditional designs. The houses are rectangular in shape, single roomed, divided into many zones such as; *pigdis, diasing, alusing* etc. At the entrance of the house there is wide verandah. *Pigdis* means the space for pigs and fowls. *Diasing* is the floor under the loft (*mada*). The space after *Diasing* is *Alusing*. The loft carries all paddy, crops, valuable utensils etc. On the floor there is a rice pounding hole. The hearth or *kuda* is at the dark corner of the house. The *mada* and *anal* (rice pounding hole) has religious importance. The thatching of house is done with grasses (*Themda arundinacea*) available in the forest. The walls are set with smaller stones and mud, the outside is not plastered. The windows in the houses are a recent addition. In modern houses two doors with knobs, handles etc. of steel and aluminum are used extensively. Extension of houses if required is made to the backsides.

Saora family is patriarchal (*Jujukukud*) and patrilocal. The most common type of family seen in this society is nuclear family called *Abakukud*. After death of the family head (senior male member/ father) the sons may live separately if they wish. Traditionally, most of the families were of *Abarukusing* type (joint family) or *Atengku* type (extended family with more persons including kin and relatives). Property is not inherited to women. A daughter may take the ownership of her mother's assets. After distribution of property among the sons the parents live with the youngest son for which he is given with little more share. In important functions of the family i.e procreation, male children are preferred, for they become the legacy holder of parents as far as inheritance of property is concerned. The sons can only perform mortuary rites (*Goar and Karja*) of the parents. The girl children are given importance for their hard work both in household jobs and in swiddening. In the absence of clan, Birinda plays a great role in rituals and functions of their society.

The principal food item of the Saora is rice (*kudu*), cooked rice with gruel (*darikul*), rice cooked with red sorrel leaves (*sunsunab or ubakul*). Of the millets, sorghum, bajra, ragi and other minor millets add substantially to their food habits. Usually, they prepare gruel (*tungdakul*) out of such cereals and millets. They hardly take vegetables. They take meals 3 to 4 times a day. Children up to one year do not eat rice. They also collect many varieties of tubers, mushrooms, leaves, etc. from forest for supplementing their main food.

Meat is an important item on the festive occasions and treatment of guests among traditional Saoras. They take meat of fowl, goat, pig, buffalo, cow, etc. Baptist Saoras are forbidden from these items. They take three types of liquor that is *arasal* (sap of *Caryota urens*) or *ali*, *abasal* or *aba* (*Madhuca longifolia*) and *sindisal* (sap of *Phoenix sylvestris*). The first two are usually taken by them. Any festival occasion without meat and liquor is meaningless for them. Both the genders can smoke. Tobacco (*Nicotiana tobaccum*) is not cultivated by them but purchased from market.

The Saora economy of the past had been based only upon shifting and terrace cultivation. Now-a-days they have taken up varied occupations to improve their economic conditions. Now they practice shifting, terrace and low land paddy cultivation and also horticulture. However, horticulture is finding more favour as against the other forms of cultivation, especially cashew plantations. All these forms of cultivation in addition to the sale of forest produces provides for their subsistence. Since these Saoras have very meager land holdings,

many of them migrated to Assam and Arunachal Pradesh to work in tea estates there. There they have established saving co-operatives by making regular collections from its members. This money is disbursed as loans at the time of need. One who takes a loan must pay back in kind of labour.

Way back in their homelands, the women are more laborious and hard working. They put in a good contribution to their household economy. They are the principal workers in the household as well as in the fields. The men, away from their homeland, equally labour hard for benefit of their employers. Saoras also find employment with the Government, private service, and temporary wage earning sectors, temporary employments and even small businesses.

There are three important groups in Lanjia Saora community having specified status and functions in a hierarchical order. *Gomango* at the top of the hierarchy is the head of the political and judicial structures. He is the chief decision maker, called as *Suda Bicharmar*. Next to *Gomango* is *Dalbehera*. When a *Gomango* dies having a minor son, the son of the *Gomango* remains as the nominal head and the responsibilities are discharged by *Dalbehera. Karjee* is the person who reports to *Gomango* through *Dalbehera* always. In case of violation of social and cultural norms fines (*aptintinaleji*) are levied in kind of livestock, buffalo (*bungtel*), goat (*kumme*), fowl (*kanseem*) etc. If a person is found incapable of paying fines he has to give his land on mortgage to anybody or to the *Gomango* till the fine is realized. If a person levied with a fine is landless, then he will have to serve in the *Gomango*'s field or house till his penalty amount is realized through his labour (*kambari*). The fine collected in kind of animal is utilized for a common feast.

In the traditional system of decision making women are never allowed to participate. But now the women are taking part in decision making in the Panchayatiraj system. Women have also been used to the police stations and lower courts. The social issues of Christian Saora are decided at *Mandali*. People committing crimes are boycotted by the Church *Mandali* and levied with heavy fine.

Saora religion is animistic. They believe that every natural object such as Sun, Moon, Water, Forest, Fire, Animals, Trees are supernatural powers and thus are characterized as *Sonums*. They believe in the presence of soul and the life after death. According to Vitebsky (1993)

Saora *Sonums* can be divided into two groups: Ancestral (the persons who have been given with three mortuary rites) and Experienced (reverse to ancestral spirits). In addition to the above two groups, celestial beings can be grouped separately. The people who die of accidents and are not given with mortuary rites goes to the Sun spirit and people know them through experiences (disease or accident). Celestial beings are those who do not have anthropomorphic forms like Sun, Moon etc. Among the gods Sun spirit (*Ooyungsum*) and Earth spirit (*Lobosum*) is very powerful. All male deities have wives. *Manduasum*, a male deity is the protector of the village. *Ildasum* and *Raudasum* are the main ancestral spirits who are linked to well-being and welfare of the community for which they are worshipped by *Shamans.*

They worship their deities and spirits in different occasions throughout their agricultural calendar. Among these new eating festivals like *udan abdur* (Mango new eating), *Ragan abdur* (Redgram new eating), *rub-da-singpur* (rain worship), *Lajjab* (worship offered to ancestral spirits and earth goddess for bumper crops), *Gungupur* (betterment of livestock), *Madapur* (mist worship), *Kurual* (better production in swiddening), *Manduasumpur* (for village welfare) are important. Other festivals are situational. On spirits demand, S*harmans* organise worships for them. Their ceremonies are much expensive due to involvement of big budget for sacrificial animals i.e buffalo and goat etc. The expensive religious affairs make them indebted. The Christian Saoras celebrate 25th December and 1st January in pomp and show. Saoras also believe in magic. The god associated with magic is called as *Tonaisum* and therefore the magic practitioner is called as *Tanaimar*. Their Dance forms are Guartang, Karjyatang, Adratang and Anjamantang Dance.

Koda (Kondh) of Araku valleys

Koda (Kondhs) are chiefly residing in the densely wooded hill slopes in the scheduled areas of Srikakulam, Vizianagaram and Visakhapatnam districts of Andhra Pradesh. They are also known as Samanthulu, Konda Kodu, Kodu, Kondu in Chintapally areas of Visakhapatnam district and in other areas they are also called as Jatapu, Jatapu Dora, Kodi and Kuinga. These terms are used for Kondhs in different areas of Srikakulam, Vizianagaram and Vishakhapatnam districts. The Kondhs call themselves in their own dialect as Kuinga or Kui Dora. Their population according to 1991 census is 66,629.

Kondh has been identified as one of the PTGs in A.P. The word Kondh is derived from telugu word Konda which means hill. The settlements of Kondhs are invariably found on the hill tops slopes, or valleys in the interior forest areas. They live in linear shaped rows of thatched houses. The settlement pattern and house types of Kondhs are distinct when compared to other tribal groups. Unlike Kondhs of Visakhapatnam district, their counter parts viz. Jatapus of Srikakulam and Vizianagaram are comparatively advanced and are living in plain areas also.

Figure - 9 Koda old man

Koda or Kondhs have good physique and fair skin. Men and women of this community can easily be identified by their physical features and ornaments. Kondhs speak dialect Kui or Kuvinga which belongs to Dravidian linguistic group. In entire Visakhapatnam agency area and in road side villages of Srikakulam and Vizianagaram districts they speak telugu fluently. The Kondhs in Andhra Pradesh are divided into the following sub-groups.

- Dongria Kondh
- Desya Kondh
- Kuttiya Kondh
- Tikiria Kondh
- Yeneti Kondh

Figure - 10 Koda Landscape

Each sub group of Kondh tribe is divided into a number of totemic clans. Each clan has a distinct name and Illu-Peru (house deity). The matrimonial alliances are permitted basing on clans names. The clans between whom the matrimonial alliances are not allowed are called Tainga or brother clans and the other clans between whom the marital alliances are permitted are called `Sandinga' clans. These groups of clans however do not form into phratries. Monogamy is the rule and polygamy are rare. Both levirate and junior sororate are in existence. Marriages by exchange, marriage by elopement and by service are socially approved ways of acquiring mates. It is customary duty of younger brother to marry the widow of the deceased brother.

The Kondhs eat both vegetarian and non-vegetarian food. They eat fish, eggs, beef and pork besides the flesh of domestic animals and birds. The staple food of Kondhs comprise of Ragi and Sama supplemented by numerous edible fruits, roots and tubers and leafy vegetables available in the forest. They consume pulses like red gram, green gram, black gram and beans. During lean season, they prepare gruel with mango kernels, tamarind and *addah* seeds and consume. They use niger seed oil and castor oil for cooking. They use milk and milk products. They are experts in *podu* cultivation. Because of this type of shifting cultivation they used to shift their habitat from place to place in order to cultivate fresh *podu* patches. They are well versed in basket and mat weaving, oil extraction etc.

Nuclear type of families pre-dominates over joint families among Kondhs. Woman is an economic asset to Kondh family. They are industrious and attend to all kinds of agricultural operations and participate in all social, religious and ritual activities.

The Kondhs mainly subsist on cultivation especially shifting cultivation. They grow variety of millets like ragi, *sama*, *and kora*; oil seeds like niger, sesamum and castor, pulses like horse gram, red gram and mungo on hill slopes in swiddening system. They also cultivate paddy on low lands; cultivate vegetables like cabbage, brinjal, tomato, potato, beans, etc; and spices like ginger, turmeric, chilli where water sources are available or in small scale in kitchen gardens. They also collect Non-Timber Forest Produces like *adda* leaves, tamarind, sikakai, broom sticks, mahua flowers, etc that they sell to Girijan Cooperative Society in Andhra Pradesh.

The cropping pattern in the Kondh area depends on the type of land and the availability of labour force in family. Accordingly, the following types of cropping pattern are seen.

On hill slopes / podu clearing / swidden system

- Multiple cropping with more than 15 varieties of crops
- Finger millet and little millet and grams on degraded swiddens
- Dry paddy alone on slopes
- Cashew as pure crop in podu clearings
- Mango as pure crop in podu clearings

On plains / valleys / stream sides

- Wet paddy followed by ginger
- Jower, Bajra as pure crop
- Dry paddy alone
- Jower citrus alone
- Niger & Jower followed by Rajma beans

Kondhs are basically Hindus and profess Hindu religion. These people are polytheists and their pantheon consists of number of deities whose names invariably have the suffix `Penu'. The name for God in Kui is Penu. The priest is called as Disari-who attends all religious functions and fixes Muhurthams. Pejjini Buddi is a married women or widow performs all rituals of Kondhs. Gumbria is a man who plays musical instruments during festivals. Mahini-pujari is a man who attends to death ceremonies.

The important festivals called Parbus of Kondhs are

- Hira Parbu (Seeds to be frondested and charmed).
- Maha Parbu (New mango fruit eating)
- Tukki Parbu (First mango Kernal eating)
- Junaga Parbu
- Kumla Parbu(consuming of maze and pumpkin products)
- Painaka Parbu
- Bhima Parbu
- Bitcha Parbu (Before sowing seed)
- Maha bonda parbu
- Rogga Penu Parbu (to avert epidemics)

The Kondhs have a village/habitation level traditional tribal council usually consisting of four or five members headed by a man called Havanta, whose office is hereditary. The members of the council are selected. The main functions of the council are settlement of disputes on marriage, land and other property. Village traditional panchayats are heterogeneous.

Kondhs perform a folk dance called Mayura (peacock dance) which is an imitation of movements of peacock. Their dress, decoration, body modulations and voice are like peacock. They are experts in performing this dance with 10 to 20 male Kondhs. Two musicians play on Bamboo flutes. They move in a circular fashion by all dancers with song of praising earth goddess. Afterwards the dancers sit on their toes and hop and cry like a peacock. The Kondhs perform this peacock dance on every festive and marriage occasions. In dance form they will depict the process of marriage patterns, rituals and divorce.

Chapter-4

DENOMINATION AND CLASSIFICATION OF LAND AND WATER RESOURCES

Land and Water are cultural resources

Land and water are important natural resources. They are, however, more important as social and cultural resources for the tribes. In the tribal religious notions the earth and water have been deified and their good will is imminent to the survival of the communities. In the tribal way of life great respect is given to the Nature and its parts such as hills, forests, landscapes, streams, rivers, farms, etc. Each part of the Nature has both utilitarian and cognitive significance. In a cognitive orientation, the tribal people believe that as long as they respect the Nature whose components have been otherwise deified with several denominations, their well-being and survival is ensured. Land, water, trees, forests, streams, rivers, sun, moon, wind, rain, and any unseen associated are deified. The communities highly respect such gods and goddesses and believe that any action violating the gods and goddesses would invite their wrath and anger that would be detrimental to the communities. Hence, these natural objects and subjects are not simply considered as natural resources but also have been conceived as cultural resources. Such belief systems guide, control and limit their interaction with the natural resources like land, water and forest.

The Dongaria Kondh religious notions associated with land and water

In the Dongaria religious notions, the goddess Earth is known as Dharani Penu. She is all-powerful and all-pervading deity of the Dongaria Kondh, and bears the highest significance in the mother cult. She wields authority over the entire environment and almost every village marks her presence with a *dharni vali,* comprising three small stones placed beside a larger one (for *jhankiri penu)*, in the center of the village. In Dongaria villages, a shrine known as *padari kudi* or *sadar kudi* is built in the form of a house and *dharani penu* is worshipped there.

According to Dongarias, the earth is the place for living and the place where food is produced. Cultivation and collection of forest produce not only serves individuals and their families, but also the deities. It is believed that the deities ensure ample crops if the people make offerings from their harvest. Farming is thus important as an activity that maintains the interaction between the deities and the people.

In their agricultural practices, although highest importance is given to *Dharani Penu*, many other gods and goddesses are also given due importance. In their ritual calendar, the Dongaria Kondhs observe various rites and rituals associated with different stages of their cultivation and farming practices. Jena, et.al. (2002:199) have presented a list of rituals and deities associated in the practice of shifting cultivation. The list indicates that along with Dharani Penu who is accorded with highest importance as the goddess of earth on whose permission cultivation and farming is taken up by the community members, there are many other associated deities whose good will has to be preserved at different stages of agricultural calendar, especially in case of shifting cultivation. Such gods and goddesses associated with shifting cultivation include, *Horu Penu, Sita Penu, Danda Penu, Nebaraja Penu, Bima Penu, Kajayu Penu, Aji Budhi Penu, Lada Penu,* etc. For each of the deities, separately or jointly or collectively, the Dongaria Kondhs conduct rites and rituals at different stages of shifting cultivation.

The deification of streams and rivers belonging to the Dongaria habitat indicates the high value given to water by this tribe. While a stream may be regarded as a component part of a hill, both are considered separate entities, distinguishable according to name. Water represents the goddess *eyu penu* (water deity), who, however, is also known by other names, mainly because several streams may originate from the same hill. The most common synonym for *eyu penu* is *gangi penu.Eyu penu* is highly revered owing to the fact that water is a crucial element of life. The Niyamgiri hill range abounds with streams. These hill streams are understood to be manifestations of *gangi penu* whereas *eyu penu* is considered to be the goddess of water in the widest sense (Jena, et.al., 2002:163). Any artificial stream caused out of soil erosion or gully formation may not necessarily be attributed the characteristics of a god or goddess as, the community members know and understand, such a happening is a cause of human interventions. The Dongaria Kondh have myths associated with origin and nature of streams. Jena, et.al (2002: 164) enumerated the various appellations by which *gangi penu* is known, and provides the name of the hills to which their origin is attributed as well as the variant names for *gangi penu* among different villages. At the time of worship, *gangi penu* may be invoked by any of these names.

The Lanjia Saora religious notions associated with land and water

The Lanjia Saora have strong religious beliefs associated with land and water. In almost similar manner like that of the Dongaria Kondh, the Lanjia Saora also regard hills, forests, land, water, landscapes, streams and rivers as gods and goddesses *(sonum).* Their ritual calendar in respect of the agricultural calendar is the best reference to know about the *sonum* related with land and water resources.

The Labosum (Lobo + sonum – earth-deity) is highly respected in the society as the owner of the earth. The Lobosum is sometimes regarded as male, sometimes as female. He/She is worshipped at most agricultural ceremonies for fertility of the soil and the production from agriculture. In all the Lanjia Saora rites and rituals Lobosum is highly revered, but in the agricultural ritual calendar the *sonum* is invoked and worshipped specially on the occasion of *Kurusal* that is conducted in the month *Gajing gai.* On the occasion worship is offered to Lobosum along with Manisum (hill sonum) and Idaisum (ikon sonum) at a *baroon* (swidden site). The ritual, done before reaping *kamboor* (sorghum) is a kind of thanks giving to the *sonums* for their benevolence realized through a bumper harvest. The ritual may be conducted by individuals in their respective swiddens or collectively done at a central place of the many swiddens. *Adapur* is the ritual when worship is offered to Lobosum and Kitungsum in the paddy fields or terraces. The worship is offered during the onset of paddy flowering wishing good production of paddy. *Madapur* and *Bubdalpur* are also other rituals in which Lobosum is offered with sacrifices for better protection to crops, especially paddy. After the harvests are over, Lobosum is worshipped specially in *Gungupur* ritual.

Jadasum is the *sonum* governing water in the Lanjia Saora country. It is regarded as the Hindu equivalent of Ganga. Jada refers to streams. The sonum is worshipped for well-being of children, especially when a new born becomes 21 days old. The worship is called Jadapur. It is believed that if Jadapur is conducted then the child when takes bath in cold water does not fall sick. However, no elaborate ritual for Jadisum is conducted in relation to agricultural calendar.

Elwin (1955) has provided a larger reference to the gods and goddesses associated with the land and water resources in the Lanjia Saora religious beliefs. They are *ajorasum, kinnalosum and jorabasum* (associated with streams and rivers), *attungsum* (associated with swiddens),

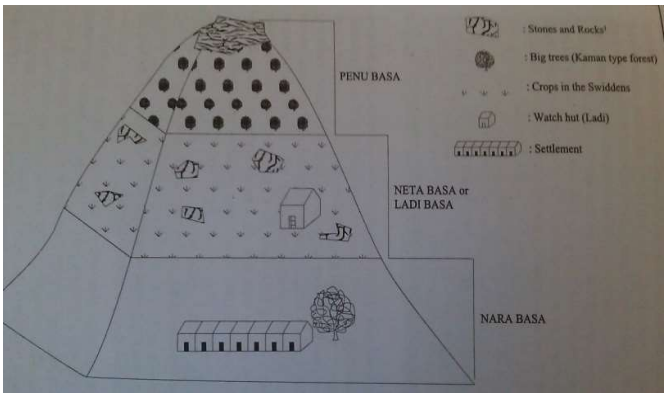
balusum, barusum and *barongsum* (associated with hills), *darisum* (synonym of Lobosum), *ganursum* (rain sonum), etc.

The belief systems and religious practices of the tribes related to land and water resources indicate that they have notions of preservation and conservation of resources associated with their socio-cultural life. The communities utilize the land and water as natural resources for their sustenance and at the same time they express their gratification to such resources known with various names of gods and goddesses for their survival. As long as the traditions continue and as long as the natural resources are deified and religious processes as cultural control mechanisms are prevailing, the tribal communities would continue to care these precious natural resources.

LAND USE AND DENOMINATION OF LAND USE UNITS

Dongaria Kondh denomination of land use units

The Dongaria Kondh has denominated their lands going by physical dimensions, land use dimensions, social dimensions and religious dimensions. The hills are perceived as living entity and social significance is therefore attached to hills. In a social dimension a hill is divided into three living spaces *(basa)*. *Basa* is used as a prefix with the entities to define whose habitat lies where. The top most part of a hill is regarded as *penu basa* (god's abode), the middle part of a hill is called *neta basa* or *ladi basa* (temporary dwellings/ watch huts where the tribesmen live to keep watch and ward on crops), and *nara basa* where the human settlements are set.



Sketch -1 Concept of Space of Dongaria Kondh, Cf. Jena, *et.al. (2002)*

In a religious dimension, the top of hill up the swiddens, called *gati,* is said to be the abode of *lada penu* or commonly *horu* (hill) *penu.* The abundance of trees and cool atmosphere is said to be conducive to the gods, goddesses and visiting deities who are invoked during rituals. These religious connotations usually deter the people from felling the trees on the hill tops. Hills with sparse tree cover are either left intact or a grove of trees is spared there as abode of hill god and other deities. These perceptions contribute to the conservation of forest vegetation and

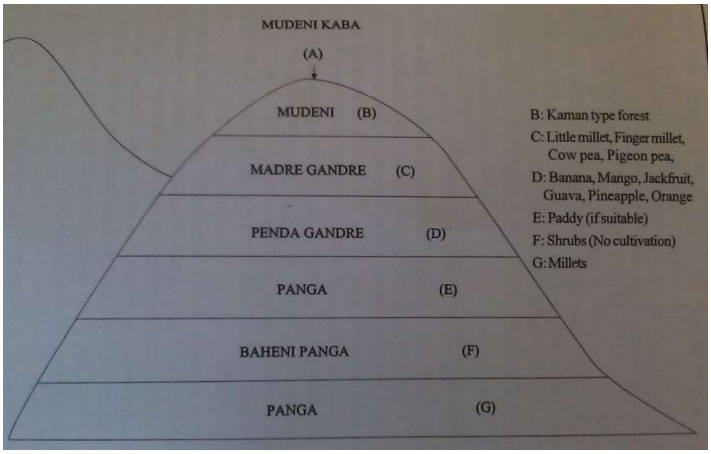
secure the good will of the gods and goddesses that are realized through the ecological services (benevolence of gods) made available to the swiddens.

Plateau shaped hill-tops are called *patra* and are believed to be the place at which the *penus* perform various activities. If the hill-top is lacking a canopy forest the *penu eja* (god's house) is represented by a huge rock or the cliff. The area below the hill top is used for shifting cultivation or swiddening *(neta). Ladi basa* is the term generally used to refer to the sentinel hut erected on swiddens, which is the territory of *danda* (slope) *penu*. It is the privilege of *danda penu* to select his abode on any part of his territory. The *danda penu* abode is represented by a tall tree or large stone on the slope. In analogy to the *danda penu's partially for* changing his abode, the Dongaria show a preference towards shifting cultivation on the hill slope: they proceed from one hill to the other, abandoning the sentinel huts and leaving a hill fallow for at least two consecutive cultivation cycles.

The lowest section of hill is known as *nara basa,* mainly because the human settlements are located on the foothill. Within the *nara basa,* certain spaces are regarded as the abode of village deities and the spaces are named by names of deities. The stream (*jadi),* also known as *gangi* is not necessarily considered part of a hill but considered an essential part of living space. For a village ritual, the goddess of earth *dharani penu*, the nearest hill god, and the nearest *gangi penu* (bearing the same name as the local stream) is worshipped.

The Dongaria believe in the interrelationship between natural (human, Plants, animals) and supernatural entities. While definite living spaces are attributed to animals, human beings, livestock, aquatic species and the *penu,* vegetation is not assigned to a specific place.

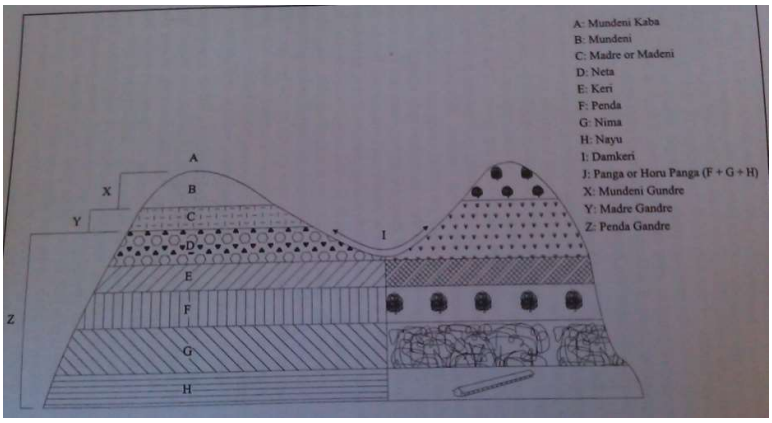
In physical configuration, the different sections of a hill as defined by the Dongaria are distinguishable according to their physical features and functions. The hill-top is known as *mundeni* or *mundeni kaba,* the middle part as *madre* or *madeni,* and the area at the



Sketch 2 - Land use zones on a hill: Dongaria Kondh Cf. Jena, *et.al. (2002)*

base or foothill is referred to as *penda, nima, panga or tana* (depending on contexts). *Mundeni kaba* or the peak may be covered with dense forest, composed particularly of timber species, or may comprise solely grassland, a plateau or a huge stone cliff. Further, the area stretching from the peak of the hill to the upper boundary of swiddens is called *mundeni gandre. The second section involves the upper middle part of the swiddens which is referred to as* madre *gandre*. Below this is is a space called *penda gandre* that is followed by the *penda.* The latter is adjacent to *nima,* an area bearing little or no vegetation and which surrounds *nayu.*

The middle section of the hill, between *madre gandre* and *penda gandre* is known as *neta* or swidden plot. Agricultural activities usually take place in this space. *Horu* is used as a suffix to describe the type of slope involved: thus *naki horu* is a steep slope, and *repa horu* is a broad slope. *Danda* is the term commonly used for slope, and any slope may be referred as *danda* in the ritual context. *Repa* is also used to describe a slope in a village settlement. The point at which two hill slopes meet is known as *damkeri, keri* being another term to describe the slope at the lower end of a hill. The junction of hills is usually evident through the presence of a stream or a village settlement. This spot is attributed the highest significance in terms of fertility of the farmland, regardless of the type of crop. *Damkeri* is also the meeting place for jungle animals, which makes the hunting of game an easy task in this area. If the space is not used for cultivating crops, it is likely to be covered with dense vegetation, partially with a *kaman* type of forest.



Sketch 3 - Denomination of parts of hill: Dongaria Kondh, Cf. Jena, *et.al. (2002)*

On the hill slope, the Dongaria cultivate a particular selection of crops. The bushy forest covering the upper part of the hill or sections of the *mundeni*, however, is usually not slashed. On the other hand, the slash and burn method is applied to the tops of low hills or hillocks. In the *madre gandre* area, seasonal crops such as cereals, pulses, vegetables and oilseed are grown. The adjoining *penda gandre* is reserved for perennials, particularly fruit

bearing species such as mango, jackfruit and banana. Naturally occurring tree species are not destroyed provided they are commercially viable. The Dongaria rely on the assumption that a better harvest results from seasonal crops if they are grown between two dense vegetation patches (i.e., between *penda* and *mundeni).* Below the *penda gandre is* the *penda* which is also used for crops, particularly rabi crops and oil seeds. Below the *penda* lies the *panga* which is used for paddy cultivation, as unlike the former it comprises flat, plain land. Occasionally, the penda is leveled out so as to extend paddy cultivation on the *panga.* Millets are sometimes also grown on the *panga.* If the *penda* or *panga* are adjacent to a village settlement, they are used for cultivating horticulture species or are converted to kitchen gardens with fruit species such as banana, pineapple, orange and guava.

Agricultural plots are demarcated on parts of a hill or sometimes cover the entire hill except its top. Some plots on the slopes are allotted longitudinally while others run transversely along the circumference (*tedi*) of the hill. The former are known as *nellu pati* while the latter are referred to as *nellu padi.* Both types of plots are defined according to the traditional system of agricultural land distribution. The *pati* type of plot is important as it covers ecologically different sections of a hill. In the distant past, the cultivated part of a hill was divided to *padi* plots, but after observing that a *pati* plot yielded a greater variety of crops, the Dongaria began to favour the *pati* method for dividing a hill. The ecological implications of each type of plot, as well as soil type, vegetation and suitability of crops can be better understood from the Dongaria swiddening practices.

According to the original distribution system, a hill was divided on the basis of various *punja* (title or functional group of a clan) in a given village. These plots were later further sub-divided to meet the needs of the following generations, an undertaking that was rather uncomplicated if *pati* was the method of choice. By constructing sentinel huts on the hill slopes it is easier to guard the longitudinal plots, but the transverse plots thereby remain rather neglected. The Dongaria Kondh are convinced, however, that transverse plots are more suitable for horticulture, but not for swiddening.

Land use wise Dongarias classify four types of cultivated land, namely - *neta*, p*anga*, *merang* and *bada*. They denominate the former three types in accordance with the topography, subsistence crops and cash crops. Lands on the hill slopes where only shifting cultivation is done are called *neta*. The foothill lands where certain cash crops are cultivated with other

crops are called g*udia* in colloquial Odia and *panga* (the foothill) in *Kuvi***.** The paddy fields which are located even at a lower level than the foothills are called m*erang*. The last type of land includes specifically kitchen gardens, called *bada*. The fruit orchards are also called *bada*. The *merang* type of land is not available in the Dongaria Kondh territory in the Niyamgiri hills. They purchase such lands from people in the plains area outside their ancestral domain.

Classification of soil by Dongaria Kondh

Dongaria Kondh terms for soil are *birga* and *tana*. English equivalent of *birga* is soil and *Tana* is equivalent to earth. While *tana* is used in general sense, *birga* is the term used in specific contexts like cultivation and other uses of soil. In their system of classifying the soil, the Dongaria Kondh considered soil nature, colour and fertility aspects. All these are definitely part of their knowledge on local natural resources.

Table – 7
Characteristics of land and soil under shifting cultivation (Sahu, Nayak, Sarangi, 2005 cf: Mishra, 2009)

Land	
Climate	Tropical, subtropical
Slope	Steeply sloping
Drainage	Excessive
Surface Stoniness	Moderate to strong
Relief	Undulating
Soil	
Depth Class	Shallow
Parent Material	Colluvium of laterites, Khondalite, Granite, Gneiss
Mineralogy	Ferratic Silicaceous
Particle size	Sandy Skeletal
Temp-regime	Iso hyper thermic
Soil reaction (pH)	Acidic
Ground water	>5m
Surface texture	Sandy
Erosion	Very severe
Water holding capacity	Low
Class of soil	Typical Haphustalfs, Rhodustalfs, Kandic & Rhodic paleustalfs, Aeric Haphustalfs

Source : "Soils of Orissa for optimizing land use" by NBSS & LUP

In their system of classification they first consider the location of the soil. It may be the soil from a hill or a foot hill or from the stream bank or a stream bed. The types of soil found at different locations vary among each other and Dongarias are very much perceptive about identifying such soil types with specific characteristics and conditions. *Tana* is classified with broader characteristics and *Birga* is classified with specific characteristics. According to them soil is made of three constituent components: *valka* (rocks, stones), *vali* (sand), and *ladre* (mud).

The soil in general called *tana* and in texture consideration it is classified into three categories: *valka tana, deni tana* and *bruhu tana.*

The *valka tana* is yellowish in colour, and is composed of more pebbles and stones that soil. Such soil is usually seen on the hills, especially on the degraded hill slopes where the top soil has been washed away. This kind of soil is characterized with degraded hills devoid of vegetation, very less soil depth, poor water retention ability and hence not favourable for crops. Hence, usually no cultivation is done there and the land is left to natural regeneration. The *deni tana* type is normally red in colour (red lateritic) and the soil is hard. It is characterized by its colour, poor permeability, morum mixed and usually found on hills and plains. The soil type is not good for cultivation. However, millet crops may be grown there although the productivity remains very low than expected. The lands where this kind of soil is seen need treatment in terms of soil working and sieving out morrum to make it cultivable. The lands where this kind of soil is predominantly seen are left barren or very rarely agricultural interventions are done.

The *bruhu tana* is the best type of soil with light red and black colour. The soil is found on hills, plains and stream banks. The soil is soft and very permeable. The percentage of humus and sand is better in this kind of soil that makes the soil soft, provides porosity and allows easy percolation of water. This kind of soil is suitable to crops as they are soft, fertile, soil working consumes less labour.

In consideration to locations of soils, the classification of soil comprise of four types: *nimatai, horutai, kakartai,* and *jaditai.* The *nimatai* type is found on the foothill which is comparatively hard soil or *deni tana* type. The second type, *horutai* refers to soil on the hills where all kinds of soil is found, however, cultivation is done on patches where *bruhu tana* type soil is available. The third type, called *kakartai,* is found under shade conditions which refer to forest floors with canopy cover. The soil here is *bruhu tana* type which is soft, and having more humus compared to that of *horutai.* This soil is therefore very rich in nutrients. The *jaditai* refers to soil on the stream banks falling under *bruhu tana* type. The soil here is having more moisture content than the same in any other location.

According to their ethno-ecological perceptions, at the foot hills there are less trees which facilitates maximum exposure of the earth to sunlight, the soil gets dried up and become hard. The moisture content of the soil makes it soft or hard. The moisture content is dependent on the permeability of soil, the vegetation cover, the infiltration of sunlight, etc.

Going by this understanding the community members take care not to clear slash vegetation at the foot hills and spare big trees to reduce infiltration of sun light.

In the humidity consideration the soil is categorized as *hila birga* (wet/ moist soil) and *bachit birga* (dry soil). The classification of soil of the same patch is connected with the seasons. In dry seasons the soil normally remains dry and hence is called dry soil and in wet seasons the soil type is called wet soil. Irrespective of the seasonal considerations soil at the stream banks and near perennial water sources remains wet throughout the year. In dry seasons even soil of dense forest patches remains moist and thus may be considered as wet soil. Wet soil is not suitable for annual crops as the crops growing there remain susceptible to diseases out of insects and pests. *Bachit birga*, if not too hard is favourable for crops.

In general usage, the Dongaria Kondh identifies six categories of soil on the basis of colour and texture. The *tala* (hair) *birga* literally means hair like fine black soil i.e. the black cotton soil type. The basic character is that it has higher clay percentage, and hence remains muddy and slippery. It stiffens and cracks when dry. Though black, its humus content is very poor. It is not very fertile. But both Kharif and Rabi crops are cultivated there for whatever return from the crops.

Chuna birga or white soil looks white mainly because of its lime content. It has enough of silica or sand in it. The soil is not much useful for cultivation purpose. It is not even good for natural vegetation. Such places are left as wastelands. In the Dongaria territory such patches are mostly seen at river sides, on hills and at some hillocks. The soil is of not good for cultivation.

Balii birga means sandy soil that is divided into *kaja balii birga* (coarse textured sandy soil) and *ladre balii* (fine textured sandy soil, silt, mud, etc.) The Dongarias are of opinion that *kaja balii birga* type soil has enough of sand but very less fertile. On low lands where this coarse textured sandy soil is available, paddy is grown and on the high lands pulses and millets is grown in Kharif, whereas tobacco, chilli and oilseeds are grown in Rabi. The *ladre balii birga* may come under the alluvial soil which may further be fine silty or coarse textured. The sub-type here refers to the fine silty alluvial soil which is very rich in fertility due to enough of organic content. Such type of soil is found at the stream banks and river bank valleys. The soil suits to paddy cultivation in low lands and vegetable, chilli, tobacco, oil seed production on high lands.

Kadit Birga or black soil is the most important type of soil for Dongaria Kondhs. The black soil mostly remains soft and favours any type of crop. Such type of soil is found mostly on the hill slopes and is fertile because of adequate organic matters in it. *Kadit birga* is sometimes deep black in colour. People believe that the ash produced at the time of burning the slashes as a practice of shifting cultivation and the decomposed forest litters make the soil very much fertile. Its softness is assessed from growth of tubers. Some places are very fertile due to decomposition of forest grasses which grow very luxuriously in such areas.

Kambit birga (red soil) can be of two sub types viz. *kambit deni tana* and *kambit bruhu tana* depending upon the hardness or softness of the soil. Such kind of soil is mostly found at the foot hills and foot hills paddy lands. Normally the soil remains hard. The soil is red in colour and rich in clay content. Generally early paddy, little millet, finger millet, sweet potato, yam are cultivated on such soil. The Dongarias collect it for smearing the earthen walls of their houses, and for decorative paintings..

Surma birga (Graphite soil) is completely different from other kinds of soil. It is available in graphite mines areas. The soil is deep black and shining. The Dongaria girls and women collect such soil for decorative painting on the walls and floor of their house. *Surma birga* is never useful for crops.

Land ownership, institutional land governance of Dongaria Kondh

The community's right over a forest is exercised on the basis of the village it belonged to, with the inhabitants of a given settlement assuming they had a legitimate claim to the surrounding forests. Forest lands and hill slopes were first distributed among clans, then among *punjas* and then among families. However, some patches of land were kept as buffer land to be distributed to new families who may come from outside, irrespective of their clan membership. Subsequently, the land fell to individuals as a result of hereditary rights or by legacy. An increase in the population inevitably meant that such plots of land were further fragmented into even smaller pieces.

There are different patterns of land distribution. There can be village-wise distribution, clan-wise distribution and *punja*-(title group) wise distribution of lands. Villages are found with exclusively one clan or with one dominant clan. In a village-wise distribution there is always a boundary between two villages. Keeping the boundary in view, hills are distributed among

respective village communities. People of a single clan or different clans residing in a village can occupy a hill land, convert it to swidden plots and impose their right on such lands. Till about five decades ago, different families in a village converted hill lands to swiddens without any restriction. They utilized their family labour for this conversion. According to the number of able members in a family, different families acquired required areas of land.

In case the number of families increased along with the need of more land, further grant of land is made possible through the village level decision-making body where *jani* and *mandal* allot the required land on lease if at all available in the nearby forest. In case of non-availability, the decision-making body along with the person in need search for available forest slopes in the distant hills if they are not possessed by any other village. Though this creates some inconvenience of covering a long distance to cultivate the land, there is no other way out for the village leaders.

First hill slopes on a hill are chosen on the basis of its suitability for cultivation. The vegetation cover of the hill slopes are cleared up by slash and burn method. The hill is not totally slashed but patches of forests are left towards top of the hill. The number of plots on a hill corresponds to the requirement of individual families in a village. The preference for vertical plots is mostly considered on ecological basis, for different kinds of crops can be grown at different altitudes. Again, along the slope surface run off flows down smoothly and thereby water logging is prevented. Crop raiding by wildlife happens mostly on the upper side of the plots. In a transverse plotting, the plots lying towards upper part of the slope remain prone to crop raiding and the family owning lands there may suffer from a total crop loss. Hence, plotting along the slope is scientific in the local context as compared to plotting across the slope. Plots along the slope offer scope for cultivating variety of crops while a plot across the slope limits the cropping to certain varieties only.

Communal property like forests is known as *kutumb biti*. Individually-owned resources or property is termed *na biti* (my property). The forest is considered, first and foremost, as a source of land and water, with trees and wildlife having secondary importance. Traditionally, land, water, vegetation and wildlife were considered as a basic whole. While forest resources cover the range of natural, physical characteristics, individual resources entail labour capacity, inherited land and the economy. Properties owned by the community are at the disposal of all its members. The community may grant rights and impose restrictions to

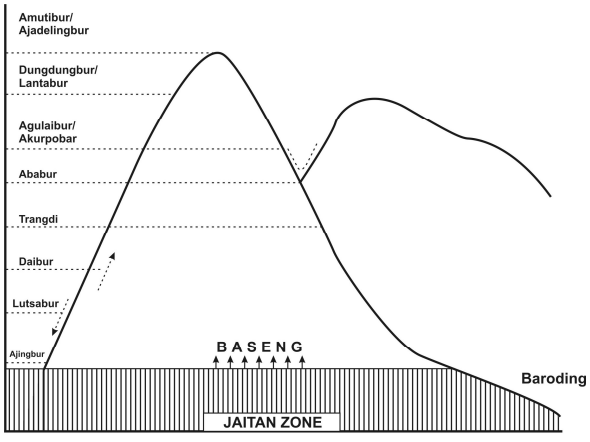
regulate the exploitation of this property, which includes all timber, fruit and sap producing trees in the forest. Individual rights cannot be claimed to such resources.

Lanjia Saora denomination of land use units

The Lanjia Saoras have, over the years, integrated modes of production on hill slopes, i.e. they have been practicing slash and burn agriculture on hill slopes, plain land paddy on terraces formed on wider slopes, and horticulture-cash crops on the degraded slopes. That apart, they also see the primary forests as sources of NTFPs for which they also manage the land, water, vegetation in the forests for sustaining supplies of NTFPs.

The Lanjia Saora understands land resources by the name *Janang* irrespective of the variety of land use patterns. In other words *janang* includes all types of lands, e.g. swidden plots (*baroon),* paddy lands *saroba),* foot hill plains *(basing),* kitchen garden *(kutta),* etc from agriculture and livelihoods point of view. In the Saoras consider the land resources as the most important resource that provides to the subsistence needs of the communities.

Baroon literally means hill with or without a forest on it. Most commonly *baroon* refers to hills that have been converted to swiddens with or without a small patch of forest on the hill top. The entire mid-hill region is slashed to make space for shifting cultivation. Depending on the slope and elevation of the hills, the clearings are made for shifting cultivation. In hills that have very steep slopes and good elevation, the shifting cultivation is done from lower middle region of the hill with the upper portion left as forests. If it is a hillock or a small hill with not-very-steep slope the whole hill or from the upper middle portion of the hill is cleared for shifting cultivation. In terms of land use a *baroon* is divided into four zones: the foot hills where agricultural lands are located, the zone above the foothill where shifting cultivation is done, the zone above that with patch of forest, and the uppermost portion of the hill where forest cover with grasses and miscellaneous vegetation is found.



Sketch 4: Denomination of parts of hill: Lanjia Saora Cf. Jena, et.al. (unpublished)

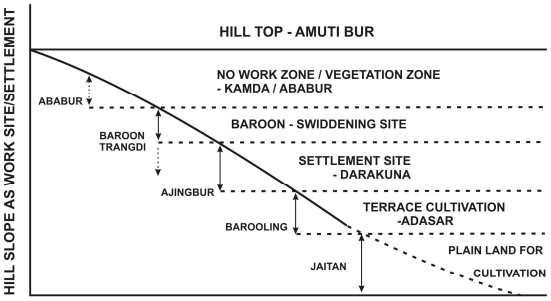
Hills of different sizes and characteristics are named differently. A high hill or mountain is called *Lankabur,* and a mountain with sharp cliff is called *manjungbur.* Top of a hill with plateau is called *agaribur.* Steep hill slope is called *dungdungbur* and wide hill slope is called *lantapbur.* For a person climbing up the hill along the spiral paths to the hill top, the slope path is called *daibur,* and the slope path that is followed to climb down the hill is called *lutsabur.* The Lanjia Saoras have specific relationship with each denomination associated with characteristic parts of a hill.

The Lanjia Saora settlements are found located in all the physical divisions of a hill, i.e. on the foothills, mid region of hills and hill tops. Accordingly the area for agriculture would be found in relation to the location of the settlement. Physically, a hill is divided into several parts and each part is denominated for the purpose of understanding the characteristics of the part. The foothill is called *ajingbur* that extends from the base of hill to its lower middle part. The mid-line of the hill along its vertical interval is called *trangdi* which literally means middle. The area falling between the *trangdi* and *ajingbur* is used for cultivation and also for setting habitations. Next layer up the *trangdi* is called *ababur* that continues up to the *amutti* or the hill top. The region between the *ababur* and *amutti* is the area for forests in case of hills with high elevation. While *ababur* is regarded as the head of the hill, *amutti* is regarded as the apex. The junction between two adjacent hills is called *agulaibur* or *akurpebur* which are often synonymous with *trangdi.* The valley land connecting two adjacent hills is called *basing* which literally means plain land. The foothill plains are also called *baseng,* as synonym of *ajingbur. Baseng* continues downward along the slope to the plain lands which is called *barooling* that further continues downward to *jaitan* I.e. low lands or wet lands. *Jaitan* is the plain land in real terms in consideration to the hilly terrains in the Lanjia Saora territory.

The further understanding of a hill as work site for specific land use divides a hill into several use zones. While *jaitan* is the available plain land forming streamsheds used for paddy cultivation, between *ajingbur* and *barooling* is the space where terraces are constructed to take up paddy cultivation. The settlements *(darakuna)* are set in the space between *trangdi* and *ajingbur.* Space between *ababur* and *trangdi* is used for shifting cultivation or swiddening. The region between *amuttibur* and *ababur* is called *kamda* i.e no work zone or vegetation zone.

In general understanding, the plain land cultivation is done in *Soroba* land*,* slash and burn cultivation is done on *Baroon* land, the platform where terrace cultivation is done is called *Dunkeli,* horticulture is done on *Baroon Arr* and *Baroon*, and NTFP is sourced from *Baroon.* All these kinds of lands typically denominated is different from each other ecologically.

The terminology for terraces, called differently as *tanmar, dunkeli, adasar,* are used in different contexts. While *tanmar* explains the physical feature of terraces, *dunkeli* explains a platform on which paddy cultivation is done. The term *adasar* is a composite of two words *adda* meaning shelf and *sar* meaning paddy, making sense that the shelves or steps on which paddy is cultivated. The bunds of the terraces are called *bidiyar* that varies geometrically from terrace to terrace at different locations. The length, breadth and height of *bidiyar* depend on the characteristic location of the land, the soil depth, slope, bed rock, streams course, etc. The upper side bund of terrace is called *alompal* and the lower side bund of terrace is called *tanidi.* There lies significant head difference between *alompal* and *tanidi* which is decided on the basis of experiences on the soil depth, soil condition (hard soil, soft soil) slope, requirement and availability of stones for bunds etc. Terrace locations by and large depend upon the hill streams. The stream course is diverted towards the terraces by digging small channels or constructing terraces right along the course of the stream and designing the inlets and outlets of the terraces in a manner to prevent flooding and waterlogging in the terraces.



Sketch 5: Unitwise land use: Lanjia Saora Cf. Jena, et.al. (unpublished)

Classification of soil by Lanjia Saora

The Lanjia saora have also classification of soils in relation to location and soil characteristics. The clay soil, called *saldasol* is normally seen in the *jaitan* zone or the low lands, wetlands and stream sheds. This kind of soil is good for the paddy crops. The sandy loamy soil, called *lekhi sol,* is found in river banks, foothill plains, and also in terraces which is good for any kind of crops. The *jeye bur lobo* i.e. the lateritic soil and morum soil is found on the hills and plains. This kind of soil is not good for agriculture as they have poor permeability and less moisture retention ability. However, millets and oil seeds can be cultivated on such soil types. The fertile soil, called *saibang lo,* is found on the hill slopes, especially where the

upper reaches have god vegetation. These soils are rich in nutrition and favours cropping of all varieties provided the soil depth is good enough.

In consideration to the source of water and the quality of water the Lanjia Saora have different denomination for water. During the rainy season, the surface run off from the hill slopes is called *udsui da.* The surface run off remains muddy usually and washes away the nutrients from the top soil. Before the surface run off flows down to the streams, the Lanjia Saora arrests the water and collect the nutrients in the terraces. They believe, the *udsui da* during early rains is very useful for the growth of the crops. The water flowing in the perennial streams originating from high hills is called *tambar da.* This water flows through its natural course and is not very nutrient rich. This water is channelized into terraces without disturbing its natural course for irrigation purposes. The water releasing from rocks, called *nedi da,* is mainly used for drinking purposes. Small storage structures like water holes, shallow wells are constructed at suitable places to store the water.

Land ownership, institutional land governance of Lanjia Saora

The landed properties are primarily classified under individual property *(Damien bitin)* and communal property *(arbatinjee bitin)*. All the natural resources that are not under individual possession and cannot be brought under individual possession are understood as communal property. The common lands, forest, streams, uncultivated hills, etc are the examples of communal property. Land is a communal property until and unless it is associated with names like *baroon* (swiddens)*, baseng* (foothill cultivable land)*, saroba* (paddy lands)*, kutta* (kitchen garden), etc which are individual properties. Forest is a communal property to which every member in the society have access to collect their requirements, gather NTFPs and fuel wood, etc.

The Lanjia Saora identify three important resources: *lebu* (money), *bunudin* (knowledge), and *rrodu* (man power) which collectively determine the making of *bitin* or *biti-darba* (property). These are the chief inputs of management and maintenance. *Biti-darba* is classified in terms of renewable or inexhaustible resources (*eraing bitin),* and perishable or exhaustible resources *(si-eet bitin).* The Lanjia Saora consider *saroba* (paddy lands), *lobo* (land/ earth), *gada* or *tulab* (forests), *jada* (stream/ water sources), and *ara* (trees owned personally or communally) as renewable resources. The people from *saroba,* agricultural produce from *lobo,* useful vegetation, materials and animals from *gada* or *tulab,* drinking water and water for irrigation from *jada,* food, shelter, cash from *ara* as perishable

resources. Through better management, the sustainability of resources may be preserved. The Saora believe that through appropriate utilization and better management a perishable resource can be converted into a renewable resource and on the other hand misutilization and mismanagement gives the reverse effect, i.e. a renewable resource becomes a perishable resource. Saora perceive their crisis as an outcome of misutilization and mismanagement of renewable resources (Behera, 2000:302-303). These understanding regulate their interaction with resources and sustain their livelihoods.

The traditional socio-political system headed by Gomango distributed hill slopes and foothills among *Birindas* or extended families. The *Birinda* heads further distributed the lands among the families within the *Birinda.* Thus the swidden plots, for example, are primarily owned by *birinda* and subsequently owned individually or by a family. Every family or household possess limited number of plots around their village by inheritance from their *birinda* members. As their society is patriarchal, the swidden plots are inherited by sons. In the pattern of property inheritance unmarried daughters get share of father's property but the married daughters are not given any share from father's property. Under situations if a father has no son then his property goes to his daughters irrespective of her marital status. Women are usually not given ownership over property. However, in case of husband's death, his widow can own his properties. The property can only retain with her if she does not marry further, otherwise the property would go to the *birinda* members. The traditional socio-political system is highly respected by the community and hence there is very little conflict over distribution of land resources within the community.

In the traditional distribution pattern of landed property the extent of land to be given to a *birinda* was assessed by the availability of able man power in the *birinda* to cultivate the lands. The traditional norms prevailed that if one was not able to cultivate the lands then the lands would go back to the village council which may be allocated to any other. The social arrangements like *anseer* (cooperative labour) did not let such situations occur when the uncultivated lands were restored by the village council as collective property. The *anseer* group comprise of members in the community who have affinities in terms of lesser labour force in the family to cultivate the lands. Hence, the group members work in each other's field collectively so that all the lands could be cultivated timely and properly.

There are reasons why the traditional socio-political system set such norms of taking back lands if the lands remained uncultivated for years. According to the community members, each land whether cultivated or uncultivated requires maintenance. The maintenance is considered in terms of preventing soil erosion and gully formation, constructing bunds and

take measures so that the neighboring field is not affected, maintain ground cover, prevent grazing, etc. In this consideration, whoever continues to cultivate his parcel of lands would obviously maintain the lands. If he does not cultivate then also he should maintain the lands in a manner so that other lands also gets the ecological benefit of such maintenance. The norms thus compelled the land owner to cultivate and maintain the cultivable lands, lest that the village council exercise its power and take back the lands.

Koda denomination of land use units

The Koda community in Paderu Mandal of Andhra Pradesh is having their own classification systems in respect of land use units in their territory. The Kuvi speaking community have linguistic similarity with that of the Dongaria Kondh and their socio-cultural life has also close affinity with that of Kondhs in their neighborhood Odisha.

The Koda live on high mountainous regions and hills their land use practices are confined to the nearby hills and valleys. The community classifies hills in respect of their elevation characteristics mainly. Hills in general are called *horu,* and the high hills are called *kaja horu.* High hills with steep slopes are called *chuji horu,* average size hills with wider slopes is called *meta horu,* and the hills ending with a plateau on the top are called *sadunu horu.* For agriculture land use the *meta horu* is the most preferred one, although, however, all hill slopes are cultivated depending upon the requirement of the community and availability of lands.

Physically, a hill is divided into three sections: the upper hill section, the middle hill section and the foothill section. The top section is called *banda* and the middle and foothill section are called *madaha* and *bailu* respectively. The Koda livelihoods activities and cultivation is mainly confined to the *madaha* and *bailu* section of the hill. On high hills, the top most part is spared from clearing for shifting cultivation and is left for forests *(Kaman)* and the communities restrain from any interference in the *Kaman.*

The foothill continues along the slope downward to *gatu* (terraced paddy fields) and *palam* (paddy land on plains). However, the terrace paddy lands and plain lands are so inadequate that the community is forced to take up shifting cultivation *(nehla)* on which the community exclusively depends upon. While small hillocks are totally slashed and cleared for cultivation, in high hills the shifting cultivation is extended up to a certain level towards top of the hill.

Unlike the Dongaria Kondh in Odisha, the Koda community is seen to be cultivating difficult slopes in terms of high terrain and steep slopes because of shortage of land around their habitations.

In distant past the communities were cultivating more than 15 varieties of crops on the hill slopes and the yield was up to their expectation. Due to continuous cultivation the slopes have been degraded a lot. On degraded slopes they cultivate millets especially in the *madaha* section of hills. The *bailu* sections of the hill where terraces have been constructed are cultivated with dry paddy. As recent developments the community has been taking up cashew and mango as pure crops on degraded *podu* clearings.

Gradually the community members are exhibiting larger dependence on the terraces and plain lands, although have not totally abandoned shifting cultivation on the slopes. On foothill plains, valleys and stream sides the communities are cultivating wet paddy, dry paddy, jower, bajra, millets as subsistence crops and ginger, niger, rajma beans as cash crops.

Ecological classification of forest and forested landscapes

Classification of forests by Dongaria Kondh

The Dongaria Kondh distinguishes between various types of forests on the basis of their ecological situation, composition of vegetation, canopy, climax vegetation, moisture regime, and above all relating their livelihood and nutrition. The forests are classified accordingly with specific denomination. The Dongaria Kondh classify the forests into eight types. They are Horu (hill), Kaman (primary forest with canopy and climax vegetation), Jada (small forest generally underwood with about or less than 40% canopy), Hada (scrub jungle), Patra (Plateau), Trunjeli muanri (sacred forests and shrines), Mahane Dangu (Part or whole patch of forest used as cremation ground), Nellu and Neta (swiddens). These categories may be further classified on the basis of forest structure. While Kaman, Trunjeli Muanri and Mahane Dangu are likely primary forests with closed canopy, the Jada and Hada are depleted primary forests or are secondary or coppice forests. Nellu and neta are spaces where once a primary forest existed that was manipulated or cleared for swiddening and they are the spaces where scrub vegetation and coppice forest appears provided after a standard fallow period. Vegetation density and diversity wise, and the moisture regime wise the primary forests are

much better compared to other types. The hill forests may be primary forests or secondary forests depending upon the level of biotic interference. The nellu and neta are usually located on the hills. However, the entire hill forest is not slashed for purpose of swiddening. The forest existing on top of the hill is spared from slashing. Hence a hill forest with swiddens, in most of the cases, bears both primary and secondary forests during fallow period, and primary forests with crops during swiddening. Jena, et.al (2002) have presented a detailed account of how the Dongaria Kondh have classified their plant groups, forests and environment.

In the Dongaria understanding, in a Kaman, the predominant vegetation is tree and under wood species with majority of species having same height and thus forming a canopy. It is usually well stocked, diverse and caters four-tier vegetation. It remains cool and shady, arrests the surface run off and thus maintains a good moisture regime providing favourable conditions for the growth of vegetation on its relatively fine and soft soil. The location of Kaman may be on hill slopes or foot hill plains but the density of the climax vegetation and canopy makes it recognized easily.

Jada is a forest of underwood, shrubs and tall climbers mostly located close to their settlement. The Jada forests are also manipulated for horticultural plantations. However, it has relatively open canopy and hence the forest floor is drier compared to Kaman. Human intervention in a Jada forest is high owing to its mixed vegetation and proximity to the settlement. The forest is located on hillocks, valleys between two hills, also on plains. The lower middle part of hill slope is perceived to be the area favourable for a jada forest. Forest on the stream banks and on a long-fallowed swidden are also called Jada.

Hada forests characteristically composed of bushes and shrubs are located on foothills, wastelands and near settlements. There may be some trees and coppicing trees but the climbers, thorny plants and invasive species predominate the composition of vegetation. In this type of forest free grazing is allowed and is not perceived as an animal habitat, although smaller animals such as hare, pea-fowl, jungle fowl and snakes are spotted there. The Dongaria households mainly source their fuel wood from this type of forest.

Trunjeli muanri are part of forests revered as abodes of gods and goddesses and hence there is least human interference. Every Dongaria village identifies one or more forest patches as Trunjeli muanri. Because of high religious sanctity attached to the space people refrain from felling trees there or clearing the forest for any common or individual cause. Hence, these

are the spaces in forests where the plus trees are seen and maintained which adds ecological importance to the forest. In their cultural life, the Dongarias observe many occasional and seasonal rituals there to seek benevolence of the gods and goddesses for their common welfare and well-being. Similar is the case of the forests where cremations are done. There are traditional restrains attached with such forests that except for the purpose of cremation no tree felling is done. One thing that is a common restrains for both type of forests is that medicinal plants are hardly exploited from there. In course of time the Dongarias perceive that the fire hardy vegetation is better thriving in the cremation ground forests. The taboos and restrictions attached to these forests also indirectly help the genepool conservation.

Classification of forests by Lanjia Saora

The Lanjia Saora have classified forests in their environment into four categories. They are Gada or Tulab, Barooh, Sala and Kitungsing. As per the Lanjia Saora myth, the supreme god wanted to classify the forests to easily understand which resource is available where and what rituals are to be organized in which type of forest.

Gada and Tulab are synonymous in explaining a forest. In terms of vegetation Gada comprises of grasses, herbs, shrubs and trees. The Gada type forest over a larger landscape is called Mada Gada meaning big forest which may be understood as high forest in the language of forestry. In contrast, the primary forests in the fringe areas and in between slopes are called Sana Gada. The Lanjia Saora distinguish the Mada Gada and Sana Gada by height of the trees. In their perception the tall trees almost at the center of a forest landscape forms a Kuitab (umbrella) i.e. canopy and gradually the canopy opens up as one moves out to the fringe areas. The mythical name of Gada is Tulab. In general usage, Tulab is understood as a denser and diverse forest compared to the Gada. A monoculture plantation may be called Gada but it can never be said a Tulab. Usually these forests are spared from swiddening and there is also lesser human interference. The Tulab thus is richer in diversity and is believed as the dwelling space of ancestral spirits for which people maintain restrains from entering into the forest at night. Gada caters the climax vegetation and its associates and hence is home to all types of wildlife.

Barooh literally means hill and hill forest. Unlike Gada or Tulab swiddening is done on barooh. Barooh is devoid of climax vegetation if swiddening is in practice. The vegetation is

thus less diverse and sporadically distributed. Once upon a time Gada type of forest was seen on Barooh till it was cleared for swiddening. For swiddening the Lanjia Saora cleared the central part of Gada type of forest on hills and spared the tall trees in the fringe. Thus the climax vegetation was lost in course of time. The fringe area was not cleared as it acted as a sort of barrier for the cattle and thereby preventing the standing crops from being browsed. The tall trees on the fringe also acted like shelter trees for making a watch hut to safeguard the crops from wildlife. However, over the years of human interference the endemic forest vegetation leaving apart the NTFP bearing species has been replaced by economic plantations like mango, cashew, etc. The slopes on a barooh that have been very depleted in terms of regeneration of endemic species have been converted into terraces for settled cultivation. In the patches where it has been very dry due to massive soil loss there the Ficus species are taking over the other natural vegetation. In a barooh, certain species like Lua (*Ficus glomerata),* Anjer (*Ficus benghalensis),* Kurgad (*Syzigium cumini),*Uda (*Mangifera indica),* Titin (*Tamarindus indica)* and Uring (Bamboo) are spared from felling. However, most of the Lanjia Saora ritual practices are conducted on the baroon (plural of barooh).

Sala is the term used to describe a small forest. The vegetation comprises of few tree species and mostly scrubs with a degraded fringe area. Usually, Sala comes up in an abandoned swidden or long-fallowed swidden located in proximity to villages. Open grazing is done in Sala and the community members collect major part of their fuel wood from there. The Sala forest has a sub category; Saladabur which is a small forest on the bank of a perennial stream that makes a distinction in terms of mixed green vegetation. These forests are habitats of snakes and monitors.

Chapter-5

LAND AND WATER CONSERVATION MEASURES

The three tribes covered under the study live in mountainous regions and mostly depend upon slope agriculture for earning a livelihood apart from other subsidiary livelihood pursuits. They have a good understanding of the terrain and are very experienced in managing the land and water resources in a way that is sustainable, although, however, over the years there have been massive degradation in the land resources in their area. All the three tribes covered under the study have their indigenous systems of classification of the land resources with which they interact in their everyday life. They have divided the terrain into land use units and have denominated each land use unit in their language. The denominations underlie the characteristic features, which is the basis of classification and denomination, of each land use unit in their environment. Further, the local denomination of the land use units happen to be very instrumental in the context of articulating and understanding the linkage among the land use units in terms of ecological functions, ownership and use. Since their sustenance depends upon the primary productions from each such land use unit, they have been very careful about the conservation and management of the land and water resources. Their traditional practices and technology involved in the management of land and water resources is diverse, innovative, cost effective, site specific and suitable to the terrain.

Over ages of experiences and interactions with the natural environment, the communities have gained knowledge and wisdom that is transferred from generation to generation through work traditions, field practices, learning out of situations and above all through oral lores. These knowledge systems are valid and scientific to local contexts and are invaluable as long as the traditional techno-economic pursuits of livelihoods earning continues. Such knowledge is threatened due to occupational mobility, changes in traditional livelihoods, influence of market economy and introduction of alien knowledge systems as a replacement to the traditional knowledge and technology. Although there is pronounced priority in development programs to integrate indigenous knowledge systems with the mainstream knowledge yet indigenous knowledge has not been properly appropriated.

A general impression that one would be able to draw after a phase of field work in the habitat of the tribes taken for this study is that the community members have put in practice many bio-physical interventions towards management of land and water resources. It would not be inappropriate to say that by default they are watershed development experts. An interpretation that may be drawn from their classification and denomination of land use units is that such classification and denomination clearly indicate the land and land use sections as considered under a ridge to valley approach in watershed development programs. Logically, they know their terrain and know what intervention to be done where for realizing what kind of impact. Hence, their understanding of watershed interventions or soil and moisture conservation or land and water management system is very much practice and experience based.

All the three communities have been taking up shifting cultivation as their mainstay of life. In the context of shifting cultivation they know about the slopes and their nature, soil type and their characteristics, importance of patch of forest or vegetation in soil and water conservation, the sections on a slope in respect of their suitability for crops, the land-water-forest inter-linkages which is comprehensively depicted in their practices under ideal conditions. It may thus be argued that all the bio-physical interventions that are in place, in their territory, has its root at understanding the overall ecological functions generated out of the land-water-forest interactions. In this approach it has been attempted to understand the various land and water conservation measures taken up by the communities in a ridge to valley approach, as part of their indigenous knowledge of natural resources management.

In order to be specific about the way tribal people understand the interventions for conservation of land and water resources in their context, the terminology as used in case of watershed development is deliberately avoided. There are two reasons in view: that the study is based on primary information and hence importance is laid upon reflecting the community understanding, and second, in their descriptions the tribal people referred to specific land area and land use which does not necessarily coincide with a geo hydrological unit or a watershed, for that purpose. Hence the following text is an attempt to reflect the community narrations in specific contexts and situations with reference to their classification of land use units.

Interventions on uplands (hill tops and higher slopes)

Interventions on knee-chin slopes

Describing a slope as knee-chin slope is a local way of expressing very steep slope which may measure more than 60^0. Generally, cultivation is very difficult on such slopes and there remains every chance of soil erosion if such slopes are intervened for agricultural land use. It therefore requires very systematic and careful interventions on knee-chin slopes to prevent soil erosion. The tribal people, through years of experiences and innovations understake suitable interventions as described hereunder.

Stone bunds, vegetation strips and contour terraces

In the territory of the studied tribal communities there are hills of different elevations with gentle to steep slopes. The steep slopes are expressed as knee-chin slopes. It is so called, because walking up on such slopes is difficult and while walking the knee and chin comes closer. Such slopes are usually higher than 40%. The communities usually restrain themselves from clearing such slopes as cultivation is a difficult affair there. If there is severe scarcity of land for cultivation, some of the very-needy community members extend their shifting cultivation to knee-chin slopes without completely slashing the vegetation there. In such cases, they follow certain methods for selection of the land to cultivate

1. Usually, no cultivation is done on the knee-chin slope. The vegetation there is left un-interfered. The Dongaria Kondh deliberately leaves a patch of forest on the hill top that extends down till the beginning of swidden area. The Dongaria Kondh are of view that if the vegetation is slashed there then massive soil erosion would occur through surface run off and there is every possibility of gully formation that would impact the swiddens down the slope. If in case, one wishes to extend his swidden up the slope, then they do not slash any vegetation there, rather plant tree crops like citrus, mango, jackfruits inside the vegetation zone so that the soil erosion could be avoided and cash economy can be generated.
2. In certain cases, situation compels to take up some sort of cultivation on such high slopes. In such cases the Dongaria Kondh clears patches leaving strips of vegetation both on the upward and downward slope. The clearing in between the strips of vegetation is cultivated.

3. Relatively open vegetation zone with good soil depth is identified. After an assessment of lower side and upper side slope of the place stone bunds are made on the lower side of the plot. Location of the bund is decided after an observation of the slope. It is attempted to take the bund length through the trees in a line so that the trees provide additional strength to the bunds. Usually the bund is laid on the down slope. This type of bunds is seen in the Koda community territory in the Araku valleys. The Koda community calls it ***valka kota.*** The Kodas also lay series of *valka kota* (stone bunds) at intervals to prevent soil erosion.
4. The Dongaria Kondhs also lay boulder bunds like the Koda. But, additionally, they plant pineapple suckers and some tree crops on either side of the bund to provide better stability to the bund and anchorage to the soil. In the high mountains in Kurli-Khambesi area such bunds can be seen in numbers.
5. According to the Dongaria Kondh, they give extended fallow period to the lands located on knee-chin slopes for natural regeneration. While cultivating there, they do not take up tuber cultivation on such slopes. For, if tuber cultivation is done then during harvesting there would be obvious soil disturbance which may become a cause for soil erosion.
6. In the Lanjia Saora area there are not many high hills as compared to Dongaria Kondh and Koda. However, on high slopes they have spared vegetations from slashing. The areas that had been slashed earlier that led to degradation of the slopes are restored with tree crops like cashew and mango.
7. The Lanjia Saora community has constructed contour terraces on many hills around. For a contour terracing they lay very strong bunds on down side of the terrace. From the upper side they do necessary earthwork by cutting the slope perpendicularly or in a slanted manner to level the terrace. Cutting the slope perpendicularly or slanting depends upon the hardness of the soil. If the soil is hard then the slope is cut perpendicular to the terrace, and if the soil is relatively soft then the cut makes about 120^0 with the terrace. The inlet and outlet are carefully designed and in certain cases the drop structures are also constructed. This is described in detail with the sub-section on terraces. There are contour terraces on the steep slopes where the head difference between the upper side and lower side is about 4 to 7 feet.

Moreover, it is understood from the tribal communities that they always wish not to disturb the higher slopes because the production on lower reaches, especially in swiddens, is determined by the health of upper slopes. The upper slopes provide nutrients to the swiddens. The vegetation on the upper slopes breaks the velocity of surface run off and provides anchorage to the soil thereby preventing soil erosion.

Interventions on the mid-hill region

The interventions in mid-hill region include Contour trench (CT), Continuous Contour Trench (CCT), Staggared Contour Trench (SCT), Gully plugs, cropping, land development, and most importantly, terracing and drop structures. While, the interventions like terracing is remarkably seen in the Lanjia Saora territory, the other interventions are rather commonly seen throughout the study areas.

In the previous chapter it has been described how the communities divide the undulating terrains into many land use units with specific denominations. It is clear that all the three tribes have larger interaction with the mid-hill and foothill sections where they organize their production activities mainly. Hence the communities are largely concerned about the land and water management in the mid-hill and foothill sections. The mid-hill and foothill sections are relative speculations as the extent of each section depends upon the elevation of the hill and the topographical features. The various land and water conservation measures taken in the mid-hill region are presented hereunder.

Bunds and trenches on contours

Contour trenches are not as common as the contour bunds. There are two reasons in this regard. First, the boulders are locally available. In all the study sites there are adequate boulders loosely scattered on the hill slopes. Second, bund construction is a less labourious work compared to trenching and the bund construction can be taken up leisurely along with agricultural operations. Further, as the Dongaria Kondh view it, apart from consuming lot of labour the trenches would disturb the soil. Further, from experiences they hold that, digging continuous contour trench is a difficult affair as very often rocks and roots are encountered while digging trenches. The Lanjia Saora are very careful while gathering the boulders for contour bund. They never excavate a stone or boulder because it might loosen the earth and make the soil prone to erosion.

The communities thus find contour bunds more feasible in terms of availability of materials and lesser requirement of labour as compared to trenching. However, all the three communities have taken it as a practice that while laying a bund, the big stones are placed like foundation. For better stability of the foundation stones they excavate the base, about 6 inches, so that the stone is lodged well. That way, it is experienced, the foundation stones can withstand the velocity of run off and give stability to the bund. Once the foundation is properly laid, boulders are set to make the bund. While selecting the boulders for bund making the people specifically chose the boulders that have sharp edges and are angular in orientation. Such boulders can be better fixed to make the bund unlike the spherical boulders that may roll down and destabilize the bund.

Contour bunds are a more effective means of checking runoff and soil erosion. In a contour bund, water stops against the bund. That is the key reason why contour bunds are commonly seen. If the slope is steep enough then series of contour bunds are laid in close proximity to each other. As the slope percentage decrease, the distance between the bunds increases proportionately. The bund distance ranges between 10 feet to 70-80 feet along the vertical interval.

On the high slopes, there is every fear that the contour bunds collapse due to the velocity of runoff. The Lanjia Saora have displayed excellent example of contour bunds on high slopes. For bund stability the foundation stone is placed after excavating the base. The base of the bund is maintained up to 1 meter and gradually tapered towards the top. The top width is maintained between 1.5 feet to 2 feet. The Lanjia Saora people suggest that on higher slopes foundation stone for the bunds should never be rested on bedrocks or exposed rocks, they should always be put inside excavations, for stability. Outlets are designed between foundation stones so that the pressures of water due to surface run off can be reduced. However, the community members are aware that bunds on higher slopes are not advisable.
The Dongaria Kondh and the Koda community believe that they do not need to dig trenches irrespective of the condition of labour input. According to them if a patch of forest is left on top section of the hill and the middle section is intensely cropped then there is no need to dig a trench as a measure to prevent soil erosion. However, according to them, the farmer must remain vigilant about the course and intensity of runoff to be sure that the runoff is not causing gully formation. If gully is formed anywhere along the course of runoff then it must be immediately plugged. If required a series of gully plugging may be done or the gully

area should be filled in boulders to break the runoff and facilitate sedimentation of the top soil carried by the runoff. In practice, the Dongaria Kondhs maintain it.

Staggered Contour Trenches

In the territory of the Koda, in Araku valleys, staggered trenches are seen on very degraded slopes. According to the community members they were not making any staggered trench in their traditional practices. This is something they learnt from soil conservation department. However, since last three to four decades the community members have been aware about the technology and requirement of staggered contour trenches. To them, staggered contour trenches mean breaking a continuous contour trench at several points and maintaining equal horizontal distance between trench to trench along the contour line. The horizontal interval between trench to trench should be about 9 to 10 feet and the vertical interval should be in the same range or vary according to the percentage of the slope.

Staggered trenches are thus discontinuous contour trenches dug on a particular contour. It is dug layer by layer on following contour lines. The trenches are arranged in a fashion that the gap area between the two trenches on upper contour corresponds with the trench on the lower contour. It is so designed to make sure that the runoff velocity is broken at the upper line of trenches, then the overflowing runoff enters into the trenches in the second line which also acts as velocity breaker. In the same manner runoff flows in and out of trenches and at each level the soil particles carried in the runoff sediments in the trenches. By that only soil erosion is not prevented, more than that the trenches arrest the water for some time to allow better permeability of soil. Hence through the contour trenches the soil moisture profile of the area changes to better.

In the Dongaria Kondh area, where traditional practices are prevailing, the staggered contour trenches are not seen. However, in the Lanjia Saora area the staggered contour trenches, after introduction in the area by soil conservation department, are gaining favour for restoring the slopes degraded by shifting cultivation with plantations. According to the Lanjia Saora, the staggered trenches break the catchments of a hill into smaller fragments (forms micro catchments) which become very useful for plantation crops. According to them the survival rate of cashew crops have been to the expectation wherever they have dug staggered trenches. The technology of the staggered trenches and its impact are described in the same way as the Koda community members.

However, a general understanding is that, in areas where there is an abundance of trees and vegetation, gaps in excavation are in any case essential to allow space for the roots of the trees to spread. Also, where there are hard rocks underneath the soil, trenches must be staggered.

Contour and bench terrace

The Lanjia Saora possess ingenious skills in setting stones and boulders to build very strong and stable bunds, guard walls and terraces on hill slopes. They set the stones in such a manner that face of one stone strongly holds face of another stone. They do not need masonry tools to measure width and straightness by height and length of embankments. Even then when the Lanjia Saora set the stones with mud for making a bund, they do so with all calculations of load on the bund. Experience of embankment construction is utilized in estimating the load on the wall for stability. Accordingly they decide width of the embankment.

Terraces are constructed on along the hill slope on contours. Usually the terraces are constructed from upper middle section of a hill downward to foothills and even up to stream level. Terraces are also constructed on stream beds. Terraces are excellent examples of land and water conservation. Terraces are the best means that allow farming on high slopes with minimal risk of soil erosion. Terraces are designed to modify original topography. The bed width of terraces becomes narrower with increase in slope gradient and length. Narrow beds are more susceptible to high run off velocity and soil erosion. Proper design of terraces is critical with increase in slope gradient. Rills start in the upper portion of the terraces and develop into gullies cutting through the lower terraces, especially when terraces remain bare and are improperly designed. The loosening of soil during terrace construction increases the top soil depth and favours farming.

Terraces slow down the velocity of runoff. They reduce the slope length by dividing the slope into numerous terraces. The terraces promote soil water storage as the flat benches allow water retention that facilitates percolation. Further, the slow movement of water inside the terrace before trickling down to downstream terraces gives adequate time for infiltration into soil. Due due to better infiltration thereby increasing the soil moisture content the soil erosion by wind and such other means is well prevented. The surface irrigation on the relatively leveled land increase crop production and provides drought proofing.

Three types of terraces are seen in the study area. They are bench terraces, narrow base terraces and broad base terraces. However, the Lanjia Saora community is the best about

making terraces. The Koda community is not expert in the state of art but according to them since last five decades or so they have been constructing terraces by learning from neighboring Kondh community in Koraput. In the Dongaria Kondh area, in the Niyamgiri hills, the terraces are not of common occurrence.

Bench terraces (BT)

The bench terrace type is very common in the tribal pockets of south Odisha and bordering Andhra Pradesh. The width of the bench and the height of steps are variable depending on the field slope, presence of rock mass, soil depth, etc. Bench terraces are a series of strips constructed across the slope; in some places with equidistant vertical intervals and in some areas at irregular vertical intervals, and separated by steep banks of stones and grassed revetments.

Narrow base terraces (NBT)

These terraces are seen where the soil is shallow, sloping lands and have narrow ridges. Since the ridges offer very less area because of the narrow design no cultivation is done on ridges. The ridges are generally maintained with grass cover. These terraces cause lesser soil disturbance compared to other types. Narrow terraces are mostly seen in the high hills of Paderu area and also in Niyamgiri hills. In the Koda highlands the vetiver grass is used for stabilization of the ridge.

Broad base terraces (BBT)

They are constructed in long and uniform fields, about the foothills, with less than 5% slope and hence cultivation is possible on all sections of the terrace. They are also called channel terraces in soil water engineering because the channels are all cultivated and are common in areas where flat and abundant land is available. Channels are gently graded to outlets for runoff disposal. Sheet and reel erosion between terraces are higher in broad base terraces. These kind of terraces are seen in wide valleys and along the streams down up to stream beds. The stream beds are sliced from sides and are converted into flat terraces with very gentle slope downstream. Often the terraces are designed with outlets on either side of the terrace at downstream end. The terraces have narrow embankments and very less back slope.

Terrace cultivation is commonly seen on the slopes extending from upper middle section of a hill downward to the stream beds. The terraces are built right up to the beds of hill streams and extends many hundreds of feet from the depth of villages to the hill slopes and in some cases rising up to the hill tops in consideration to the suitability of slope. The

platforms of the terraces are flat throughout and the fall of each terrace is stone packed. The construction of the terraces is so ingeniously and skillfully done that no soil is carried down with water. The water management is equally skillful. The flow of water from one terrace to the other is controlled by channels and water ways which are provided on the ridges of terraces. There is another way of facilitating flow of water from higher terraces to the lower ones. Two or three pits are dug at the lower side of the upper terrace and these pits are packed with boulders. The water flows into these pits and from there through the boulder trickles to the terraces down below. The water management is so skillful that it avoids flooding of the terraced fields. In many places water trickles from level to level through stone fencing and ultimately flows down to the lands in the plains. But in no case either the soil is carried over with water from the terraced fields or any damage is caused to the stone embankment.

The terrace beds are skillfully sloped in consideration to the inlet and outlet. Usually the inlet end gently slopes down to the outlet end so that water can slowly move through the field before being released through the outlet. Some terraces are inwardly sloped from the downside bund towards the upper side slope. This is done in consideration to the soil on the terrace bed. If the soil has lesser permeability then the water is allowed to stay for sometime inside the terrace so as to allow the soil to absorb maximum moisture. After some days the water is channeled out from the terrace through small channels along the embankments. In the inwardly sloped terraces rice varieties that can survive water logging are cropped. Some terraces are outwardly sloped. If the permeability of the soil is higher then the terrace is sloped towards the lower end and maximum outlets are provided to drain out water. Where the soil is porous and quickly absorbs water in such areas the outwardly sloped terraces are constructed. Most terraces, however, are leveled with about 1% sloping towards the outlet. In such terraces the soil is moderately permeable. These three types of terraces in consideration to sloping in or out or maintaining the level is seen in Lanjia Saora areas.

Location of terraces depends on the hill streams. According to older people, in the early days, the community members preferred to settle in areas where ample area was available for terracing. They blocked the course of streams at certain points and diverted the stream course to avoid flooding inside the settlement. The diversion of the streams was made towards the terraces.

In the Lanjia Saora terminology, the terrace at the higher level, or the first terrace at the upper end is called *Alompal* and each terrace platform down the slope and towards the foothill stream is called *Tannidi.* The hill tops are usually spared from terracing.

Usually on the wide slopes the Lanjia Saoras make stone embankments first and then level the earth by cutting the slopes from upper side of the slope and dumping the soil on the lower side of the slope to make the field perfectly leveled. The terrace is secured with strong stone embankment usually on the lower side and occasionally on the upper side of the slope. These stone embankments are called *Tinniradang* synonymous with more commonly used term *Tumarpal*. The *Yayaar* (boundary) of the patch decides whether it will be called *Soraba* or *Dunkuli*. The size of the plot is deciding parameter. *Saroba* is a long and contiguous plain land with series of bench terraces whereas the *Dunkeli* is smaller fragments of *Saroba* having embankments on all sides. Embankments are made of lose boulders in the beginning and in course of time the soil deposit due to runoff makes the bund stronger. The head difference between the two end of terraces along the slope ranges from 1-2 feet to about 7-8 feet. In such cases the boulder embankment settles down easily. However, boulder embankments of terraces on steep slopes stand at a height of three to five feet, on an average, from adjoining terraces. Such embankments need additional care and interventions to make them stable. In such cases the Lanjia Saora cement the boulders with mud so that they do not fall down easily. Afterwards, the soil deposit from the run off makes the embankments stronger and stable. These mud cemented embankments are called *Band* meaning mud-set guard wall.

There are very few terraces that gets irrigation from perennial streams. Rainfed agriculture is usually practiced on terraces. Each terrace has one or more inlets and one or more outlets. The runoff from the hill slope enters into the first terrace on the upper reaches through more than one inlet. More than one inlet is designed to reduce the force of runoff entering into the first terrace. The inlet points are decided in consideration to the slope. Similar number of outlets is also designed to discharge the run off. The outlet of the upper terrace is the inlet of the lower terrace. The rain water in this way flows down and down to the last terrace on the slope and finally discharge the water to streams. This way the water logging in the terraces is avoided.

The remarkable feature in the inlet and outlet designing is that they are never kept in one line. In most cases it is seen that the inlet and outlet position are diagonally opposite. The terrace is not perfectly leveled rather a gentle slope of 1% to 3 % is maintained from one lateral end to another. In a terrace if the inlet is positioned at the upper end across the hill slope, the outlet is positioned at the diagonally lower end along the gentle slope within the terrace. Thus water travels from the inlet end within the terrace to the outlet end very gently. The velocity of water is reduced by designing the slope appropriately and therefore hardly any soil erosion occurs from the terraces. In this way the water is made available to all sections in a terrace and thereby the soil is well drenched, the crops are well irrigated, and the excess water is drained out.

Box-2: Traditional Technique used to Crack and Break rocks

The Lanjia Saora are very adept to cracking huge rocks and breaking them into smaller pieces without using any explosives. They set fire to a pile of wood placed on the rock. After sometime the rock becomes very hot. Then they pour some water on the hot rock. The rock cracks at certain places, usually at the fissure lines. Lanjia Saoras use a digging rod with the sharp end pushed into the crack. The digging rod is used as a lever to break a patch from the rock. This method continues till the whole rock is broken into pieces or the required quantity is met. Hammers are often used to aid the digging rod in the job or for directly breaking the rock from cracks.

There are two advantages of the technique. First, they do not depend on any other for materials and second, the deeper cracks as usually happens when a rock is broken with use of gun powder do not appear preventing the rain water disappearing through the cracks. This seems ecologically a sound practice.

The Lanjia Saoras are able to explain why the inlet and outlet is never designed in the same line along the hill slope. According to them if the inlet and outlet are placed in a line then the velocity of runoff cannot be checked and the runoff may result in formation of gullies facilitating soil erosion.

Gender dimensions in terrace making

In setting the stones or boulders to make an embankment women are better to men in certain aspects. Setting boulders for making embankment requires good deal of effort, requires lot of patience and takes a long time. Women are better to men on these aspects. Side by side with setting embankments women also level the terraces with desired slope level. Hence, women are considered experts in terracing.

The men on the other hand engage themselves in hard physical work which is otherwise difficult for men. Male folks usually gather heavy stones and boulders at the site of work.

When required they lift and place heavy boulders for setting foundation of embankments. If huge rocks are available on the terrace site they are cracked and broken down into smaller pieces using traditional techniques and the smaller pieces are used to construct embankments.

According to *Balanco-Canqui & Lal, 2010,* there are two types of bench terraces: conservation terraces and upland terraces. The conservation terraces are also called irrigation terraces or level bench terraces.

The conservation terraces are having inward gentle slopes for flood irrigation and water storage. This kind of structure is usually seen in valleys especially for rice cultivation. On the other hand, the upland terraces that are constructed at mid hill zones are gently sloped outwards for allowing drainage. On the upland terraces both rain fed and irrigated crops.

The American Society of Agricultural Engineers (ASAE) 2003 has grouped terraces based on alignment, cross-section, grade and outlet. In general there are four main type of terraces: broad base, narrow base, bench and steep back-slope segments. Terraces are termed continuous if they cover large areas of the field and discontinuous if they are small and localized. When water conservation is a major concern, broad base and drainage terraces are preferable to absorb and store rain water. In soils prone to erosion, however, bench terraces or traditional terraces are appropriate. Terraces are best suited to terrains with slopes 7.5%. on sloping lands, terraces are primarily installed to grow crops without causing excessive soil erosion. Drainage type terraces are used in regions with high precipitation and poorly drained soils whereas absorption type of terraces are preferred in regions with limited precipitation and permeable soils (Balanco-Canqui & Lal, 2010, pp 296).

***Classification of terraces**:*

a) Alignment wise

***Parallel**: these terraces divide the field in uniform parallel segments with an equal distance between ridges. These structures are common to gentle slopes and their spacings are adjustable to machine traffic.*

***Non-parallel**: these terraces are built on the field contours. Thus adjustments are needed for proper equipment turns. These terraces are appropriate for fields with non-uniform slopes.*

b) Cross-section wise

Broad base*: These terraces are sited on long, uniform, gentle slopes and are all cultivated. The terrace channel and ridge are about 15m long with three main segments: cut, front and back slope.*

Narrow base*: the front and back slopes of these terraces are too steep to be cultivated and are thus maintained under perennial grass.*

Conservation bench: *these terraces have wide channels for maximum water storage and ground water recharge. Channel width depends on field slope, runoff volume, soil properties and drainage area.*

Steep back slope: *these terraces are used to reduce slope length in fields with steep slopes. The back slope is steep and is maintained under perennial grass*

Ridgeless: *these terraces have no ridges but have wide channels to intercept and drive runoff and are used in uniform and nearly flat soils.*

Bench: *These terraces are common and have a wide bench to store water, grow plants and allow machine traffic. The steep backs slope is either under permanent grass or gabion revetments.*

c) Grade wise:

Level: *these terraces are used in nearly flat lands. The outlet is completely or partially closed depending on runoff amount. These terraces are used in regions with low rainfalls. If used in regions with high rainfall the soil must be permeable with gentle slopes.*

Graded: *These terraces are constructed on the contour in sloping fields where erosion is more of a concern than water storage. The ridges retard and absorb runoff.*

d) Outlet wise

Blocked*: The terraces have blocked or no outlets. All waters from rain and irrigation infiltrates into the soil.*

Vegetated*: The outlets of these terraces are covered with grass*

Underground: *The outlet is buried in the ground and commonly consists of a corrugated plastic pipe. Unlike other outlets, underground outlets do not remove land out of production but must be installed at a proper depth to reduce damage from traffic and tillage (pp 297)*

On the terraces pady is cultivated. Usually two types of paddy are cultivated. One is called *Adangsar* (Big-paddy) or *Ambadhana* (Mango-paddy), and the other is *Mudasar* or *Sanadhana* (small-paddy). The *Adangsar* is cultivated by January-February at places where there is provision for irrigation and harvested by May-June when mangoes start ripening. Ambadhana is not commonly cultivated on hill terraces, for there is no adequate provision for irrigation to the crops. The other type of paddy called *Mudasar* is cropped during the onset of monsoon and reaped by November-December. *Mudasar* is mostly cultivated on the hill terraces as important Kharif crop.

Soil traps and barriers of horizontal rows at regular intervals

Burnt logs, scrubs, wattles of bamboo are used across contour lines for trapping the silt and soil out of surface run off from hill slopes. These mechanical measures are taken especially in rainy seasons after which the wood and bamboo materials are removed and used for fuel. Grasses like vetiver are planted across the slopes to create vegetative barriers. In many border areas of Odisha-Andhra in the southern part the tribal communities have been using vetiver grass as a good barrier of soil erosion especially on foot hill areas. In course of time the vetiver bushes create a very solid bund like barrier against soil erosion. Small channel like dug out structures and or bunds with lose boulders are constructed at regular horizontal intervals to arrest soil erosion. The horizontal interval depends on the type of slope. In case

Figure – 6: Bunds for soil trapping

Figure - 7: Excavation for soil trap

of gentle slopes the horizontal interval is more compared to steep slopes. The distance between bund to bund or trench to trench is decided from experiences. In case of knee-chin slopes the horizontal interval is very less. While walking uphill slope when the knee and chin comes very close is called knee-chin slope.

Soil traps of drop structures

Drop structures are designed with boulders and wooden planks. In highly erodible places a small ditch is dug out as water inlet and spill way. The runoff is collected there and the soil in runoff sediments in the ditch. The overflowing water is channelized out through small

Figure - 8: Water spill way from fields

Figure - 9: Terraces with paddy crop

channels adjacent to farm bunds. Usually the indigenous drop structures are seen in terraced slopes. These inlets cum spill ways are generally constructed at the gully head or at lower end of gully and are stabilized with grassed or cropped water ways. At places loose boulder is collected around the ditch like embankment to not allow widening of the ditch due to soil erosion. It is also understood from the Lanjia Saora community members that sometimes wooden planks and poles are also driven into the ground around the ditch for preventing any damage to the ditch. Recent developments shows that the ditches are stone walled cemented at the top looking like small wells in the field that simultaneously serve the purpose of water storage and silt traps. This also controls the intensity of flow at downstream points.

LAND AND WATER MANAGEMENT IN SHIFTING CULTIVATION (SWIDDENING)

Shifting cultivation and multiple cropping

Since ages the tribal communities covered under the study have been practising shifting cultivation on the hill slopes around their settlement. It is a type of slash and burn cultivation. The vegetation on the hills are slashed and burnt and the plots are cultivated with a mixture of crops. No ploughing, no irrigation and little maintenance, are the important considerations for which the communities prefer this practice as an ecological adaptation to such hilly environment. The hill lands are considered to be fertile lands due to the decomposition of forest litter. A plot is usually cultivated for two to three years and then abandoned or left for fallow to regain fertility. This is a continuous process. After a fallow period of 5 to 6 years the cultivators again return to the same plot. In the current scenario, it has become a common practice that the slope lands are given no fallow period between cycles of cultivation. Now fallowing of lands is by and large determined by the extent of land under possession of a family, the requirements at subsistence level, availability of alternate income sources, etc. The highlights of shifting cultivation, as studied among the communities, in the context of land and water management are:

- Clearing of fields primarily by felling, cutting, slashing and burning and using fire to dispose of vegetative debris after drying (in special situations fire may not be used).
- Frequent shifting of cropped fields, normally in some kind of sequence in land control, resting in special social groupings under customary laws.
- Many different systems in crop planting fields but both multiple cropping and specialised cropping present.
- Use of annual and short term food crops predominant, but important use of long term shrub and tree crops is common.
- Use of crops primarily for subsistence. In recent times cash crops have been given importance.
- Frequent among groups of using permanent or near - permanent settlement sites.
- Use of vegetative cover, as soil conditioner and source of plant nutrient for cropping cycle.
- When system is efficiently operated, soil erosion not greater than soil erosion under other systems that are being efficiently operated.

- Soil depletion not more serious than that under other systems of agriculture when operated efficiently.
- Details of practice vary greatly depending upon the physical environment and the cultural milieu.
- Operative chiefly in the regions where more technologically advanced systems of agriculture have not become economically or culturally possible or in regions where the land has not yet been appropriated by people with greater political or cultural power.
- Destructive of natural resources only when operated inefficiently and not inherently destructive than other systems of agriculture when these are operated inefficiently.

Slashing and burning

The shifting cultivation follows certain stages in the cultivation cycle. The preparatory phase includes slashing followed by burning before the first shower of rain in early summer. Before burning the slashes people collect the cut woods and twigs for their household use. Sometimes it requires two successive steps of burning. After the first burning the field is inspected for any hard wood or root escaped the fire. While doing the second time burning they do it at specific sites where the burning was required to clear the field from hard wood and roots. According to the community members burning the slashes not only add nutrient to the soil from the carbon of slashed materials but also it acts as a sort of soil treatment to reduce the possibility of insect and pest infestation in later times during the cultivation phase. During burning the slashes the communities are careful about making fire line or put barriers to reduce the possibility of spreading of fire beyond the swidden plots. They use fire trenches, boulder bunds, and clear slash strips of vegetation on the boundary of the plots to check the spread of fire. Since trenching involves lot of labour hence they preferably clear slash strips of vegetation around the plot. Through the slashing and burning sequence the field condition is well examined to see if there was any gully or water way formed during the previous rainy season. Accordingly they maintain the sites to prevent soil erosion.

While clearing a forest patch for swiddening the community members give adequate attention to the management of soil, stones, and vegetation and water resources. That, while debushing they spare saplings of economic trees, they do land leveling of erosion prone areas, collect stones and according to size and shape collect them and mound them separately, if required takes up measures along and across drainage lines, and take up measures to remove big rocks in traditional methods of fire and water treatment.

Sowing, broadcasting and dibbling of seeds

The lands thus prepared after slashing and burning are sown with mixture of seeds after one or two showers of rain when the field traps enough moisture for germination of seeds. Usually, all the seeds are not broadcasted. The seeds that have relatively longer dormancy are put in dibbled holes. No ploughing or hoeing is done while sowing, broadcasting or dibbling of seeds. In the early rains the soil absorbs every drop of rain and gets saturated with moisture and hence the chances of soil erosion are low.

Junturi is the Lanjia Saora term for slash and burn agriculture or swiddening. Swiddening is also called *Baroon abaran* (hill-work) implying various activities undertaken in the cultivation cycle. There are specific vocabularies for each activity in the slash and burn agriculture. *Gajeng* means slashing, *Dulba* means burning and *Lala* means seeding or sowing. *Pajeng* means weeding, *Gala* means reaping, *Mal* means stacking or heaping the reaped crops in the threshing yard. The one-word for reaping and stacking is *Galamal* . *Rai* is the term used for plucking of pods and beans and peeling them.

There is no uniform pattern indicating the design or arrangement of crops in a swidden, yet from experiences, the Lanjia Saora know better which crop should be placed where. In a multiple cropping system each swidden looks like a random mixture of crops. However, there are some common arrangements in similar slopes. The castor seeds are usually dibbled on the border of swiddens and the yams are put together with castor so that the climber can grow better on the castor plant. Arhar is dibbled randomly along with cow pea so that the climber can shelter on the arhar plants. Cow pea and other beans are also planted with maize. Castor earmarks boundary of a swidden if stone fencing is not made. In presence of stone fences, castor seeds are also dibbled randomly. In some fields it has been seen that line sowing of pigeon pea, maize, cow pea have been done. Such arrangements are made to divide the field into several accessible units for mid-term agricultural operations. Further, by putting the seeds of creepers and climbers below or near the shrub type crops like pigeon pea they provide support for climbers.

Some arrangements in placing are made about millets. Usually sorghum is sown on the upper reaches of a swidden, often with red sorrels. Small creeper plants like beans, burbudi are placed with sorghum. Other millets are broadcasted in a mixture randomly. Creeper

plants are cropped together with relatively shrubby crops that are harvested later than the creeper crops. On higher slopes the horticultural species, spices, etc are cropped.

Multiple cropping and intercropping benefits

Multiple cropping is a common feature of shifting cultivation. Multiple cropping on a site provides to the subsistence and cash economy of the cultivator families. In a multiple cropping system the crops mature at different intervals of time and hence the cultivators continuously keep harvesting one or other agricultural produce for food and market. Apart from these considerations, the multiple crop cover protects the soil from nutrient losses through hydrology and also contributes through efficient recycling of resources, aspects which would be considered at length, elsewhere. The biomass that a multiple cropping provides caters to the needs of the cultivator families, their livestock and also for enriching the fertility of soil.

The high species diversity under the shifting cultivation contributes to the stability of the egro-ecosystem. Apart from the fact that under a transient environment of the steep slopes, such a high species diversity with a multi-layered crop canopy above helps in multi-layered root mass distribution below the soil would help in optimal use of nutrient from throughout the soil profile, there are other implications of this in terms of production efficiency. The sowing of multiple crops at one time and the harvesting at different intervals provide more space for the remaining species to grow when they are at their peak growth period.

Multiple cropping provides climate resilience to the cultivators because there is a natural compensation mechanism that works in the multiple cropping system, i.e. if one crop fails completely the other crop may compensate the loss with a better yield. In the subsistence context, the climate resilience in the swidden cultivation system sustains the livelihood and food security of the communities.

The mixed cropping and intercropping are best local ecological risk covering practices and adaptations by shifting cultivators. In a mixed cropping system, the crops can be differentiated in terms of height, canopy, adaptation, growth habit, nutritional requirement, and maturity period. This contributes well to the stability in production in rainfed agriculture. As per the practitioners' understanding through multiple cropping and intercropping the land resources are better utilized as there happens limited competition for

resources among the component crops in the system. The multiple cropping system is also climate resilient because the growth habit and adaptation of component crops is varied, and at least few component crops can survive extreme situations. When different component crops are grown side by side in the same field, the component crops act as barriers to the pests of other crops. Thus all component crops are mutually benefited. Further, since the ground area is totally covered by multiple crops, there remains very little scope for growth of weeds. Hence, multiple cropping is a natural default system to reduce the occurrence weeds. The intercropping of legumes as a component crop is advantageous in low fertile soil as the component legume crops help in nitrogen fixation.

Old traditional swiddens gradually become converted to fruit orchards giving it a forest like structure. Preservation of stands of timber in and around the swidden serves as a seed reservoir for endemic species. Sophisticated fire control mechanism such as fire breaks, fire fighters, coordinated burning is maintained. Swidden soil is often more moist than adjacent forest soil. Careful rotation of swiddens is maintained looking at man to land ratio. Bush fallowing period of different intervals is practiced to allow flow of nutrients to reserve the trend towards leaching and be recycled through burning. Careful control of weeds is remarkably done. Minimal disturbance of top soil in cropping practice help minimizing erosion. It is a sound practice as there is least risk of total crop failure even due to drought or excessive rainfall because variety of seeds are cropped together and the crops mature at various intervals of time. People are keen observers on the ratio of labour input to productivity and hence, when productivity dicreases in relation to labour input, they leave the land for fallowing till the fertility is regained. Unproductive swiddens are converted to permanent orchards thereby introducing new varieties and land use patterns. Above all, subsistence crops and cash crops are taken simultaneously from same patch of land.

Fallow management is a key to swidden land management

The Dongaria Kondh perceive that, fallowing lands after continuously cultivating a slope for five-six years cannot give desired result in terms of soil and moisture conservation or regeneration of vegetation or restoration of soil fertility or in general the land and water management. Such a perception is based on the fact that every year, before the cultivation, the field preparation requires clearing the vegetation from the said plot. So, whatever regeneration takes place in the first year of cultivation is cleared in the second year. If such consecutive clearings are done for five to six years then the roots or trunks of the bushes

and trees fail to regenerate further. In the process, some bushes get totally cleaned by roots also. Hence, after five-six years if the lands are fallowed then optimum regeneration cannot happen. It is therefore important that the lands must be fallowed after the third year of cultivation. In their traditional practice, which in many ways has undergone changes over the years, the farmers were not slashing the forests during the second and third year of consecutive cropping. By that the regeneration of forest vegetation was happening properly. When after the third year the lands were being fallowed the forest regeneration was adequate and that was preventing the soil erosion and restoring the land with fertility. The fallow management, in this connection, is very important. In villages where the land to man ratio in shifting cultivation is better, there the old traditions of fallowing the lands in consideration to vegetation can be better observed. A visual comparison of the regeneration in one-year cultivated, two-years cultivated, three-years, cultivated swiddens would suffice to such a perception regarding fallow management of Dongaria Kondhs.

About an ideal duration for the fallow period the Dongaria Kondh believe that, an ideal fallow period should be conceived on the basis of observation on regeneration of plants and biomass increase in the fallowed swiddens. According to them in the very first year of fallow period the weed varieties grow to the maximum. They use the available nutrition from the top soil and hence grow luxuriantly in the first year. The *Eupatorium* species, *Pogostomon* species are examples of such weeds that grow very fast in the first year fallow along with regeneration from roots of bushes and trees. These weed species, however, do not have deep spreading roots. As the fallow period continues, certain deep rooted plants, endemic to the area, start growing better by utilizing the soil nutrients in deeper layer of the soil. When the deep rooted plants start growing well the weed growth inhibits. The deep rooted plants provide better anchorage to soil and thereby prevent the soil erosion. The deep rooted vegetation have little lateral spread of roots and therefore utilize the nutrients in deeper layer of the soil. In the meanwhile, the leaf litters increase the fertility on top soil which is not utilized by the deep rooted plants. Hence, the length of a fallow period should be decided on the basis of regeneration and especially by an observation of growth of deep rooted species. It is a fact that on a particular hill slope all the households in a village have a share of land. Observation on growth of vegetation on the entire patch is considered for deciding an ideal fallow period. Observations on some particular swiddens or on the hill tops (that were spared from slashing) should not decide when the fallow period is to be broken.

Traditionally, the experienced people were deciding when the fallow was to be broken, not that how long the fallow period should be.

Importance of vegetation in land-water management

The Dongaria Kondh are of opinion that the rapidly declining resource of soil fertility is efficiently and effectively utilized by mixed cropping over time and space. Hence it is an advantage from perspective of land resource management.

In the early stages of cropping cycle, experienced by all the three tribes, shifting cultivation is a major cause of soil erosion and hence detrimental to the land-water-vegetation resources of a landscape. The chances of soil erosion increase in case of late operations in slashing, clearing and sowing. According to the communities the major factor for soil erosion is rain. If the cultivation delayed then the extent of soil erosion increases. This is to say that best time for slashing and burning is February-March, maximum it may extend up to April. By April the land should be cleaned and ready for sowing after initial one or two showers of summer rain. If the slashing, burning and clearing is delayed and extends up to end of May then by the time of sowing the monsoon rain would be arriving. If the sowing happens during the monsoon rain then not only the seeds get washed away but also due to continuous rain the runoff washes away the top soil. Hence, it is desirable that by the time of monsoon rains the crops should have been well established so that they can give anchorage to soil, even if they may not be that efficient at that stage as vegetation barriers to break the velocity of runoff. This implies that timely management of agricultural operations is very important from the perspective of conservation of land and water in swiddens.

The Dongaria Kondhs have planted horticultural crops in the middle of sloping hillside and by that they see long-term interest in their swidden lands and thus give adequate attention to land and water conservation measures. They have been realizing the importance of high density pineapple plantations along with legumes and other tree crops on the slopes as soil conservation measures which, at the same time, provides them an alternative to shifting cultivation on steep slopes. The Lanjia Saora has also intensified the horticultural crops in the mid-hill region. The runoff, fertile soil and the nutrient originating from the upper two-thirds of the hill slopes are used for growing paddy on terraces and lower portion of the slopes. The impact that Lanjia Saora is able to realize is not realized by Dongaria Kondh as they do not have terraces and many paddy lands.

Advantages and disadvantages of tuber crops

Dongaria Kondh have a good perception regarding the role of tuber crops in land and water management in swiddens. They believe, the life cycle of the tubers is such that it indirectly protects the soil and increases the moisture profile of soil. In case of planted tubers, the planting is done along with the sowing of mixed crops. Tubers are usually harvested in the dry seasons ranging between December to April. The soil becomes loose by the digging and the pits are filled in again. Since, wind is not a major factor for soil erosion in the swiddens, hardly any erosion happens to the loose soil The places where the tubers were dug out remain there as small holes even after filling in the holes. During the rainy season water percolates down into the soil and increase the moisture profile of soil. Hence, by default the tuber crops are helpful in capturing rain and increase the soil moisture. However, the disadvantage is that if the tubers are harvested during the rainy seasons then massive soil erosion happens. The root and tuber crops like cassava, yam, colocacia, ginger, arrowroot, turmeric are always harvested in dry seasons.

The three tribes studied here show differences in their cropping pattern and crop husbandry on swiddens. The variety of crops and their intensity of cultivation implicitly present a picture of the type of ground cover the swiddens are provided during the Kharif season. A general impression that may be drawn from the following inventory is that the variety of crops and their rooting systems create better situation for natural and effortless soil and moisture conservation as they provide a good ground cover to the slopes. In this approach, the Dongaria Kondh are better compared to the other tribes.

Table – 8: Phytosociology of crops under shifting cultivation systems including terraces

Crops	**Odia name**	**Intensity**		
		Dongaria Kondh	**Lanjia Saora**	**Koda**
Cereals				
Eleusine coracana	Mandia	Moderate	Low	Moderate
Panicum miliare	Suan	Moderate	Low	Moderate
Setaria italica	Kangu	Low	Low	Moderate
Sorghum vulgare	Janha	Low	Low	Moderate
Pennisetum typhoides	Bajra, Ghantia	Low	Low	Moderate
Zea mays	Maka	Moderate	Moderate	Moderate
Oryza sativa	Dhan	Low	High	Low
Pulses				
Cajanus cajan	Kandul	High	Moderate	Moderate

Vigna indica	Jhudunga	High	High	High
Phaseolus mungo	Biri	Low	Low	Moderate
Phaseolus radiatus	Muga	Low	Low	Low
Macrotyloma uniflorum	Kolatha	Low	Not cultivated	Not cultivated
Lens culinaris	Masura	Not cultivated	Not cultivated	low
Phaseolus vulgaris	Rajma beans	Moderate	Low	High
Lablab purpureus	Simba			
Vegetables Tubers				
Cucurbita maxima	Boitalu	Moderate	Moderate	Moderate
Lagenaria vulgaris	Lau	Moderate	Moderate	Moderate
Musa paradisiaca	Kadali	Moderate	Low	Low
Dioscorea bulbifera	Khamba alu	Moderate	Low	Moderate
Cucumis sativus	Kakudi	Moderate	Moderate	Moderate
Luffa acutangula	Janhi	Moderate	Moderate	Moderate
Lycopersicon esculentum	Tomato	Not cultivated	Low	Low
Solanum melangina	Baigan	Low	Moderate	Moderate
Solanum tuberosum	Alu	Low	Moderate	Low
Hibiscus sabdariffa	Ambili bhendi	Not cultivated	Moderate	High
Hibiscus esculentus	Bhendi	Low	Moderate	Low
Momordica charantia	Kalara	Low	Low	Low
Manihot esculenta	Gachha kanda	High	Low	High
Capsicum annum	Lanka	Low	Moderate	High
Capsicum frutescens	Dhanua lanka	Low	Moderate	High
Colocacia antiquorum	Saru	Low	Not cultivated	High
Zingiber officinale	Ada	Moderate	Moderate	High
Curcuma longa	Haladi	High	Low	Moderate
Curcuma zedoaria	Paluo	High	Not cultivated	Low
Ipomoea batatas	Kandamula	Moderate	High	High
Allium cepa	Piaja	Low	Moderate	Moderate
Allium sativum	Rasuna	Low	Low	Moderate
Amorphophalus bulbifer	Dhala Olua	Not cultivated	Not cultivated	Moderate
Amaranthus gangetius	Parbatia khada	Moderate	Not cultivated	Low
Oil seeds				
Guizotia abyssinica	Tila	High	High	High
Sesamum orientale	Rasi	Low	Low	High
Brassica rapa	Sorisa	Moderate	Moderate	Moderate
Ricinus communis	Jada	Moderate	Low	Moderate
Helianthus annus	Suryamukhi	Not cultivated	Not cultivated	Moderate
Trees, fruits and economic crops				
Ananus comosus	Sapuri	High	Low	Low
Citrus aurantinum	Karuna	High	Not cultivated	Not cultivated

Citrus medica	Tabha	High	Not cultivated	Not cultivated
Citrus limon	Pahadi lembu	Low	Not cultivated	Not cultivated
Citrus reticulata	Santra/ Kamala	High	Not cultivated	Not cultivated
Citrus aurantifolia	Lembu	High	High	Moderate
Anacardium occidentale	Kaju	Low	High	High
Mangifera indica	Amba	Moderate	Low	Moderate
Punica granatum	Dalimba	Moderate	Not cultivated	Moderate
Cinnamomum zeylanicum	Dalchini	Moderate	Not cultivated	Not cultivated
Cinnamomum tamala	Tejapatra	Moderate	Not cultivated	Not cultivated
Carica papaya	Amrutbhanda	Moderate	Moderate	Moderate
Syzygium jambos	Golap jamu	Low	Not cultivated	Not cultivated
Syzygium samarangense	Jamurola	Low	Not cultivated	Not cultivated
Amomum aromaticum	Aleicha	Low	Not cultivated	Not cultivated

Erosion controlling vegetation

There are plants and trees that the respective tribal communities care for preventing soil erosion and increase productivity from unit area of land. While some of the plant species are local to the respective areas, some species are planted in their area. While certain plant species have both economic and ecological values, some are there which are considered only ecologically valuable especially in the context of land and water resource conservation and management. From experiences, the communities describe which plant/tree species should be planted where so that it serves the ecological and economic purposes. The following table presents an inventory of plant species with respect to specific locations where they serve the ecological functions of land and water conservation. The Dongaria Kondh, in this regard, are better positioned as they have integrated plants and trees of all habits including subsistence crops, cash crops, invasive weeds apart from other wild vegetation for better management of land and water resources. The new succession that has come up in Dongaria Kondh swiddens is now a mix of endemic and exotic varieties. The Lanjia Saora are different in terms of using date palm, ficus, Indian privet and sisal mainly to

protect the terraces which are not at all seen in Dongaria Kondh area. Similarly, the Koda are different with introduction of tree crops like eucalyptus, silver oak, palm, and among grasses, the endemic vetiver grass and the exotic lemon grass for management of land and water resources. A comparison of the three tribes clearly indicates that apart from the land and water conservation aspect, the land use is very comprehensive and optimum that assures higher return from unit area of land. With higher density of vegetation the erosion of soil from the swiddens is the least.

Table – 9: Important vegetation (wild and cultivated) for land and water conservation

Dongaria Kondh		**Lanjia Saora**		**Koda**	
Plants and trees	**Location**	**Plants and trees**	**Location**	**Plants and trees**	**Location**
Banana	Streamside land and embankment	Date palm	Terrace bunds	Sisal	Contour bunds, erosion prone slopes
Citrus species	Upper reaches of swiddens	Ficus	Terrace bunds	Vetiver grass	Field bunds, terrace bunds
Pineapple	Throughout the slopes	Cashew	Hill top, degraded slopes	Palm	Terrace bunds
Cashew	Hill tops, degraded slopes	Mango	Swiddens with good soil depth, higher slopes, foothills	Cashew	Upper slopes, degraded swiddens
Mango	Slopes, by the streams, foothills	Indian privet *(Vitex nigundo)*	Swidden borders, foothill fence	Mango	Foothills, kitchen gardens
Cinnamon	Higher slopes	Banana	Low lands, kitchen gardens	Eucalyptus	Degraded slopes, abandoned swiddens
Elaichi	Where soil is loose	Bamboo	Gullies, ravines, stream banks	Silver oak	Higher slopes
Pomegranate	Slopes	Broom grass	Stream banks	Broom grass	Stream sides
Bamboo	Stream banks,	Sisal	Abandoned	Lemon grass	Foothill

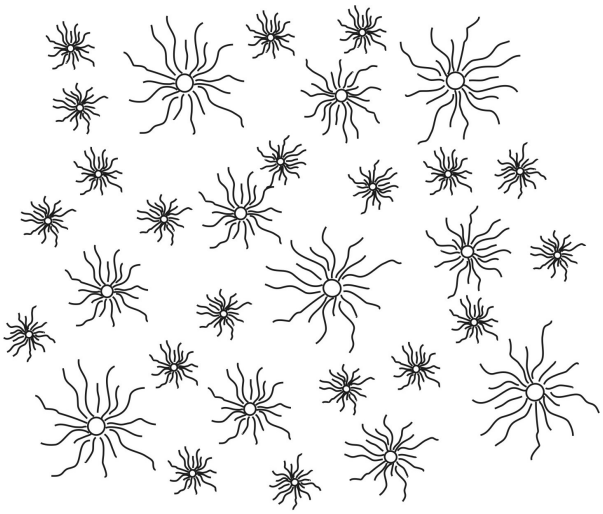
	gullies, ravines		degraded swiddens		erosion prone areas
Broom grass	Stream banks, gullies, ravines	Grass varieties	Terrace bunds		
Turmeric	Higher slopes				
Castor	Swidden borders				
Lantana	Embankments, contour bunds, gullies				

Importance of weeds

Weeds are wild plants that grow in highly disturbed sites and are generally considered to be undesirable and adversely interfering with crop yield. The tribals view weeds as a useful component in agro-ecosystems and play an important role in land and water management. The removal of weeds during mid-term agricultural operations is a difficult task as the intensity of cropping is high. However, the weeds serve important functions not only in regulating the soil erosion but also in regulating the insect and pest infestation to the standing crops in swiddens. There are weeds that are exploited as wild edibles also. The Dongaria Kondh are experts in using weeds for mulching on ginger crops in the swiddens. Obviously, one of the important roles of the weeds in the crop-lands is related to reduction in soil erosion, protection of the soil surface from solar radiation, recycling of nutrients through organic manure and improved soil micro-climate. The ingenuity of the swiddeners lies in his ability to distinguish the 'weed' and the 'non-weed' status of the same species or set of species in their swidden plot, depending upon the intensity of the weed population in relation to the crops.

Root system is important for preventing soil erosion and better land and production management – A case Study

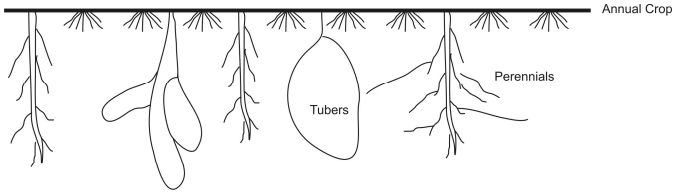
A Dongaria Kondh informant, Suresh Wadaka, shared his observations on rooting system of variety of crops in swidden. According to him there are crops with deep tap root systems and most crops with grass like (adventitious) root systems, and there are also tubers that are different from other crops in rooting system. For preventing soil erosion and better slope stability, according to him, there is a need of all kinds of root systems, when one group would be saving the top soil from being washed away, the other group would prevent gully formation.



Sketch 6: Root Distribution in Shifting Cultivation - Deep Rooted and Shallow Rooted Crops (Vertical View)

The crop arrangement is made accordingly. According to him, a horizontal root distribution would indicate the root spread of the crops while vertical root distribution would indicate the depth to which the roots penetrate. An understanding on both the situations helps the farmer to decide the crop arrangements which is depicted in a picture form as below.

The vertical root distribution indicates the farmer about the spacing aspect for growing crops. Basing on the understanding of root system of a crop by the farmer decision is taken about the cropping density that decides the percentage of individual seeds in the mixture. The vertical distribution indicates that the tubers should be planted in the gap areas of deep rooted crops or trees. Seasoned farmers place the tubers distantly from deep rooted trees because at the time of digging out tubers they would not be encountered with tree root systems. Inexperienced young farmers might go about planting tubers near a tree root thinking that the creeper would grow on the trees. From point of view of soil conservation such a practice is unscientific.



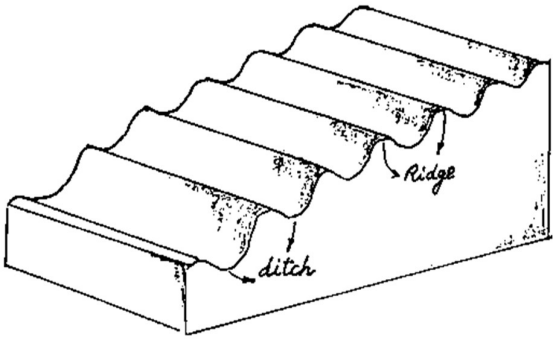
Sketch 7: Root Distribution in Shifting Cultivation - Deep Rooted and Shallow Rooted Crops (Crossection View)

Contour tillage

Crops are grown on contours that provide good anchorage to soil and prevent soil loss during

Sketch - 8: Contour tillage

Sketch - 9: Contour tillage



heavy run off. At places trenches are dug out to arrest the soil particles in the trenches. These treatments work best where there is a good soil depth, the soils are coarse textured, slopes are less than 30 percent, and woody vegetation density is low. However, this is less effective on hill slopes compared to roadside wide valleys. It is said that contour tillage helps in better infiltration of water as it provides resting surface for water to facilitate infiltration. It acts like a mini catchment that arrests soil from run off. On the knee-chin slopes the contour tillage is a difficult option as it causes sharp drops and also requires frequent modification in depth of the bed on contours. Further, it requires lot of lose boulders in proximity that becomes a determinant for creating option for contour tillage.

Tools and implements play important role in soil conservation

The tribal system of agriculture is still in primitive stage; at least when shifting cultivation as their mainstay of life is in view. Tools and implements used for various operations under shifting cultivation are very simple and primitive, being made within village, or more rarely bought from market, but in either case the cost is negligible. It is a credit to the tribal shifting cultivators that they have a wide variety of tools for various operations, such as land clearing, planting, weeding, interculture, plant protection, harvesting, threshing, etc. These tools and implements play very instrumental role in soil conservation and management. Usually under shifting cultivation system the land is not ploughed. Hoeing and digging are also very limited. People are also not that much economically well-off to afford for farm mechanization. Further, since they are not *de jure* owners of the land under shifting cultivation they are also not able to access the government agriculture subsidies for farm mechanization. For cultivating the foothill plains they still use the traditional bullock or buffalo driven simple ploughs. These ploughs have very small knife, not even 6 inches long, which cannot cut the earth deep during ploughing. The hand hoes have small blades of about 2-3 inch width which cannot cut much earth. These simple implements do not disturb the soil much during agricultural practices. Hence the chance of soil erosion due to soil working is the least.

Laxman Sabar belonging to Lanjia Saora community in Puttasing explained an interesting practice in ploughing. That, according to him, the plough is mainly used in cultivating the foothill paddy lands and the terraces. A seasoned farmer would operate the ploughs across the slope not along the slope. The reason for such a practice is that if one operates the plough along the slope then the chances of soil erosion due to runoff increases manifold. The runoff may make channels inside the field along the plough marks where the soil is found loose. Hence, plough lines are drawn across the slope. By doing so not only soil erosion is prevented, but also the soil gets enough time to absorb water when the runoff breaks within the furrows of the plough lines. According to Laxman, summer ploughing is an usual practice of the Lanjia Saoras because they usually cultivate in the Kharif season. For ploughing they do not wait for the rain to make the earth moist to make the ploughing easier. They plough their land under extreme dry condition when the soil is hard, before even the first shower of rain, immaterial if it is tiresome. The sole purpose of summer ploughing is intended towards capturing each drop of pre-monsoon rain. Such a practice has the advantage of increasing the soil moisture profile of the lands that are usually ploughed. According to Laxman, every practice they have adopted since generations is eco-friendly. If one keenly observes each practice and try to understand it in their context would, for sure, find it scientific in local context.

Labour and energy in land-water management

The chores to be performed by male and female folks in shifting cultivation are well defined in all the three tribal communities studied. The males contribute more labour for slashing forests, burning the slashes and crop protection; the females contribute more labour for cleaning, sowing, weeding and harvesting. Since the shifting cultivation is done on hill slopes by manual labour, the steeper the hill slope, the more the labour needed.

Terrace cultivation on hill slopes at any elevation has a much lower energy input compared to shifting cultivation. Terrace cultivation requires energy for terrace construction which is an one-time affair. It does not require energy frequently as in the case of slashing and clearing under shifting cultivation. Valley cultivation, which receives the water, sediment and nutrient carried by the runoff, has a higher energy output-input ratio compared to shifting cultivation and terrace cultivation. Hence, the challenges for the land and water conservation are larger in shifting cultivation at higher elevations. Thus, the labour requirement under shifting cultivation is much higher because apart from agricultural operations, the land and water conservation measures are to be taken up every time.

According to the community members, if the swidden fields are not cropped properly with multiple crops, the land and water conservation, management and restoration become stupendous task. Fallow management becomes a very importance task in this regard.

Bamboo based drip irrigation by Dongaria Kondh

Dongaria Kondh practice bamboo based drip irrigation for meeting critical irrigation needs of crops during adverse situations. The practice may not be found as a common scene, but it is still in use by communities in remote pockets. Dongaria Kondh find this as a good system for growing crops in areas where water becomes scarce in lean periods as the topography is undulating and hilly. It is very useful in areas where soils have poor water holding capacity and where there is preponderance of boulder soils.

In this method the Dongaria Kondh divert the gravity flow from a small stream by use of bamboo trunk. One end of longitudinally split bamboo is placed at a point on the stream with the other end towards the fields. If the field is distantly located then bamboo pieces are joined together for the required length. Several perforations are made in each bamboo piece so that water falls on the ground drop by drop when water travels in the bamboo pieces. Such pipe line like structure runs about one to two meters above the ground supported by bamboo and wood stands. The supporting stands are made in consideration to the required gradient of the bamboo pipe line. The gravity flow channelized this way is used for critical irrigation needs of crops in swiddens.

Water management by Lanjia Saora

The Lanjia Saora are experts in water management. In their traditional norms the water management is considered a community responsibility. Their socio-political system about water governance was very organized, although, however, such management systems have become weak in the contemporary scenario. Mishra (2009) reported the traditional socio-political systems of the Lanjia Saora in water governance and management, especially on tank water management in irrigation context. According to him, the *bandha*s (tanks) were worshiped and carefully maintained by the community. No activity that would pollute the *bandha*, including washing of clothes, was permitted. The *Gomango* used to mobilize the water users' to contribute labour for routine repairs and maintenance of *bandha.* Since the traditional *bandha* management composed of water users' mostly from the same village, organization of the *bandha* is along village lines and, the Village Chief often served as the irrigation leader. In this pattern of organization there are obvious advantages with regard to

communication between water users' and the water authority. The congruence of village and *bandha* unit enhanced the ability to informally enforce rules and obtain compliance to group procedures.

The *Gomango* appoints one man as *Barika,* from a Scheduled Caste family to look after the *bandha* and matters of the village. In the context of *bandha* management the *Barika* used to play a major role in village. The duty of the *Barika* was to open and close the outlet. He used to see the flow of water and also used to inform the village farmers about the opening and closing of the outlet. He used to keep an eye on channels through which water used to come to the *bandha* and also used to oversee the fields. In case of a need, with the prior permission of the *Gomango, Barika* used to inform the village farmers about the time and place of meeting to discuss about the matters concerning *bandha*. In the meeting the farmers used to decide which outlet will be open and when and how much water will be provided to whom. Due to proper understanding with head reach farmers the tail-end farmers were getting water. The village committee sometimes used to request the head reach farmers to allow water to tail end farmers by making *karanali* (small canal in the land).

In order to manage limited water in the tank in an equitable manner among all the farmers' in the command area, the Village Chief, with prior consultations with the farmers, used to impose restriction on adopting water intensive cropping pattern and other agricultural practices. Sometimes he used to advise farmers to reduce the area under paddy or to go for some mixed crops. Some farmers even went for the same variety of crop in consultation with the other farmers in the *bandha* area, which implies all of them raise a particular crop which will ripe almost at the same time. This avoids competition for water during the stage of crop ripening. If some conflict occurs among farmers relating to irrigation, the farmers of that outlet used to try and solve the disputes among them. If they were unable to resolve by themselves, they used to draw the attention of the *Gomango*, who calls a meeting of farmers through *Barika* to resolve the conflict.

The traditional system of tank management was a well designed system of water distribution. All the farmers had strong faith in *Gomango.* There was no partiality and all the farmers were getting equal water depending on the situation. In time of requirement, community members voluntarily participate in maintaining the *bandha.* All the Water Users in a *bandha* co-operate with one another for collective maintenance of the entire *bandha.* The opportunity for enjoyment brings many volunteers to work. Such days were festive occasion.

The routine work involves clearing and de-silting of *bandha* and maintaining water conveyance network, while the system is in operation. Ordinary maintenance, such as the periodic clearance of silt, repair of the *bandha* and field channels, is done by the cultivators themselves prior to the onset of monsoon. They used to sell this silt to farmers from which they were earning some money for their Committee. They used to take care of the problems of encroachment near the village *bandha*. All the farmers were helping the *Barika* to fill up the *bandha* during rainy season. They were making small canal kind of structures directing the water flow from hills towards *bandha.* The farmers in the respective Water Users' Committee were giving some amount of paddy to the *Barika* after harvesting. In the past, under this system, following the order of the *Gomango,* the cultivators had to supply one man to carry out the tank and canal work. In case of wealthier peasants, they were allowed to send paid labourers but had to be present to supervise the ongoing work.

CHAPTER - 6

DISCUSSION ON FINDINGS AND CONCLUSION

Land and water management has become an international subject in the contemporary context of climate change. The Johannesburg Plan of Implementation (JPOI) of WSSD, 2006 focused on climate change and its adverse effects and clearly links it with poverty and other development concerns, such as land degradation, access to water and food, and human health.

In India, several policies and programs have been formulated and implemented over the years emphasizing upon the conservation and productive use of land and water resources. The Drought Prone Area Program (DPAP) in 1972-73, Desert Development Program in 1977-78, the constitution of National Land Use and Conservation Board in 1985, National Land Use Policy in 1988, Integrated Wastelands Development Project (IWDP) since 1989-90, and watershed development based approaches since 1995-96, are some of the initiatives taken and implemented in this direction. The 73rd and 74th Amendment Acts (1992) of the Constitution brought the land use, conservation, management and related issues under the purview of local bodies in both rural and urban areas. The initiatives taken by other ministries also had a bearing on the prevention of degradation of lands. The National Rain

fed Area Authority (NRAA) was established in 2006 to give focused attention to Rain fed areas of the country. This advisory body formulated some common guidelines for the Watershed Development Project and is in consultation with all the States for its implementation. It indicates that there is a pronounced priority on conservation of land and water resources at the National level that percolates down to the regional and state level and ultimately to the ground. The nineth plan document particularly emphasized on bringing the underutilized land under cultivation, management of wastelands, maintenance of village commons, decentralized land management system, Panchayati Raj institutions to manage the village lands.

Many parts of Odisha, especially the mountainous areas in the tribal belts, that are characterized by rain fed agriculture and mixed farming systems have been facing decreased returns from agriculture. Ecologically, rain fed areas is the most fragile even though they sustain substantial populations. In these areas, the sustenance of rain fed agriculture assumes critical importance for livelihoods of communities. The key to the sustainability of agriculture lies in reviving the linkages among components of the natural resource base in the area, revitalizing ecosystem services, adopting an integrated farming systems approach and managing the commons in a way so that resources reinforce resources.

No significant improvement can be expected without the people being brought to centre-stage. It is well realized now that unless local people are brought to the centre stage of management and their traditional adaptation and indigenous knowledge are duly respected the problem of land and water management in rain fed agriculture regions would remain to be there. Indigenous knowledge of local communities, in this context, becomes highly relevant because it underlies a pluralistic approach to conserve and manage the resources of a particular region. Local indigenous knowledge includes experiences on fundamental understanding of processes of ecological change, slope dynamics and biological conservation and hence assumes importance in the context of land and water management.

Tribal cultivators traditionally took recourse to numerous means of irrigation. In broken and undulating landscapes which are unsuitable for irrigation, the ingenuity of the tribal people could make irrigation possible to a limited scale. In the mountainous areas, extensive canal systems are not practical because the main streams are below the level of the land to be irrigated. Studying their land and water management systems at a landscape level provides a

range of situations, problems, opportunities and innovated technologies to be studied comprehensively.

In the contemporary context the land and water management has become a prime concern towards restoring the natural resources and sustaining the primary production systems. General assessment of current status of land and water in tribal areas of Odisha indicate that there have been massive degradation in such natural resources that calls for critical interventions in a holistic approach. Interventions may range from bio-physical interventions for eco-restoration to interventions in livelihoods, social and cultural practices, and involving traditional technologies. In this context, the experience based indigenous or traditional knowledge of the tribal communities happen to be very instrumental.

Although there have been univocal appreciation for local and traditional knowledge systems in integrated natural resources management, yet in absence of a precise documentation of the knowledge systems hinder integration of the traditional knowledge in sophisticated scientific management knowledge, especially in the context of land and water management in tribal areas.

According to the World Bank (1997), the basic component of any country's knowledge system is its indigenous knowledge. It encompasses the skills, experiences and insights of people, applied to maintain or improve their livelihood. Indigenous knowledge is developed and adapted continuously to gradually changing environments and passed down from generation to generation and closely interwoven with people's cultural values. Today, many indigenous knowledge systems are at risk of becoming extinct because of rapidly changing natural environments and fast pacing economic, political, and cultural changes on a global scale. Indigenous knowledge is part of the lives of the rural poor; their livelihood depends almost entirely on specific skills and knowledge essential for their survival. Accordingly, for the development process, indigenous knowledge is of particular relevance for the sectors like agriculture, animal husbandry and ethnic veterinary medicine, use and management of natural resources, community development, poverty alleviation, etc.

In this context, the present study has attempted to document the indigenous knowledge of certain tribal communities in Odisha on Land and Water management. The tribal communities studied include the Dongaria Kondh and Lanjia Saora communities in Rayagada

district of South Odisha and the Koda community in the Araku valleys of Andhra Pradesh as a neighboring community in a cross-cultural context. All the three tribal communities have been designated as Primitive and Vulnerable Tribal Groups. The study has attempted to understand their land and water management practices, technologies, understanding and perceptions, site-specific interventions in a rain-fed agriculture subsistence setting in the mountainous regions. All the three communities covered under the study exhibit significant variations in terms of land use technology although topographically they have close affinities. The scope of the study, by and large, examined

- Suitability of technologies and knowledge systems in relation to terrain and topography, classification and denomination of land, land use units, soil
- The understanding of land and water conservation measures taken on different land use units emphasizing upon the knowledge of moisture management with physical and bio-physical interventions
- Land use unit wise cropping as a means for better soil and water management and coping with micro-climatic changes
- Understanding on ecological functioning and resilience in a forest-agriculture system
- Studying the social control mechanisms in favour of the soil and water conservation

Discussion

The subject of land and water resources is very much associated with the tribal way of life; in their socio-cultural-religious beliefs, work traditions, economic and techno-economic pursuits of livelihood earning, and norms and traditions in their socio-political systems exercising governance of land and water resources. Each of the three communities have been found to be having religious notions attached to land and water resources, giving a meaning that land and water are not simply natural resources, they are much regarded as cultural resources as their life and livelihood is linked to the deification of land and water. Religious lore around deification of land and water implicitly regulate the community behavior towards land and water and which enormously contributed to the preservation, conservation and management of land and water resources. Thus, the norms of interacting with land and water resources are culturally embedded.

The understanding of the tribal communities on land and water resources is reflected in their classification and denomination of land and land use units in their territory. The basis of classification is largely based on their understanding of ecological functions of each land use unit that are comprehended in their terminology. Specific terms given to each land use unit indirectly defines the diversities within a landscape and provides to understand the characteristics of each land use unit, how the communities interact with these diverse land use units, their production functions and management aspects. Aptly, the classification and denomination, as a common knowledge within the community, directs the uniform mode of interaction with the resources. In other words, each community member knows what production functions can be taken up in which land use unit, e.g. it's a common knowledge that shifting cultivation should be taken up on mid-hill slopes.

A deeper understanding of the land use classification by the tribes is required for making a comprehensive assessment of their indigenous knowledge related to their environment and the natural resources. Many aspects of such indigenous knowledge is so much embedded in their work traditions that unless properly observed in field it would be difficult to interpret. The difference between the original knowledge system and the ascribed ones can be easily differentiated from participatory observations. The purview of indigenous knowledge is vast, and each aspect of their knowledge is very intricately interwoven in the tribes' social, cultural, economic, religious, and aesthetic modes of life. Hence, the domain of indigenous knowledge is diverse, conceptual and contextual. Each tribal term or denomination of a space, from indigenous knowledge point of view, bears a meaning in specific and bear an understanding in wider contexts. The current study has attempted to make a precise documentation of the tribes' indigenous knowledge in the context of land and water resource management which is found to be very much rooted in their social, cultural and economic life and interpreted in their own contexts only. Such interpretations, although appear parochial during the documentation process, justify to be of universal knowledge and application when compared with the mainstream knowledge domains. Apart from classification of land use units, the classification of forests in terms of vegetation provide to understand further the ecological inter-linkage between forest and agricultural lands and the water relations between them.

The study, however, in a broader perspective looked at specific interventions of the tribal communities for conservation of land and water resources. The observations have been comprehended in respect of the land use zones in a hilly and mounrtainous landscape where

the communities live. Consequently, three major land use zones have been identified: the upper portion of hills and mountains, the mid-ridges and the foothills. The methods employed in the conservation of land and water resources, and the other practices and aspects that suffice to or complement to such methods have been documented.

Certain interventions like stone or earthen bunds, terracing, drainage ditches, cut-off drains and vegetative measures are some of the major deliberate interventions taken towards conservation and management of land and water resources.

Earthen or stone bunds are constructed as embankment or ridge built across a slope along the contour. On moderately sloping areas the farmers construct the stone bunds for erosion control. On steep eroded bare lands stone terraces are most used structures in study area. As it is stated by key informants during focus group discussion the stone terraces are considered effective in erosion control in steeply areas.

Terraces and Contour ploughing is a practice of tilling the land along the contours of the slope in order to reduce the runoff on a steep sloping land. It is used separately or in combination with other conservation structures such as plantation of trees and cut- off drains. Contour ploughing and cut-off drains are often implemented together.

Drainage ditches are one of the widely used soil and water conservation practices in the study area and also known as traditional ditches. These are micro-channels constructed on cultivated farms to drain off excess water and control soil erosion. These are low cost measures in which construction is part of the normal ploughing activity. However, unlike the plough furrows, the ditches are made wider and deeper in dimension and usually run diagonally across the field.

Cut off drains are one of the physical structure constructed by digging the soil deep in order to divert the runoff before reaching the farmland. Cut-off drains with contour ploughing are also preferred by farmers. The farmer constructed such structures to prevent loss of seeds, nutrients, and soil due to excessive runoff coming from uplands and dispose the excess water for the field.

Trees and other non–crop plants such as sisal, eucalyptus, silver oak, vetiver, bamboo, date palm, are planted along the contour sometimes together with other conservation practices.

This type of conservation method is applied in order to reduce runoff and conserve the soil and water round the root of the plants. Indigenous and newly introduced trees and shrubs are planted on over used eroded lands to make the land fully productive again. In certain areas, common highly degraded lands are closed off to livestock to protect it from grazing and planted with trees for regeneration.

Fallowing of land under shifting cultivation is a recommended practice for shifting cultivation. After two to three successive cycles of cultivation the slope lands are fallowed for regeneration of vegetation. During the fallowing the land regains fertility with growth of the vegetation. Hence, extended fallow period is recommended by the communities for enhancing the soil fertility. In the current scenario, since the hill slopes have become very limited, the lands are hardly fallowed. This increases the challenges for land and water management.

Leaving crop residues on the field after harvest is another traditional practice used by the farmers in the area. Usually, after harvesting of crops, the lands are left as such. That is the time when the lands lack a ground cover and hence remains prone to erosion. As an erosion control mechanism the farmers leave the crop residues in the field that works as a sort of ground cover. Observation with the tribal farmers provides that they cut the panicles of millets without cutting the plant from its roots, pluck only maize without cutting or uprooting the plant, reap the paddy from about half of its length and leave the biomass there in the field. This biomass remains there as temporary ground cover that ultimately decays to add fertility to soil. Farmers are implementing this type of measure to improve fertility of the soil and there by protect soil from erosion.

The tribals are also aware that due to several factors that include their own practices and environmental factors, massive soil erosion has happened over the years from their area. As major causes of soil erosion they identify the factors like cultivation on steep slope; over cultivation; excess rain; poor agricultural practices; over grazing in order of importance.

Similarly, as cause of productivity decline, the following such as frequent cultivation; soil erosion and land degradation; unreliable rainfall; limited or no fallowing; lack of irrigation are largely accountable.

As measures to be taken to enhance the declining fertility of the farm land, the tribals make the following suggestions like crop protection; shifting to other land; using manure; change land use type; fallowing of lands.

Key Findings

- Very inadequate work has been done on indigenous knowledge of land and water management in the context of Tribals in Odisha. At a time when the indigenous knowledge of local communities as potential for better natural resource management has got global relevance and so appreciations this study on indigenous knowledge on land and water resources in rainfed tribal areas bears paramount significance. Earlier workers, however, have tried to probe into this arena into bits and pieces, or as part of a larger objective, the literatures in this regard are very sparse and sporadic. Ethnographical accounts on the tribes of Odisha implicitly provide some hints and clues for studies in this direction.
- Land and water are cultural resources for the tribal communities. In the management aspects of land and water resources an overtone of culture is reflected in case of each PVTG covered under the study. In certain cultures like that of Dongaria Kondh the land and water management is overtly attuned to culture whie in the case of Lanjia Saora and Koda it is relatively covert.
- The understanding of terrain, the suitable land use in different zones of the terrain, the soil type existing in different zones provide good understanding of the ethno-ecological perception of the tribes. These perceptions led practices has within it embedded a vast body of indigenous knowledge of the communities on land and water, interaction of the resources in determining agricultural land use and accordingly guide the interaction of the communities with land and water resources. It is realized that an understanding of ethno-ecological perception opens up the arena of further understanding on land and water resources and their management in local context.
- The facts presented in the report provide factual information and build the evidence in favour of the Dongaria Kondh community as having appreciable ethno-ecological knowledge on land and water resources and their interactions especially in a land based livelihoods context. The perceptions of Lanjia Saora community are also immense but the terrain and land use pattern of of Lanjia Saora community is less diverse in comparison with the Dongaria Kondh.

However, the Lanjia Saora community is master-of-art in terrace cultivation and hence their knowledge has the potential to guide the management of land and water resources elsewhere on terrace agriculture systems. In the context of Koda community of Andhra Pradesh, the ethno-ecological perceptions are relatively less or it may appear so because not much of justice has been made in terms of dedicated time for study on the tribe.

- The Dongaria Kondh indigenous knowledge on understanding of land and water in their domain is very diverse compared to the other two tribes studied here. This may be accounted for their varieties of land use practices which are slope and terrain specific. Conscious efforts for managing cover crops on upper slopes, restoring nutrient supply to the foothill plains, religious attributes warranting preservation of natural vegetation on hill tops are some of indicative practices for *in situ* conservation of land and water. The balance between natural vegetation on hill tops, the cover crops of horticultural species on the upper mid-ridges, shifting cultivation on mid-ridges and seasonal crops on foothills and valleys is so well managed as a practice that implicitly they contribute to effective management of land and water resources.
- The Lanjia Saora community may be considered one step lower to Dongaria Kondhs in respect of their knowledge on land and water management, for the latter has a major component of horticultural land use which the former is lacking. But, however, this does not, by any means, make the Lanjia Saora any less in terms of having the indigenous knowledge for land and water management. The Lanjia Saora depicts repositories of indigenous knowledge in terracing. The indigenous but ingenious engineering skill showcased by Lanjia Saora in terrace agriculture showcase their understanding on slope, soil, runoff and land use and the interaction of all in a subsistence based agriculture context. Such knowledge systems are no less scientific in comparison to modern knowledge systems and hence such knowledge systems qualify to be mainstreamed or practiced through a blending with modern knowledge systems.
- The Dongaria Kondhs and the Lanjia Saora have experience based knowledge in appropriating specific interventions at specific locations and slope conditions which are technically parallel to the sophisticated knowledge in soil and water engineering. They understand slopes typically in their own way, e.g. knee-chin slope i.e. very steep slope while walking on which the knee and chin come closer. The distance between knee and chin while walking on a

slope gives an idea of the degree of slope. Accordingly they make idea for appropriate intervention for soil and water conservation structures applying thumb rules. Like the Lanjia Saora describe, the elevation of a bund between a downstream terrace and upstream terrace depends upon the soil depth, presence of bed rocks, etc. hence, each intervention they undertake is very site specific and no generalization would be possible. For each intervention on each site their traditional knowledge and age old experience shows the way.

- Stone bunds, loose boulder checks, vegetation strips and contour terraces are said to be appropriate interventions on high slopes with justifiable technical logic. On the mid-hill region appropriate interventions count Contour Trench (CT), Continuous Contour Trench (CCT), Staggered Contour Trench (SCT), Contour Bund (CB), Bench Terraces (BT), Narrow Base Terraces (NBT), Broad Base Terraces (BBT), soil traps and barriers at horizontal rows, at regular intervals, soil trap drop structures, etc are feasible interventions which all the tribes are acquainted with. The drainage line treatment with Loose Boulder Check Dams (LBCD), Brush Wood Checks is most common.
- Enormous indigenous knowledge is embedded in the practice of shifting cultivation or swiddening. The three tribes studied here are at three different levels of practicing shifting cultivation. While the Dongaria Kondh practice of shifting cultivation is relatively less intensive, the practice of Koda is both extensive and intensive. The Lanjia Saora community has sort of abandoned shifting cultivation and has raised tree crops like cashew and mango. In the multiple cropping system, the variety of crops cultivated in swiddens is large compared to the Koda and Lanjia Saora. Further, the Dongaria Kondh have a very good knowledge of spacing of crops in unit area considering the root structure of crops, tubers, tree crops so as to maximize the production of different crops in unit area in a scientific manner. As long as the multiple cropping system continues to be there, the Dongaria Kondhs would be using such knowledge systems to multiply benefits from unit area of land. Dealing with a diversity of crops has made the Dongarias innovative which is scientific in their own accord. As such each tribe have typical experience and knowledge of managing the land and water resources at different stages of shifting cultivation which is by and large appreciable. The Dongaria Kondhs perceive that are of opinion that the rapidly declining resource of soil fertility is efficiently and effectively utilized by mixed cropping over time and space. Hence it is an advantage from perspective of land resource management

- The Dongaria Kondhs have probably the best understanding and explanations as regards to fallow land management. In villages where the land to man ratio in shifting cultivation is better, there the old traditions of fallowing the lands in consideration to vegetation can be better observed. A visual comparison of the regeneration in one-year cultivated, two-years cultivated, three-years, cultivated swiddens would suffice to such a perception regarding fallow management of Dongaria Kondhs. According to them an ideal fallow period should be conceived on the basis of observation on regeneration of plants and biomass increase in the fallowed swiddens.
- The tribes identify certain endemic species as erosion controlling vegetation. Knowledge of this is incredible about the Lanjia Saora although not less appreciable about the Dongaria Kondh and the Koda. This knowledge is of paramount importance from point of view of stabilizing the land and water conservation structures at various sites and locations. While the Dongaria Kondhs care banana, citrus, cashew, mango, pine apple, cinnamon, elaichi, pomegranate, turmeric, castor and lantana weeds as efficient soil binders on slopes; the Lanjia Saora care for date palm, cashew, ficus, mango, Indian privet, banana, bamboo, broom grass, sisal, grass as soil binders and as bund stabilizing agents. The Koda community care for sisal, vetiver, cashew, palm, mango, eucalyptus, silver oak, broom grass, lemon grass for purpose of arresting soil erosion. However, a close look at the plant species cared by the three communities provide to understand that while the Dongaria Kondhs have integrated crops and weeds for arresting soil erosion, the Koda is more used to the plantation species especially the exotic varieties for the same purpose. The Lanjia Saora community has well integrated the endemic vegetation and the plantation species for effectively preventing soil erosion. All the tribes, however, have reasonable agreement that the weeds are not bad, they are important from ecological point of view generally.
- A comparison that can be drawn between the three tribes in terms of farming systems approach which implicitly talk about the land and water management systems by them also puts the Dongaria Kondh at top of the ladder. The Dongaria Kondh have integrated agriculture (on slopes and plains), horticulture (vegetables, fruits and tree crops), animal husbandry, forestry in their farming system approach, whereas the Lanjia Saora have agriculture (terraces and plains), horticulture (tree crops), animal husbandry and apparently no forestry in their farming system approach. The Koda have only

shifting cultivation and forestry to sustain their livelihoods. What is emerging out of this is that the land based production systems of Dongaria Kondh is more stable compared with that of the other two tribes.

- The study has thrown light on the importance of indigenous tools and implements in the context of land and water management. It appears convincing to note that there has been least farm mechanization in the study areas and the tribal farmers have been using their indigenous farming crafts till date, which by default is preventing the soil erosion. Summer ploughing using the traditional bullock or buffalo driven ploughs is a very scientific practice the tribes do to retain moisture in soil by arresting each drop of rain in the summer.
- The Lanjia Saora community outshines the others in the area of water management. In their traditional norms the water management is considered a community responsibility. Their socio-political system about water governance was very organized, although, however, such management systems have become weak in the contemporary scenario though. They exhibit ingenious skill, expertise and understanding on water management which is exemplary and important learning.
- The Tribal Heritage Agriculture System (THAS) is gaining global recognition and relevance in the current scenario. The system of agriculture adopted and practiced by Dongaria Kondh and Lanjia Saora have justifiable merits for consideration under THAS. Further research in this direction would be a welcome step to add to the hypotheses and realization that THAS is more stable in a natural resources management context especially in the management of land and water resources. The management paradigms are inbuilt or ingrained in their work traditions and prevailing practices.
- The data presented in the report showcases multitudinal strategies adopted by the tribal communities over years for conservation and effective utilization of land and water resources to secure their livelihoods. In an exploratory study, the scientific aspects of their management practices can be better studied through participatory observations on practices than by using any other structured instruments. Each aspect opens up a new arena for in-depth study in future. Indigenous knowledge related to their land and water conservation is an embedded knowledge embodied in their socio-cultural interactions with such resources, community level ideals on governance of resources and above all in their work traditions in agriculture and livelihoods pursuits.

Conclusion

The consequence of increase in population coupled with the lack of a diversified resource base, has been a tremendous pressure on land-water-plant resources. The area available to each household has been progressively decreasing and the options for continuing the traditional agricultural practices are gradually shrinking due to poor land and water resource management. Shifting cultivation that used to be a good silvoagriculture practice in which the dwellers grow agricultural crops in forests has turned to more kind of settled agriculture due to the population increase and shortage of lands. The options for shifting from place to place to and allowing the lands for restoration of fertility during the fallow period have become very limited with the communities.

The tribal peoples' indigenous knowledge on land and water resource management is by and large linked to shifting cultivation which is their mode and means of livelihood earning. Apart from the required agroecological conditions, shifting cultivation is practiced where there is availability of forest land, and labour force at the household level, and there is a lack of capital. Where there is sufficient land to support fallow but no capital, no other farming system would produce higher returns to the labour, than shifting cultivation. The system is therefore very labour intensive requiring very little capital and other inputs. In sharp contrast to it, the terrace cultivation and plain land cultivation is less labour consuming and less diverse in technology. The unavailability of forest land, the legal instruments restricting shifting cultivation, limited choice with the communities for shifting from place to place, are some of the reasons that have compelled the communities to regularly cultivate particular patches. When gradually the production declines the communities take to tree crops or leave the patches abandoned. When people interact with patches of lands regularly, they also take care and maintain the land and water resources. When the lands are abandoned then they remain prone to soil erosion and other ecological degradations.

The tribal indigenous system of land and water management are basically community managed and to a small extent self managed using available forest raw materials such as bamboo, wood, stones and boulders, etc. All operations including agricultural operations are done using hand tools and manual implements. Farm mechanization has not happened so far and that goes to the advantage of land and water management.

Ownership of land and rights over land matters a lot in the context of land and water management in tribal areas. The physical possession over hill slopes for shifting cultivation

has not been legally recognized in favour of the communities and households who have physically possessed the land.

All the tribes studied here tend to follow a clan based land tenure system which provides customary rights in land, trees, forests, etc. for instance, the Kondh clans were called *Muthas* which may be further sub-divided into lineage based territories as in the case of Dongaria Kondhs. In the case of Lanjia Saora it is *birinda* (extended family) based territories. Tribes like Kondhs, Saoras, traditionally carry out shifting cultivation along with paddy cultivation in valley lands. The land use and tenure system varies from tribe to tribe but most swiddening tribes broadly cultivated four types of lands – Valley bottom paddy lands or wet lands; homesteads, backyards; uplands and swiddens or shifting cultivation fields. Some of the tribes such as Saoras also prepared terraced lands. Community ownership is exercised in hill slope lands used for swidden cultivation which are distributed by the village community and revert back to the community after each cycle.

The tribes tend to accept individual ownership of swidden lands i.e. the same family reverts back to a plot of land after each cycle though community maintains a number of control mechanisms. The clan or lineage based systems of different tribes tends to be territorial i.e. certain valleys and hill sites belong to certain clans and lineages. For example, amongst Dongaria Kondhs, village occupy territories with well defined boundaries marked by natural land marks like rocks, streams, ridge lines, etc., and everything within the boundary belongs to the village. Trespassing or encroachments across boundaries are extremely rare and seen as a serious offence. In such clan/lineage based system the community could allow outsiders to settle in the village based on community decision or traditional leadership distribution, and even allot land for cultivation. Non-clan members generally, could not settle in the villages without permission from the village community.

The traditional land tenure system of different tribes has been dramatically modified by increasing pressure on land, reservation of forests, imposition of formal land tenure system and interaction with markets.

Clan and lineage based territories practiced by tribes were not recognized in the settlement processes. The communal nature of ownership of land, especially swidden land amongst tribes like Saora and Kondh, etc, was totally ignored. Even in tribes where customary

individual ownership over hill sites were recognized, the cultivated hill slopes were settled as government land. This has been one of the most critical constraints on tribal access to land, especially in south Odisha. Hence, the subject of land and water resource management in tribal areas today calls for adequate government attention to review the land tenure systems with consideration for tribals doing shifting cultivation.

Shifting cultivation has been proving to be the major factor for degradation of land and water resources in tribal areas. The system of shifting cultivation cannot be avoided completely but need to be reorganized. The alternate substitute planning for the system at the level of physical land use and interventions, agronomic practices and socio-economic processes in consultation with the tribal is need of the hour.

GLOSSARY OF CULTURAL CORE TERMS

S: Sanskrit, DK: Dongaria Kondh, LS: Lanjia Saora, K: Koda, G: Gond

A

Cultural core terms	**Concerned Tribe**	**Meaning**
Aat	G	Highland
Abakukud	LS	Nuclear Family
Abarukusing	LS	Joint Family
Adangsar	LS	Big-paddy
Adapur	LS	Ritual/ worship offered to Lobosum and Kitung in the paddy field or terrace
Adasar	LS	Paddy-shelf; a type of terrace
Adevamatrika	S	Cultivated areas not dependent on rainfall or water
Adhara parivaha	S	Channels for diverting water from a reservoir or river
Adratang	LS	Form of dance
Agaribur	LS	Plateau
Agulaibur/akurpebur	LS	The junction between two adjacent hills
Ajingbur	LS	Hill top
Ajingbur	LS	Foot hill
Ajibudhi Penu	DK	Spirit of grandmothers

Ajorasum	LS	God/Goddess associated with streams and rivers
Alompal	LS	The Upper side bund of terraces or terraces on upper end
Alusing	LS	Part of Saora traditional house
Ambadhana	LS	Mango-paddy (tall paddy grown in Kharif)
Anjamantang	LS	Form of dance
Anjer	LS	Banyan tree - *Ficus benghalensis*
Anseer	LS	Cooperative labour
Anudaka	S	Waterless region
Anupa	S	Wet. Areas of heavy rainfall
Aptintinaleji	LS	Fines/ Penalty
Ara	LS	Tree/ Wood. Often used to explain individual and/or community ownership over trees
Aranya	S	Forest region
Arasal, ali, abasal, aba,sindisal	LS	Different types of liquors; sap, fermented and distilled
Arbatinjee bitin	LS	Communal land property
Atengku	LS	Extended family with more persons including kin and relatives
Attungsum	LS	God/Goddess associated with swiddens
Audaka	S	Humid areas

B

Bachit birga	DK	Dry soil
Bada	DK	Kitchen Garden, back yard orchard
Bahal	G	Low land
Bailu	K	Foothill section of the hill
Balia	DK	A vegetable
Balii birga	DK	Sandy soil
Balusum, barusum and barongsum	LS	God/Goddess associates with hill
Banda	K	The top section of the hill
Bandha	G	Irrigation structures
Barika	DK	Messenger (a position/status in village

		socio-political system). Barika is a male who belongs to Domb community
Barongsum	LS	God/dess associated with hills
Barooh	LS	literally means hill and hill forest
Baroon	LS	Plural of barooh and refers to swidden sites/plots
Baroon abaran	LS	Hill-work/ swiddening
Barusum	LS	God/dess associated with hills
Basa	DK	Living space
Baseng/ Basing	LS	Foot hills. Also used to understand foothill plains with or without forest on it
Bejuni	DK	Women shamanin
Berna	G	Medium land
Bhauma	S	Dry lands
Bhairo Penu	DK	Ancestral spirit
Bhima Parbu	K	Agricultural ritual for wind god
Bicha Parbu	K	The festival before seed sowing
Bidiyar	LS	The bunds of the terraces
Bihan Puja	DK	Worship offered to seeds before sowing
Bima Penu	DK	Wind god – helps pollination in crops
Birga	DK	Soil
Birinda	LS	extended family with more persons including kin and relatives
Bismajhi	DK	Position in village socio-political system. He acts as revenue collector and village fund manager whose secular position comes next to Jani
Bitin or biti-darba	LS	Property
Bruhu Tana	DK	Soil with light red and black colour. Also used to explain patchy soil where cultivation is taken up
Bubudin	LS	Knowledge
Bungtel	LS	Buffalo
Buru Penu	DK	A malevolent spirit

C

Chahal	G	Irrigation structures

Chhatar Penu	DK	An ancestral spirit
Chuna birga	DK	White soil
Chunga	DK	A narcotic/stimulant
Chuji Horu	K	High hills with steep slopes

D

Daibur	LS	The spiral paths along contours to the hill top
Dalbehera	LS	A leadership status one step down to Gomango – the village head. Dalbehera acts as Gomango in his absence.
Damien bitin	LS	Individual landed property
Damkeri	DK	The meeting place of jungle animals
Danda	DK	Slope (both in physical and spiritual attributes)
Danda Penu	DK	Lord of slope
Darakuna	LS	Settlements
Darikul	LS	Gruel
Darisum	LS	Synonym of earth deity
Dasing	LS	The floor under the loft
Deni Tana	DK	Soil generally red in colour
Dharni Penu	DK	The Earth Goddess; all-powerful and all-pervading
Dhan nuakhia	DK	New eating of rice
Dhanya	S	Grains
Dhapa	DK	A small room with verandas in front and back
Dharani Penu/Jhankar	DK	Is the benevolent supreme goddess
Dharani Vali	DK	Stones representing Goddess Earth
Dhungia	DK	A preparation of raw chewing tobacco (powdered and mixed with lime) used as stimulant/ narcotic
Diasing	LS	Part of Saora traditional house
Disari	DK	Astrologer, sometimes conducts magico-religious performances
Dongar Penu	DK	Lord of swidden
Dongar Puja	DK	Worship at the swidden

Dulba	LS	Burning
Dungdungbur	LS	Steep hill slope
Dunkeli	LS	Platform/ terrace on which paddy cultivation is done; Smaller fragments of *Saroba* having embankments on all sides

E

Eraing bitin	LS	Renewable or inexhaustible resources
Eyu penu	DK	Water deity

G

Gada	LS	Small forest, comprises of grasses, herbs, shrubs and trees
Gada - Tulab	LS	Synonymous in explaining a forest
Gada Pada	LS	Gada type of forest in a large landscape
Gajeng	LS	Slashing of forests for swiddening
Gajing	LS	Month (February-March)
Gala	LS	Reaping
Galamal	LS	The one-word for reaping and stacking
Gangi penu	DK	Water God/dess. Hill streams are understood to be manifestations of Gangi Penu which is synonymous to Eyu Penu
Ganursum	LS	Rain God/dess
Gati	DK	The top of hill up the swiddens
Gatu	K	Terraced paddy fields
Ghanta Parab	DK	Important regular festival in their agricultural and ritual calendar
Gramya	S	Village areas
Guda kalu	DK	Molasses liquor
Gudia	DK	Foothill lands where certain cash crops are cultivated along with other crops
Goar and Karja	LS	Mortuary rites
Gomango	LS	Headman in the traditional socio-political organization.

Guartang	LS	Dance forms
Gungupur	LS	Thank giving to Lobosum ritual after harvesting; worship for well-being of livestock

H

Hada	DK	Scrub jungle
Hada Sala	DK	A wooden post in the cowshed
Hila birga	DK	wet/ moist soil
Hira Penu	DK	A village deity
Horu	DK	*Horu* is used as a suffix to describe the type of slope involved
Horu	DK, K	Hill
Horu Penu	DK	Gods Associated with shifting cultivation
Horutai	DK	soil on the hills where all kinds of soil is found
Havanta	K	Head of village council
Hira Parbu	K	Seeds to be frondested and charmed

I

Idaisum	LS	Ikon God/dess
Ildasum and Raudasum	LS	Ancestral spirits who are linked to well-being and welfare of the community for which they are worshipped by *Shamans.*
Irpi kalu	DK	Distilled liquor made out of mahua flower

J

Jada	DK	Forest of underwood
Jada	LS	Stream/water resources
Jada	DK	depleted primary forests or are secondary or coppice forests
Jadapur	LS	Worship when a new born becomes 21 years old
Jadasum	LS	Is the God/dess Governing water in the Lanjia Saora country

Jadi	DK	Stream
Jaditai	DK	Soil of the stream banks
Jaitan	LS	The plain land in consideration to hill terrains
Janang	LS	Land resources irrespective of use patterns
Jangala	S	Dry. Applies to low rainfall areas
Jani	DK	Priest who conducts regular rituals and worships
Jatrakudi Penu	DK	The Village Deity
Jeye bur lobo	LS	Lateritic Soil
Jhankar	DK	Carved Wooden Posts Representing the Consort
Jhankar Penu	DK	Associate deity with Dharni Penu
Jhudanga	DK	A vegetable
Jorabasum	LS	God/dess associated with water
Jujukukud	LS	Patriarchal
Junga Parbu	K	Different festivals of Koda Kandha
Junturi	LS	Term for slash and burn agriculture

K

Kaja Horu	K	High hills
Kaja balii birga	DK	Coarse textured sandy soil
Kajayu Penu	DK	Spirit of forefathers
Kakartai	DK	This soil type is found under shade conditions which refer to forest floors with canopy cover.
Kaman	DK	Primary forest with canopy and climax vegetation
Kambari	LS	Labour
Kambit Birga	DK	Red soil
Kambit deni tana and kambit bruhu tana	DK	Two types of red soil
Kamboor	LS	Sorghum
Kamda	LS	No work or vegetation zone
Kanda	DK	Tuber which is cooked and eaten
Kandul	DK	Pigeon pea
Kanseem	LS	Fowl

Kara	DK	A narcotic/stimulant
Karanali	LS	Small water channel in a field
Karja	LS	Mortuary rite conducted at interval of 3 years
Karja tang	LS	Typical dance during *Karja*
Karjee	LS	A position in traditional socio-political system. Karjee reports to Gomango through Dalabehera
Kata	G	Type of irrigation structures
Kateiveli Penu	DK	Concert for Dharani Penu
Kating	DK	A variety of cow pea
Kedar	S	Marshy lands. A tract that could get sufficient water through irrigation
Keri	DK	Slope at the lower end of a hill
Khatapravartim	S	Water set into motion by digging canal
Kinnalosum	LS	God/dess associated with water
Koda	K	Kondh
Konda	K	Hills
Kora	K	Little millet
Kuda	LS	Hearth in the dark corner of the house
Kudi	DK	A thatched shrine
Kudu	LS	Rice
Kui	K	The dialect of Kondhs which belongs to the Dravdian linguistic group
Kuitab	LS	Umbrella
Kumla Parbu	K	Festival for consumption of maize and pumpkin products
Kumme	LS	Goat
Kundeli	DK	A narcotic/stimulant
Kurgad	LS	*Syzigium cumini*
Kurual	LS	Worship for Better Production in Swideening
Kurusal	LS	A festival in agricultural season
Kutta	LS	Kitchen Garden
Kutumb Biti	DK	Communal property like forests
Kuvi	DK	A Dravidian Language
Kuvinga	K	Kondh dialect speaking group

L

Labosum	LS	The earth deity
Lada Penu	DK	God who lives on hill top
Ladi basa	DK	Term generally used for the sentinel hut erected on swiddens
Ladre	DK	Mud
Ladre balii	DK	Fine textured sandy soil, silt, mud
Lai Penu	DK	At the household level various ancestral spirits being worshipped and propitiated
Lajjab	LS	Worship offered to ancestral spirits and earth goddess for bumper crops
Lala	LS	Seeding/sowing
Langal Kanda	DK	Yam - an edible tuber
Lankabur	LS	A high hill or mountain
Lantapbur	LS	Wide hill slope
Lebu	LS	Money
Lekhi sol	LS	The sandy loamy soil
Lobo	LS	Land/earth
Lobosum	LS	Earth God/dess
Lua	LS	*Ficus glomerata* tree
Lutsabur	LS	Down slope path

M

Mada	LS	Loft
Mada, anal	LS	Rice pounding hole
Madapur	LS	Mist worship
Madaha	K	The middle section of hill
Mada kalu	DK	Sago palm toddy
Madre or madeni	DK	Middle part of a hill
Madre Gandre	DK	Lower side bund of swidden
Maha Parbu	K	New-mango eating festival
Mahane Dangu	DK	Part or whole patch of forest used as cremation ground
Mal	G	Slope land
Mandal	DK	Designation of Mutha Head
Mandiarani	DK	A ritual during early monsoon conducted when ragi germinates in field

Manduasum	LS	A male deity who is the protector of the village
Manduasumpur	LS	Worship for village welfare
Manisum	LS	Form of Hill God/dess
Manjungbur	LS	Mountain with sharp cliff
Maunli Penu	DK	Malevolent spirits those inflicts diseases who are satisfied by Shamans and Bejunis
Mayura	K	Peacock (Dance form)
Merang	DK	The paddy fields which are located even at a lower level than the foothills
Meria puja	DK	Big three-day-long festival with buffalo sacrifice
Meta horu	K	Average size hills with wider slopes
Mudasar or Sanadhana	LS	A dwarf paddy variety, literally called small-paddy
Munda	DK	A crossed wooden post erected beside Kateiveali Penu
Munda	G	Type of irrigation structure
Mundeni gandre	DK	The upper boundary of swiddens
Mundeni or mundeni kaba	DK	Hill top
Mutha	DK	It consists of a group of adjoining villages and is treated as an administrative-cum-social unit

N

Na biti	DK	Individual landed property termed as "my property"
Naku horu	DK	Steep slope
Nandinibandhayatana	S	River Dam
Nara basa	DK	Human settlements
Nebaraja Penu	DK	Synonym of Niyamraja god
Nedi da	LS	The water releasing from rocks
Nehla	K	Swidden
Nellu	DK	Spaces where once a primary forest existed, later cleared for swiddening
Nellu Padi	DK	Plots arranged transversely along the circumference of a hill
Nellu Pati	DK	The arranged longitudinally along the slope of a hill

Neta	DK	Swidden plots
Neta	DK	Land for shifting cultivation
Neta Basa	DK	Temporary dwellings/ watch huts where the tribesmen live to keep watch and ward on crops
Neta	DK	Swidden
Nima	DK	An area on foothills bearing little or no vegetation
Niyamraja Penu	DK	Lord of Niyamgiri hills
Nyalsing	LS	The traditional houses in which Soara lives

O

Ooyungsum	LS	Sun Spirit

P

Padari Kudi	DK	Shrine housing Dharni Penu in village
Pageng	LS	Weeding
Painaka Parbu	K	An agricultural ritual
Palam	K	Paddy land on plains
Panga	DK	Foothill plains
Parvata	S	Mountainous areas
Patra	DK	Plateau
Penda	DK	Area at the foot hill
Penu	K	God/dess; suffixed with deities
Penu Basa	DK	God's abode
Penu eja	DK	God's House
Pidika/ Pidika yatra	DK	Ritual to save crops from insects
Pigdis	LS	Space for pig and fowls
Punapadi	DK	An agricultural ritual
Punja	DK	Title Group

R

Ragan Abdur	LS	New eating festival of red gram
Ragi	K	Millet Kandhs cultivate
Rai	LS	Term used for plucking of pods and beans and peeling them.
Rani Kanda	DK	An edible tuber

Repa horu	DK	Broad slope
Rogga Penu Parbu	K	Festival to avert epidemics
Rrodu	LS	Man power
rub-da-singpur	LS	Rain Worship
S		
Saba roye	LS	The Sanskrit term for carrying a dead body
Sadar Kudi	DK	Shrine housing Dharni Penu, synonymous with *Padari Kudi*
Sadrangi laka	DK	Worship to the crop containers after harvest
Sagories	LS	The Scythian word for axe
Sahodaka	S	Regions blessed with a good supply of water
Saibang lo	LS	Fertile soil
Sala	LS	Small forest
Saladabur	LS	small forest on the bank of a perennial stream
Saldasol	LS	Clay soil
Sama	K	Millet
Sama	S	Plains
Sana Gada	LS	Gada type of forest in a small landscape
Sanda	S	Vegetable gardens
Sandinga	K	Clans between whom matrimonial alliances are permitted
Saraba	LS	long and contiguous plain land with series of bench terraces
Saroba	LS	Paddy lands
Setu	S	Irrigation work
Sita Penu	DK	Goddess associated with shifting cultivation
Si-eet bitin	LS	Exhaustible resources
So	LS	Hidden
Sonum/ sonums	LS	Supernatural powers regarded as Gods and Goddesses
Sthala	S	Dry lands
Suda Bicharmar	LS	Decision maker
Suku Penu	DK	Malevolent spirit – inflicts diseases
Sunsunab	LS	Leaves

Surma birga	DK	Graphite soil

T

Tade kalu	DK	Distilled liquor out of banana
Tala bigra	DK	Hair like fine black soil (tala means hair)
Tambar da	LS	Water flowing in the perennial streams originating from high hills
Tana	DK	Earth; also refers to foothill plains
Tanamar	LS	The physical feature of terraces
Tanaimar	LS	Magic practitioner
Tangia	K	Fraternal clans between whom matrimonial alliances are not allowed
Tanidi	LS	The lower side bund of terrace
Tedi	DK	Circumference
Tinniradang	LS	One type of stone embankments synonymous to tumarpal
Titin	LS	*Tamarindus indica*
Tonaisum	LS	God associated with magic
Trangdi	LS	The mid-line of the hill along its vertical interval; literally means middle
Trunjeli muanri	DK	Part of forests revered as abodes of gods and goddesses
Tukki Parbu	K	New eating of mango kernel ritual
Tulab	LS	The mythical name of Gada (small forest)

U

Ubakul		Leaves
Uda	LS	*Mangifera indica*- Mango Tree
Udakamarga	S	Channels for diverting water from a reservoir or river
Udakabhagam	S	Water cess
udan abdur	LS	Festival for begin the eating of mangoes in the year
Udsui da	LS	The surface run off from the hill slopes
Uring	LS	*Bamboo*

V

Vali	Dongria Kandha	Sand
Valka	Dongria Kandha	Rocks, Stones
Valka Kota	Koda Kandha	*Stone bunds*
Valka Tana	Dongria Kandha	Yellowish soil
Vata	S	Flower gardens and fruit orchards
Visawa	S	Uneven lands

Y

Yayaar	Lanjia Saora	*Boundary*

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Annexure – I

KEY INFORMANTS WHO CONTRIBUTED TO THE STUDY

LANJIA SAORA

Name	**Village**
Laxman Sabar	Puttasingi

Pitar Buya	Marakui
Malati Raika (W)	Puttasingi/ Gunupur
Mukunda Sabar	Puttasingi
Devdeen Sabar	Sagada
Sarat Sabar	Sagada
Saloman Raika	Sagada
Iliazar Sabar	Gudada
Sukba Raita	Marakui
Atale Gomango	Dungdungar
Jaman Sabar	Dungdungar
Seta Raika	Angara
Samuel Raika	Angara
Joel Raika	Angara

DONGARIA KONDH

Name	**Village**
Daitari Kadraka (very old)	Khambesi
Suresh Wadaka	Khambesi
Nabaghan Wadaka	Khambesi
Mandra Jakesika	Khambesi
Pule Wadaka (W)	Khambesi
Rani Wadaka (W)	Khambesi
Tunia Jakesika	Kurli
Mandro Jakesika	Kurli
Katu Wadaka	Kuduveli Padar
Ramesh Nalla	Chatikona
Kailash Manahira	Chatikona
Sahadev Kadraka	Khajuri
Gobardhan Wadaka	Khajuri
Sindhu Wadaka (W)	Khajuri
Jati Kadraka (very old)	Khajuri
Muna Kadraka	Radanga
Samburu Kadraka	Kadraguma
Krushna Kadraka (very old)	Kadraguma
Lachaka Pusika	Batiguma
Teju Kadraka (very old)	Ghartoli
Salku Sikaka (very old)	Mundavali
Haguru Jakesika (very old)	Hutesi

KODA

Name	**Village**
Seemachalam Babu	Gonduru
Suri Babu	Eradapalli
Nuka Raju	Gonduli
Apala Naidu	Barimela
Apna	G Munisinghput

Lachhman Rao	Dokuluru
Iswar Rao	Vanjangi
Seemachalam	Kilchuru
Lachhmeya	Gonduru
Surunarayan	Dokuluru
Devulu Pachari	Araku
Balram	Araku
Dhananjay	Araku

PHOTOGRAPHS

Water Channels inside field

Drainage line converted to fields

Field bunds strengthened by wood

Field preparation on drainage line

Terraces on drainage line with outlet

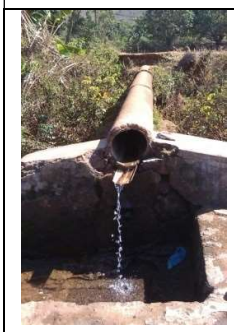
Terraces on valleys

	
Terrace n swidden continuum	Terraces n field bunds
	
Bench terraces	Downstream and upstream terraces
	
Multiple outlet for water management	Paddy on terraces
	
Continuous bench terraces	Contour terraces

	
New terraces in making	Outlet in terraces
	
Banana planting on upside of bunds	Date palm strengthens terrace bunds
	
Pine apple planting to add strength to bunds	Vegetation around terraces
	
Sharp bunds n new terrace making	Terrace forest continuum

	
Small water holes on terraces	Stone setting for terrace stability

	
Terrace height dependent on soil depth and sheet rock	Terraces in a microwatershed
	
Swidden land use with gully control	Swidden land use with gully control
	
Swidden field preparation	Fragmented fields prone to soil erosion

	
Swidden watch hut and standing crops	Crop residues after harvest in swidden
	
Fragmented fields on slopes	Swiddens around village
	
Brush wood check to prevent gully widening	Drainage line converted to flat fields
	
	Traditional Koda village

Diversion irrigation

Degradation of forest with soil and rock exposed

Burning of slashes for swiddening

Mid day meal with roasted tubers at swidden site

Clearing forests for swiddening

Cleared patch, exposed soil, initiation of gully

Felling, slashing and burning before cultivation

Landscape view of land use practices

Tapping water for moisture downstream

Landscape provides clues for appropriate land and water conservation measures