

The Habitat Diversity and Patterns in the Use of the Local Natural Resource Bases by the Rural Populations of North-West Karnataka

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Abstract : The north-west part of Karnataka (latitude 14-15° N, longitude 74° 30' - 75° E) represents a very high diversity region in the Indian subcontinent in physical, biological and cultural aspects. Five distinct ecological habitat zones are identified lying along a 150 km transect drawn in a west to east direction and one village community from each of these habitats is selected for the present study. The ecological features of the habitats are described and subsistence strategies of the people of the village communities that depend on the use of local natural resource bases are discussed in details. The common patterns observed are the exploitation of all types of subhabitats available in the local landscape to produce a diversity of biomass and minerals that meet the local demands for food, fodder, fuel etc. and agriculture as the common mode of subsistence. The variable importance of particular modes of subsistences (agriculture, horticulture, livestock rearing, etc.) and further specific variations in them in any of the habitats, suggest the evolution of traditional patterns of using the local natural resource bases in response to the variation in the ecological features of the habitats and basically to meet the local demands. The recent trend in changes in these patterns suggest the influence of the linking up of local economy with the market of the outside world and of the availability of modern technologies to these communities.

Indian subcontinent harbours a high level of ecological diversity and the people traditionally have living patterns intimately related to this diversity. Their patterns of subsistence by exploiting the local natural resource bases reflect their adaptation to the ecological variables of their habitats. In this paper, a case study from the north-west part of Karnataka is presented to show the ecological diversity of habitats and of natural resource bases of the region, and the patterns of subsistence activities based on the exploitation of this diversity by the inhabitants living in traditional rural set ups.

The north-west part of Karnataka (latitude 14 - 15°N, longitude 74° 30' - 75° E) (Figure 1) represents a very high diversity region in the Indian subcontinent in physical, biological and cultural aspects. The mountain range of Western Ghats runs parallel and quite close to the coastline of the Arabian sea in this part of Indian west coast. The different physical habitat parameters like altitude, topography, soil types, rainfall, type of and area under aquatic bodies vary rapidly in a west to east gradient (Figure 2) the natural vegetation also shows similar gradual changes (Gadgil 1987; Sinha and Hedge 1987; Pascal 1986; Bourgeon 1989; Daniels 1990;) As a result, a gradual but rapid turnover of ecological habitats is observed in this region in the west to east direction. Five distinct ecological habitat zones are identified lying along a 150 km transect drawn in that direction from the coastal town Kumta in the Uttara Kannada district to the eastern boundary of the district of Dharwar (Bhattacharyya 1993).

METHODOLOGY

The habitats and their geographical extent are identified from the study of the different maps (e.g., Pascal 1986; Bourgeon 1989) followed by a reconnaissance field survey. Five village communities are selected for the present study, one from each of these ecological habitats to represent the local rural populations. Each such village community is a cluster of villages or hamlets which are closer to each other spatially as well as in terms of regular interdependence than others in the neighbourhood. The diversity of subhabitats within the area inhabited and used by the selected community of each of these habitats was noted during the later field works. Information regarding the use of each of those subhabitats by the local village communities both at present and

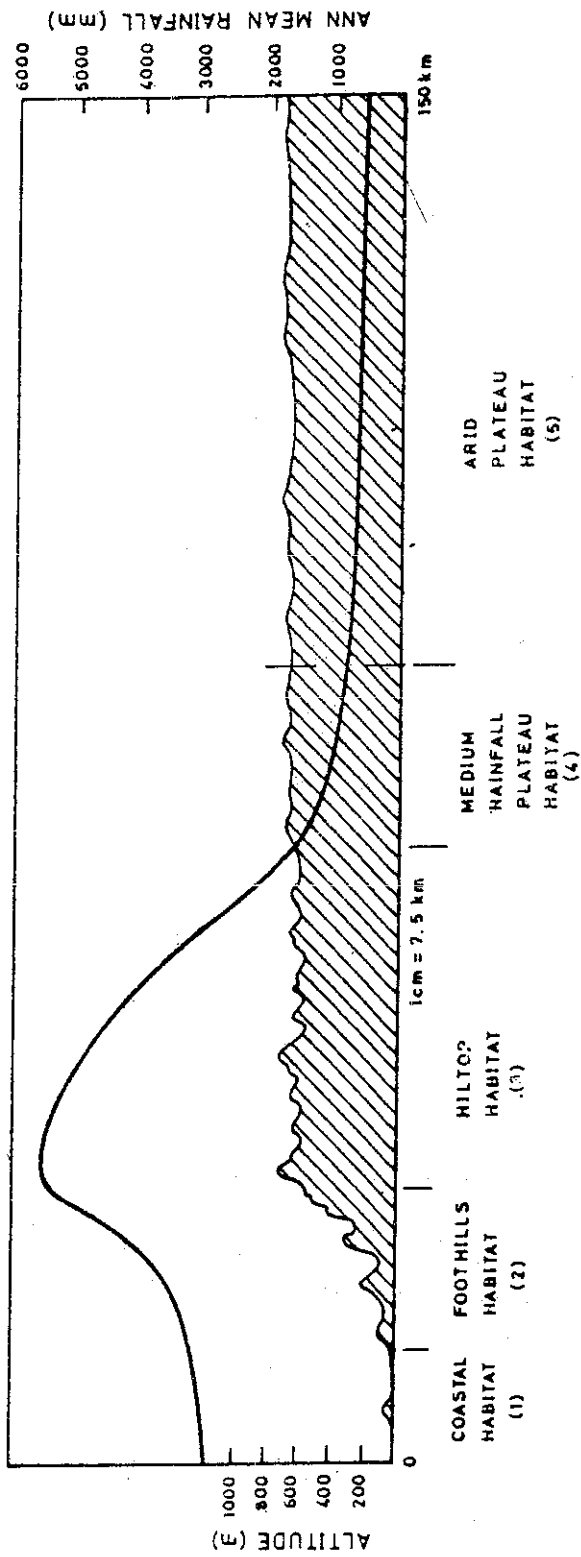


Fig. 2 The Change in altitude, topography and rainfall pattern along the transect

The potential natural vegetation belongs to evergreen, semievergreen types including the mangroves along the seashore and in the estuary. But, it is at present, highly degraded, represented by scattered shrubs and patches of grasses in the hillocks with very few individual trees belonging to mostly fruit-bearing species like mango (*Mangifera indica*), jack (*Artocarpus integrifolia*), *Garcinia sp.* standing here and there or rarely occurring in small patches. Mangroves are almost entirely wiped out, occurring only in a few small patches where the common species are *Brugiera spp.* (Pascal 1986; Daniels 1990; Gadgil *et al.*, 1990). The aquatic fauna include a wide variety and rich population of edible fishes in the sea and in the estuary. The other important elements of the fauna from the human perspective are abundance of prawns, crabs, clams, bivalves etc. The sea birds like gulls are also intimately connected to this aquatic fauna.

The forested foothills : The altitude starts fast rising towards further west from the coastal-estuarine habitat. The region between altitude of 100 m to 500 m is identified as foothill habitat. It is characterized by narrow valleys between high hills, still covered with dense forest in most of the parts (73.26% of total land area under the forest, see Table 7.2). The types of natural vegetation in remote undisturbed patches are of evergreen and semievergreen climax type (represented by *Persea macrantha*, *Diospyros spp.*, *Holigarna spp.* etc.), while in disturbed patches one finds secondary growth of evergreen/semievergreen or moist deciduous type (Pascal 1986). The west to east span of this habitat is on average 17.5 km (range 15 to 25 km).

The river Aghanashini cuts through the valleys being joined by numerous streams most of which are seasonal. The annual average rainfall goes up here from 3000 mm to 3500 mm, downpour is restricted to the monsoon months of June to September. During these months often heavy floods occur in the river and in the major streams which cut off communications between different parts of the region. This moist, forested foothill habitat had been a high malarial zone till the early half of this century.

The fish fauna in the streams and river include only a few species of edible fishes. The wild life includes animals like pigs, deer and a variety of birds, hunted by local populations.

The undulated hilltops : The Western Ghats in the district of Uttara Kannada are rather blunt without high peaks. The hilltop habitat has an average altitude of 550 m (ranging from 500 to 600 m), frequent with hillocks rising 50-100 m more. The width of the habitat from west to east is 37.5 km on average (range 20 to 40 km). The annual average rainfall reaches from 3500 mm to 5000 mm and moving little further east it drops to 1500 mm. The topography is heavily undulated with small valleys between hillocks. The original vegetation cover of semievergreen and evergreen dense forest types are now rare, abundant are thickets of evergreen and semievergreen forests (Pascal 1986). In the eastern side moist deciduous patches are found in few places. The soils are lateritic and acidic.

The medium rainfall plateau : As the Western Ghats meet the Deccan plateau to the east, the average annual rainfall drops quickly to 1500mm. Then within further 20km it goes down to 900mm. The landscape becomes much more smooth with average elevation of 650m and occasional hillocks gently rising to 750m at the most. This habitat has an average width of 20km (range 25 to 40km). The natural vegetation changes to dry deciduous types represented by *Tectona grandis*, *Terminalia tomentosa*, *Anogeissus latifolia* etc. In riverine patches originally extensive bamboo groves (*Bamboosa sp.*) were found (see Campbell 1883; Dharwar Gazetteer 1959). At present degradation has resulted mostly in the scrubby vegetation with sparse growth of the original species. The soil is mostly brown in colour and clayey in texture. The rock formations are mostly granite rather than lateritic unlike the rocky landscape of previous three habitats. The whole region abounds in tanks of different sizes made by bunding of the shallow valley basins in historical periods for irrigation of local crop fields (see Campbell, 1883; Dharwad Gazetteer 1959),

with the considerable modifications of the habitats. The latter is due to their traditional specialization in raising mixed crop gardens by converting narrow forest valleys. The tough terrain and high incidence of malaria kept this habitat sparsely populated (Campbell 1883). The habitat is still not very densely populated (Table 1) and has the domination of Haviks continuing in the population.

The history of human habitations in two plateau habitats are most probably much longer than the above ones (see Campbell 1883; Dharwar Gazetteer 1959). The two share many common historical features. Both were perturbed in most of the cases by the same events of invasions and battles in different periods of history. One of the most remarkable socio-religious events of the history that affected the sociocultural environment of both the zones is the evolution of Lingayat ideology during 12th century AD which found a stronghold in this region and is still continuing today.

These habitats do differ from each other in many aspects too. The medium rainfall plateau have a very long history of intense agriculture with tank irrigation probably longer than any of the other habitats. The arid plateau is more referred historically as the country of nomadic shepherds and weavers. Many cultural aspects like house-plans, and minor details in the religious-ritual practices do differ between these two zones.

These rural populations are segmented into caste groups, each of which is endogamous and distinct with some traditional cultural identity (hereditary occupation, for example). A village community is organized by several caste groups coexisting together with a definite traditional pattern of reciprocal, at the same time hierarchical, interrelationships. Thus, they represent the caste society typical of Indian subcontinent.

USE OF LOCAL NATURAL RESOURCE BASES BY THE COMMUNITIES

Use of different subhabitats in the local landscape : Every village community in any of these habitats lives in a landscape that is a mosaic of different terrestrial and aquatic subhabitats. Local communities use all of these subhabitats differentially, by modification to a greater or lesser extent to provide a wide variety of different types of biomass and minerals in order to satisfy the basic demands for food, fuel, fodder, manure, materials for house building, and for fabricating different artifacts. The surplus productions of some of these materials (or materials or artifacts processed from them locally) are used to exchange for other materials or artifacts or different specialized services from other regions which are not locally available at all or are available inadequately.

Table 2. *Different subhabitats in the local landscape used by the local communities*

Subhabitat	% total geographic area	Patterns of usage
COASTAL ESTUARINE HABITAT :		
1. Land lying in the intertidal zone along the river course and in monsoon estuary; locally called as 'Gajni'	28.24*	Bunded to control inflow of saline tidal water; during brackishwater paddy cultivated; during winter devoted to prawn cultivation; also crabs and fishes caught in winter.
2. Low lying plain land above the tidal line	17.65*	Major part is cultivated, main crops : freshwater paddy, groundnut, pulses; some parts are used to raise garden with coconut, betel nut, banana, mango, jack.

HILL TOP HABITAT :

- | | | |
|---|--------|---|
| 1. Flat land in the narrow valleys : | 4@ | |
| a. 'Hondadagadde' (the moist ones) | | Cultivated in the rainy season, main crops : paddy (mostly of hybrid varieties) and sugarcane. |
| b. Makkigadde (the drier ones) | | Cultivated in rainy season, main crops : paddy (mostly of indigenous cultivators); people cultivating these lands have their households also here. |
| 2. Land at the bottom of narrow valleys between usually close to a stream or irrigation tank. | 12@ | Multistorey horti, garden of betel nut, banana, cardamom hills, and pepper in recent years cocoa replacing banana; the garden is usually bordered by fruit trees like mango, jack and coconuts, often households are adjacent to a garden (referred as bagayata') |
| 3. Forests on the upper slopes and at the top of the hillocks adjacent to the mixed crop gardens. | 75@ | Usually managed and exploited by the owner of the adjacent garden, to supply the leaf manure, mulch, for the garden also to meet the fuel and other plant biomass demands of the owners' household; referred to 'soppinabetta'. |
| 4. Forests in other hilly patches not adjacent to any mixed crop garden | 8.7@ | Meet the regular biomass requirements of fuel, fodder, manure, timber etc. for the local people who does not have soppinabetta : also used as common grazing land.
Forests in more inaccessible patches that still exist far in the habitat are generally used to gather minor forest produces like cane, honey etc. by a small proportion of families mostly during winter. |
| 5. Grasslands on the slopes of some of the 'soppinabetta' with a few trees, created by clearing of tree cover; the common species of grass is called 'Karda'. | NA | Grasses are harvested locally feed the livestock. |
| 6. River and streams river Aghanashini and innumerable hilly streams mostly seasonal. | NA | River and perennial streams serve as drinking water sources, streams, especially the seasonal ones are often banded and redirected to storage tanks or to pass through the gardens for irrigation. |
| MEDIUM RAINFALL PLATEAU : | | |
| 1. Plain land with clay soil of brown type | 66.45! | Cultivated, 22% twice a year by irrigation, rest once only; major crops : paddy, jowar, cotton, chilly, millets, maize, groundnut, etc. |
| 2. Hillocks mostly with for grassland or shrubby vegetations, rarely with a few tree scattered over the area. | NA | Used for grazing livestock, collecting firewood
Granite quarrying from rocky outcrops.
In recent years in major part Eucalyptus plantation have been raised for commercial exploitation. |
| 3. River : the perennial river Varada is the only river flowing through the habitat | NA | Used for irrigation, mud from the river bed and bank are gathered for house constructions and pottery. |

laterite stone blocks, mud, limestones etc. by the local communities.

(4) Natural bodies of freshwater supply like streams, rivers, tanks are used by the communities for drinking, for domestic usages etc., and irrigating farm lands. But, in every habitat they are supplemented with man-made structures for storing rainwater or natural water flow (wells, ponds or streams banded to reservoirs etc.) because of seasonality, awkward locations, poor quality of water or inadequate supply of these natural sources

Apart from these common patterns, the communities of different peninsular habitats vary from each other in many aspects, including in the availability of different local terrestrial and aquatic subhabitats and in patterns of using them.

Productions of different material resources (biomass and minerals) from different subhabitats: There are two basic ways through which human population exploit the surrounding landscape to produce a wide array of different raw material resources for living. These include : i) by manipulating the natural productivity of different biomass in their favour through modifications of habitats and modifications of the plants and animals used in the production of the biomass. This is achieved through cultivation — agricultural and horticultural, by animal husbandry, by sericulture, pisciculture etc. ii) by gathering (or hunting) natural produce (e.g. fishing, gathering firewood, fodder or plant leaves to weave mats, hunting game etc.)

Table 4 briefly describes the appropriation of a variety of biomass and minerals by exploiting different available subhabitats by village communities of the 5 habitats. It also briefly narrates the usage patterns and importance of those produced in the life of local communities. A majority of these products are meant for local use either by the producer families for self consumption or exchanged locally by the producers to receive other materials, tools or services. Each of these village communities generates some specific types of resources and surplus of some other resources which are exchanged for other materials, equipments and services from other habitats which are not locally available to an adequate level.

This exchange is achieved by local communities of any habitat primarily through the market system centered at nearest towns. Traditionally, the exchanges were largely in the form of barter but at present take place mostly in terms of cash. The basic patterns of the subsistence activities based on the exploitation of the local natural resource bases by the populations living in these village communities are described below.

Cultivation : Cultivation is the most important production system in any of these habitats. Though, food is the major product of cultivation, its products also include other materials essential for living like fibres (e.g. cotton) or additives like betel nut and betel leaf. A variety of secondary products from cultivation like the vegetative parts of the plants, husks of the fruits, contribute importantly to the demands for fuel, fodder, manure, thatch materials etc. in the local communities. The extent to which cultivation products supplement other sources (like gathering from local patches) to meet these categories of demands differs from one habitat to other.

Agricultural production on the local farmlands plays the most basic role in the functioning of any of these village communities, as it contributes a major share of the food consumed by the local population. The surplus of food grains, traditionally, as well as presently to a recognizable extent, are used in barter for other materials and services through exchange interactions among the members of the local communities.

In the medium rainfall plateau, agriculture is practised most intensively. This is favoured by a high proportion of local landscape being suitable for cultivation, and possibilities of irrigation by the large numbers of tanks (Table 3). Climate, rainfall and soil characteristics also support cultivation of a wide variety of crops in this habitat. Among the 5 habitats, this is the only habitat that traditionally and till today relies on surplus of farm products to exchange for other materials

Horticulture	Courtyard garden at upland	P : coconut	Food, Oil source
		banana betel nut fruits (mango, jack, <i>Garcinia</i>)	Food Addictive Food
		S : Husks of coconut	Fibre for ropes, thatch, Fuel
		coconut leaves betel nut husk, leaf sheath, betel nut stem	Fuel Poles for house construction
Rearing livestock	Bena' / 'Khuski', the hillslope pastures	Cashew nut	Food
	Grazing at hillocks, stall fed with gathered and purchased fodder	Dung, milk, draft force, hide,	Manure Food Ploughing Cart pulling leather
Prawn culture	'Gajni' (in dry season)	Prawn	Food
	Gathering 'Gajni', 'Tari' field bunds (in monsoon) Khuski/Bena (in monsoon) Hillocks	Weeds Grass Laterite blocks Laterite Soil Lime stone ('shedi')	Fodder Fodder House construction House construction House construction
	Natural vegetation patches	Grasses, shrubs	Fodder
	Upland	Dry shrubs, twigs, Dry & fresh leaves	Fuel Manure
	Mangroves	Wooden poles, Twigs branches	Bunding Gajni Fuel
	(Freshwater) Water holes, streams Estuarine land converted to salt pan	<i>Pandanus</i> leaves 'Kekoo hooloo' (<i>Cyperus</i> reed)	Weaving mats Weaving mats
Fishing	Seacoast (except in monsoon)	Salt	Food
	River Estuary Courses : all seasons in winter & summer	Fish, prawns, crabs Nonedible fish & crustaceans	Food Manure
FOOTHILLS : Agriculture	in monsoon	Fish Oyster, clams, Leaf dust ('kepu')	Food Food Manure
	'Tari croplands	Drift wood	Fuel
		P : Paddy grains, sugar cane pulses	Food Food Food
		S : Paddy straw bagasses	Fodder Fuel

		vegetative parts	Fodder
		Mud	Pottery, House construction
Horticulture	Wetter 'Tari' land		
	Bagayata. horti gardens adjoining households	P : Banana betel nut coconut	Food Food Food
		S : Husks, leaves, sheaths etc., of coconut & Arecanut	Fuel
		Fruits (mango, jack, <i>Garcinia</i> etc.)	Food
	'Khuski' / 'Bena grassland at hill slope	Cashew nut	Food
Rearing livestock	Grazing land in forest patches also stalfed	Dung	Manure
		Draft force	Ploughing, cart pulling
		Milk	Food
		Hide	Making leather
Fishing	River/streams	Fishes	Food
Gathering	Natural vegetation in hills and plains	Twigs, branches, from trees	Fuel
		Dry & fresh leaves	Manure, Mulch
		Timber	Construction, carving,
		Cane	basket weaving, furniture
		Bamboo	Construction, weaving
		Honey, wild fruits (3-4 varieties), herbs, flowers, Soapnuts	Food, medicine, detergent
		Plant parts of different species (bark, leaves climber etc.)	Basket weaving, ropes etc
		Wild pepper	Spices
		Resins	Chemicals
		Tali palm (pith of the stem)	Food
Hunting	Bena' / 'Khuski' Forested areas	Grasses	Fodder
		Pigs, deer, rabbits, birds	Food
HILLTOP HABITATS			
Agriculture	'Tari' fields	P : Paddy grain Sugar cane Pulses	Food Food (molasses) Food
		S : Paddy straw Bagasses	Fodder Fuel
Horticulture	Bagayata	P : betel nut, spices banana, coconut fruits (mango <i>Garcinia</i> , etc)	Food Food Food Food

		S : Husks, seaths of betel nut and coconut betel nut stem	Fuel Poles for house construction
Rearing livestock	Grazing in the forests, stall fed	Dung, Milk Draft force	Manure Food Ploughing, cart pulling
Gathering	Khuski/Bena	Hide Grass (<i>Themeda</i> spp.)	Leather making Fodder, Manure
	Soppinabetta	Leaf/ (dry/fresh) Twigs, branches Timbers	Manure, mulch Fuel Construction
	Hillocks with forests, other than soppinabettas	Leaf (dry/fresh) Twigs, branches Grasses Timbers	Manure, Mulch Fuel Grazing Construction
	Better patches of forests	Honey, wild fruits, flowers, herbs Pepper, Soap nuts, cane, bamboo Other plant materials etc. Honey	Food, medicine Spices, Detergent Weaving baskets, mats, furniture Weaving Baskets Food
Apiculture Sericulture	Forest flora Mulberry plantation in soppinabetta	Silk	Fibre (weaving)
Fishing	River/streams	Fish Water Mud Water	Food Drinking, irrigation House construction Drinking, irrigation
MEDIUM RAINFALL HABITAT			
Agriculture	Croplands	P : Jowar grains Paddy grains Name grains Maize Cotton Ground nut Sunflower Chilli Pulses S : dry stalks of cotton jowar, chilly Fresh stalk of Jowar, Maize, Sunflower, paddy, straw, vegetative portion of pulses etc Weeds	Food Food Food Food Fibre Oilseed, food Oilseed Spice Food Fuel, thatching Fodder Fodder
Horticulture	Cropland bunds in the cropland fields Courtyard of households	Betel leaf coconut betel nut Fruits, drumstick, Papaya, mango	Addictive Food Addictive Food

Rearing livestock	Grazing and stall fed	Dung Meat Draft force	Manure Protein food Ploughing, cart pulling Food
Gathering	Hillocks, bushy patches around the settlement and crop field	Milk Grasses, Shrubs	Grazing, fuel
	Rocky out crops	Stones	Construction
	River/tanks	Mud	Construction, pottery Food
PLATEAU HABITAT			
Agriculture	Crop lands	P : Jowar Groundnut Chilli Millet Cotton Sunflower S : Fresh stocks of Jowar, Maize, Millet, Sunflower, Husks & Vegetative portion of ground nut etc Dry stalks of Jowar, chilli, cotton	Food Oilseed, food Spice Food Fibre Oilseed Fodder Fuel, thatching, material
Live stock rearing	Grazing in pastures fodder from Agri-byproducts	Dung Meat Hide Milk	Manure Food Leather Food
Gathering	Hillock & uncultivable plain lands	Grasses, Shrubs Deer, rabbits Food (meat) (hunted)	Fodder Fuel wood, Fodder
	Rocky outcrops	Stones	Construction
	River	Fish Water	Food drinking, irrigation cattle drink
	Tanks	Water	cattle drink

In other habitats, agricultural practices are reduced to the role of only meeting the local subsistence demands. That too, in two hilly habitats, the local production of food grains (paddy only) is insufficient to meet the local demand. The acidic soil and lesser facility of irrigation in the two hilly habitats results in low agricultural productivity. In the coastal habitat, till the recent trend of dedicating the estuarine paddy lands - 'Gajni' to the more profitable income generating practice of prawn culture, the local production of paddy (mainly 'Kagga', an indigenous salt resistant variety) had been sufficient to meet the local demand. In the last 15-20 years more and more 'Gajni' lands have been used for prawn culture for long duration. In consequence, the salinity of the lands has been going up, thereby pushing down paddy production.

In the hilltop habitat, horticultural production of betel nut, pepper and cardamom generates the major surplus used to exchange for different materials (including food grains) and services flowing in from outside the habitat. Secondary products from this horticulture also fulfil the local demands for fuel, and construction materials etc. to a greater extent than agricultural productions. However, paddy straw is still a major source of fodder. In recent years, steadily

increasing demands of betel nut and spices in commercial market and state support for it, induced conversion of more and more paddy lands to gardens (Lele 1993). This is contributing to the increasing importance of commercial horticulture over the subsistence agriculture in this habitat. The gardens in the narrow valleys usually get supply of biomass for their requirements of green manure from the adjacent 'soppinabettas' - the forest patches maintained in the upper slopes by the adjoining garden owners. Traditionally, the garden owners enjoy the exclusive privilege of exploiting the 'soppinabettas' adjacent to their gardens. The 'soppinabettas' also supply the firewood and other biomass for the household needs of the garden owners. The increasing ratio of garden areas to the 'soppinabettas' seems to be creating pressure of overexploitation on the former resulting in their degradation. In many cases, the garden owners are known to exploit the common patches of minor forests to avoid more pressure on their 'soppinabettas'.

In foothills, the only source of such surplus generating income appears to be the gathering of variety of plant products like cane, soap nut, wild pepper, resin etc. from the tropical forests. Gathering of similar kind of MFPs (Minor Forest Produce) is also carried out in the hilltop habitat, but to lesser extent.

In the coastal habitat, abundance of fish produced from river-estuary courses and sea and in recent times prawns from the prawn cultures at 'Gajni' lands, generates the surplus that enables local communities to acquire goods and services not locally available.

Table 5. Livestock rearing (Estimated excluding calves and breeding males)

Average # Live stock per 10 fam	Coastal	Foothills	Hilltop	Med plateau	Arid plateau
	15.12	10.92	42.04	31.09	70.65
% of different animals in the total livestock population					
Bullock :	153 (25.04%)	28 (47.45%)	35 (9.45%)	600 (27.52%)	3515 (15.9%)
Buffalo :	106 (17.34%)	0	115	350 (16.05%)	2243 (10.15%)
Sheep :	0	0	0	60 (2.7%)	13174 (59.62%)
Goat :	0	0	0	800 (36.69%)	4098 (18.54%)
Cow :	352 (57.61%)	31 (52.54%)	220	370 (16.97%)	2579 (11.67%)
Total sample size :					
Animals :	611	59	370	2180	22094
Households :	404	54	88	701	3127

Livestock rearing : Rearing livestock or animal husbandry is common to all habitats but considerable variations exist among the habitats in the importance of different species (Table 5) and their patterns of contribution to the local communities. Livestock contribute mostly to the local subsistence demands in all but the arid plateau habitat. The major contribution of the domestic animals common to all of these village communities seem to be their excreta (dung and urine) which are used to make manure either mixing with soil (in plateau habitats) or with leaves, staws or grasses (in other three habitats). Another important use of livestock in any of these communities is the use of bullocks (or occasionally the buffaloes) as draft animals to plough the fields. Milk and dung used for fuel are of secondary importance (except in case of large production of milk from hybrid variety of cows recently introduced to these communities).

The arid plateau is an exception, although the cattle population here also provides similar services. However, the large population of sheep and goats reared here provides the major surplus.

(as meat) mostly exported to the urban communities. The dung is also generated at a surplus level, exchanged for grain and money locally as well as with the local population of medium rainfall plateau when the herds are taken there for grazing during the dry season (November to May). The wool produced from sheep is locally used to produce woollen blankets, one of the chief products of the arid plateau exported to adjacent regions outside the habitat.

The cattles are commonly reared in all habitats (though the indigenous breed traditionally reared in the three high rainfall habitats are different from that of the two plateau habitats) and this probably suggests their important role in all habitats to provide the biomass for manuring the crop fields (dung) and the draft force by the bullocks (sometimes he-buffalos) for ploughing. The importance of rearing sheep and goats being restricted only to the arid plateau habitat is obviously related to the better adaptation of the arid climate and habitat by these animals.

The diversity of biomass obtained in different habitats to rear the livestock from the local natural resource bases by cultivation of lands as by products, gathering from the natural patches of grassland or scrub vegetations or by grazing the animals, are described in Table 4.

Gathering activities : Most of the *gathering activities* in these communities are aimed at meeting local subsistence demands except for fishing in coastal habitats, MFP collections in foothills, and stone quarrying in arid plateau habitats. The timber and bamboo extraction from the forests of foothills and hilltops is one of the most lucrative gathering activities. But these resources are controlled by the state forest departments. Local populations derive their timber and bamboo supplies by purchase from state licenced outlets or by illegally gathering from local patches of forests. Traditionally also, the commercial production of timber and its export to outside were under control of a central authority of the local king but bamboo used to be an almost free access forest resource to the local inhabitants traditionally.

At present, gathering of biomass from local terrestrial subhabitats is very much reduced in significance in the *coastal habitat* as most of the local patches of natural vegetation have become highly degraded. The nearest healthy forest patch which is used for gathering firewood and leaf biomass by the people of the village cluster community studied from this habitat, is located at the base of the foothills some 8-15 km away from any of the villages. A good portion of firewood supply is met by collecting driftwood from upstream forests floating down the river. Usually, households located along the banks of the river course (mostly fisherfolk) avail of this opportunity. But, the bulk of fuel demand for this population is met from fire wood purchased from Government depots. These Government depots get the supply from foothill forests.

The only exception to this picture in coastal habitat are a few village communities like Halkar in the cluster of villages selected for the present study who have succeeded in keeping the patch of forest adjacent to their village in good shape. They still fulfil most of their biomass demands for fuel and leaf manure from this patch.

On the other hand gathering of aquatic biomass in this habitat generates considerable surplus. This involves intensive fishing in the river, estuary and sea along with gathering of a variety of molluscs and crustaceans.

In *foothills*, the high forest cover to human population ratio allows the highest production of biomass from the natural vegetation among all the transect habitats. A wide variety of MFP are gathered by local community for self consumption, as well as to sell as surplus on the market. This include highly valued materials like wild pepper, cane etc. (Table 4).

In the *hilltop habitat* substantial quantities of land based biomass may still be gathered, though not as much as in the foothills. Those who traditionally own gardens have assigned to them the privilege of exploiting 'soppinabettas', forest patches on the adjacent hillocks under their private protection. Those who do not own any garden traditionally, have no such soppinabetta

forest patches assigned to them. They have to depend upon common forest patches which are quite degraded at present or to go to distant patches in remote areas which are still in good condition. These latter patches are also exploited to gather a variety of MFP similar to those in foothills. In recent years, as already discussed, the exploitation pressure on these common patches is further increased due to the exploitation also by the garden owners who are having 'soppinabettas' along with their gardens.

In the two *plateau habitats*, secondary agricultural products do meet a substantial fraction of the total demand of biomass for fuel, fodder, thatch etc. However, a majority of the population still depends on gathering of biomass. Thorny scrubs and bushes growing on hillocks, along river banks, road side and field bunds etc. provide the only source of gathered firewood. On the arid plateau the situation is a little better because of the abundant growth of thorny *Prosopis juliflora* and indigenous species of *Acacia* which produce sufficient quantity of firewood for the local communities and some surplus exported to urban centres. One of the thorny *Acacia farnesiana* (locally called 'peek jaali') also provides good fodder for the local sheep and goat population.

The commonality and variations in the patterns of subsistence strategies based on local natural resource bases, pursued by its inhabitants are revealed by the following analysis (see Table 6). Cultivation of crops involves the bulk of the population in all the communities. Cultivation of agricultural crops is more important than horticulture in all but the hill top communities being maximum at the medium rainfall plateau. More people (53.4%) depend on the mixed horticulture of betel nut gardens as major source of earnings than on agricultural crops in the hilltop habitat where ecology of the habitat suits perfectly this type of specialized horticulture.

Table 6. Percentage of total community population involved in different habitats

	N=354 fam. Coastal		N=54 fam. Foothills		N=95 fam. Hilltop		M=467 fam. Med. Rainfall		N=1052 fam Arid plateau	
	M	T	M	T	M	T	M	T	M	T
Agriculture	48.58	70.62	55.5	90.7	35.38	68.4	78.37	85.65	61.36	76.7
Horticulture	10.45	44.06	22.2	96.29	53.4	89.77	0	0	0.13	1.2
Cultivation										
Horticulture	59.03	—	77.7	—	88.78	—	78.37	—	61.49	—
Fishing	25.14	81.6	0	0	0	0	0	0	2.85	5.22
Livestock										
Rearing (shepherd)	0	30.99	0	42.59	0	16.84	0	57.6	7.9	69.73
Gathering										
MFP	0	0	0	77.7	0	40	0	0	0	0

M = % of families only as major source of family income, T = % of families involved for major or subsidiary source of income.

Horticultural subsistence activities are also pursued by a sizable proportion (22%) of population in the foothills community as a major source of income next only to agriculture in importance. In coastal communities a good proportion of the population (25.14%) pursues fishing as major source of income and a total of 81.6% do fishing and gather other aquatic resources like molluscs, crustaceans etc. for self consumption. This proportion is greater than that of the population depending on horticultural activities (10.45%) but much less than that depended on agricultural activities as major source of earning (48.58%).

Fishing is pursued as a major source of income by 2.85% of the population of the arid plateau community and by none in the foothills and hilltop communities, although to a negligible

extent, only for self consumption. In the community of medium rainfall habitat negligible number of families pursue fishing as a regular subsistence activity.

In only the arid plateau a portion of the community (7.9%) depends on livestock rearing as the major source of income, though this is the case at subsistence level in all the five habitats. Those who specialize on livestock rearing are basically the shepherd families.

On the whole, a large majority of the community population in any habitat pursues some type of subsistence activities related to production of biomass used as food, fuel, fibre etc., as a major source of income.

Group specific use of different natural resource bases

A few of these natural resource bases have been observed to be used by the coexisting groups in these communities in somewhat diversified patterns. These are as follows :

a. *Diversification of fishing habitats among the fishing groups in the village communities studied from the coastal habitat* : There are two distinctly recognizable subhabitats in this habitat. a) the sea-coast, of which an approximately (25 X 10) km² area is used by the local sea-fishing families of these communities and b) the river-estuary course, and area of about (3 X 10) km² of which is used by the local communities for fishing. There are three hereditary fisherfolk groups, namely the Harikantras, Nakhwajis and Ambigas, coexisting in this village community. Traditionally, Nakhwajis were used to catching fish only in the sea. Sea fishing was more important to Harikantras also. Harikantra settlements are more abundant than of Ambigas near the sea coast (Reddy and Gadgil 1991) and it appears that they traditionally used to restrict themselves in river fishing more near the mouth of the river. Ambigas by tradition used to restrict themselves to fishing in the river-estuary only. While fishing has been a major source of income for most of the families from these three groups, there are five other non-specialist groups coexisting with them in this community who traditionally do fishing regularly but on a subsistence scale. These secondary fisherfolk groups used to catch fish only from the river-estuary. There has also been diversification in the use of particular fishing techniques and equipments among these coexisting groups. Reddy and Gadgil (1991) has documented several fishing techniques and equipments used exclusively by different traditionally fisherfolk groups coexisting in the coastal communities of the Uttar Kannada district.

There have not been many changes in this traditional pattern of fishing until very recently. Within last 20 years modern motorized boats and motors to mechanize traditional boats were introduced. For example, many Ambigas have recently mechanized their traditional boats and are venturing into sea-fishing while some of them are going on sea-fishing trips on the neighbouring Harikantras' (or rarely Nakhwajis) trawlers or purse-seines' as hired workers. If these very recent changes are overlooked, the basic patterns of diversification of use of the fishing habitats by these three specialist fisherfolk groups still continues today to a recognizable extent (Reddy and Gadgil 1991).

b. *Group specificity in the use of different plant species for weaving mats, baskets, etc. by the coexisting caste groups in any community* : Every transect habitat, more than one ECG from a community are found to use different plant part (e.g. leaves, barks, climber stems etc.) of different locally available species to weave a variety of products like mats, baskets, brooms, ropes etc. There is remarkable group specificity observed in the use of particular plant species and in the making of particular products from it by the groups pursuing it living in the same community. Table 7 describes the pattern found in 5 different habitats regarding this. It is commonly found that in different habitats, one of the weaver groups does not at all use one or more species used by another group coexisting in the same community. For example, in the communities of foothills, Kumri

Maratha primarily use cane to weave different types of baskets and vessels but not bamboo. The latter is used by neighboring Holeyas to produce similar products and Holeyas usually do not use cane. A few species in each habitat is used for weaving by only one of the groups in the same community. An example is the use of 'Kekoo holloo' (*Cyperus reed*) and *Pandanus* leaves only by Gam Vokkaliga and Halakki Vokkaliga respectively in the communities of coastal habitats (Table 7). Other than in case of bamboo used by Holeyas in foothill habitats, most of these exclusive use of plant species by the groups are directed mostly towards household use and usually contribute very little to the total economy of the families.

Table 7. Group specificity in the list of plant resources used for weaving products like mats, baskets, brooms

Habitat	Plant species	Local availability	Products	Groups using it	Self use/Sell	Importance to Fam, Economy	
Coastal Estuarine Plain	1. 'Mundige' (<i>Pandanus</i> spp)	Potentially high, at present scarce	Mat	Halakki Vokkaliga*	Mostly self	Minor	
	2. Kekoo Holloo (<i>Cyperus reed</i>)	abundant	Mat	Gam Vokkaliga*	Self	Minor	
	3. Bamboo	Not found, from foothills (purchased)	Basket	Holeya+	Mostly sell	Major	
Foothill	1. Cane (<i>Calamus</i> spp.)	Abundant (but scarce as priced by forest dept.)	Baskets, Cradle etc.	Kumri Maratha* Halakki Vokkaliga Kare Vokkaliga* Catholic Christ Holeya+	Mostly sell Self Mostly sell Mostly sell Mostly sell	Major Minor Major Major Major	
	2. Bamboo	-do-	Baskets	Holeya+	Mostly sell	Major	
	3. Phoenix (leaves)	Low abundance	Mat	Kumri Maratha Kare Vokkaliga Baini Divaru	Self Self Self	Minor Minor Minor	
	4. Dadasalu (<i>Grewia tilifolia</i>)	Abundant	Mat	Kumri Maratha*	Self	Minor	
	5. Tali palm (leaves) (<i>Borassus</i> sp.)	Medium	Rain-coat	Kare Vokkaliga*	Self	Minor	
	6. Kugal balli (<i>Gymnema pergularoides</i>)	Medium	Small Basket	Halakki Vokkaliga*	Self	Minor	
	7. Mundige (<i>Pandanus</i>)	Scarce	Mat	Tengin Divaru Halakki Vokkaliga* Kumri Maratha Baini Divaru	Self Self Self Self	Minor Minor Minor Minor	
	Hill top	1. Cane	Scarce	Basket 'Kukki'	Channaya+ Kare Vokkaliga* Baini Divaru*	Sell Sell Sell	Minor Minor Minor
		2. Phoenix (leaves)	Low	Mat	Kare Vokkaliga Channaya Baini Divaru Gam Vokkaliga	Self Self Self Self	Minor Minor Minor Minor
		3. Wante	Medium	Basket	Kare Vokkaliga* Channaya*	Self Self	Minor Minor
4. Bamboo		Medium	Basket	Channaya+ Kare Vokkaliga Medar+	Self Sell Sell	Minor Minor Major	
5. Mundige (Pandanas)		Medium	Mat	Channaya Gam Vokkaliga	Self Self	Minor Minor	
6. Kugal balli		Medium	Basket	Baini Divaru*	Sell	Minor	

(*Gymnema perularoides*)

Medium Rainfall Plateau	1. Mede holloo	High	Rope	Kunchi Koragar+	Sell	Major
	2. Phoenix leaves	High	Broom	Koragar+	Sell	Minor
				Kunchi Koragar	Sell	Major
				Ashadi	Sell	Minor
				Shaikh Muslim	Sell	Minor
	"Midribs"		Baskets	Koragar+	Sell	Major
Arid Plateau	1. Phoenix leaves	High	Mat	Madar	Sell	Minor
				Koragar+	Self	Minor
			Broom	Koragar+	Sell	Minor
	'Midribs		Baskets	Koragar+	Sell	Major
			Broom	Koragar+	Sell	Minor
	2. Mede hooloo	High		Kunchi Koragar+	Sell	Major
			Ropes	Kunchi Koragar+		
		Mouth	Arya Maratha	Sell	Minor	
		cap for cattle, sheep, goat				

+ use related to hereditary caste occupation of the group

* traditionally used by the group but not related to caste occupation.

c. Other diversified resource use patterns in the communities : Sources of calcium carbonate have been found to be used traditionally exclusively by only one group in any of these local village communities for processing lime. In coastal habitats, "Uppar" was the caste group which used to prepare lime from the shells gathered by others from river bed and sold to them. At present, other groups e.g. Halakki Vokkaligas pursue similar resource use patterns. In the plateau habitats, Shunagar or the traditional lime maker families from the caste group called Ganga makalu still prepare lime from lime stones for the local communities for regular use.

No diversification has been documented from these communities in their usage of farmland, the most important natural resource base in the life of many of these communities. Neither, has this been documented in case of the usage of local resource bases for fuel, fodder and manure which have now become scarce to most of the village communities studied here excepting from the foothill habitats.

Access, control and ownership of different natural resource bases :

Private ownerships : Farmlands, both agricultural and horticultural, in all these communities are under private ownership and that has been the traditional pattern too. Though, the management and cultivation may not be directly carried out by members of the owner's family themselves, as in cases of land leased to tenant cultivators.

Though ownership, use and management of farmlands occur mostly at the level of individual families, there are a few exceptions. For example, traditionally the paddy cultivation of 'Gajnis' the estuarine farmland in coastal habitats used to be and are still managed by cooperatives of several families (mostly from the same caste group) of a village community. The more recent use of "gajni" for prawn culture is also organized through a similar collective effort.

In spite of its private ownership, farmland could be used as *common property resource* by others for gathering some secondary products from it. For example, in estuarine "Gajni" water

anyone can catch crabs or smaller fishes. In the black cotton soil land of arid plateau, limestones pebbles could be collected free of any charge by lime makers who are not owning the land.

Some farmlands in each village community used to be traditionally dedicated to the service of the God/Goddess of the local temple. While the temple deity was recognized as the owner of these lands, its control and production used to be enjoyed by the family of the hereditary priest of the temple, usually from the Brahmin groups. A smaller portion of the temple lands used to be at the disposal of a few families of temple servants (musicians and floor painter etc.) mostly from groups with a lower socio-economic status. This pattern is still continuing in a few village communities of the transect habitats (e.g. in coastal habitats).

1 Common Property Resources (CPR) :

Parts of the landscape in and around village communities other than farmlands and household areas, are generally used as CPR by the whole community. Though, ever since British times the ownership of these village non-private lands has been vested with the state. Local patches of natural vegetation which supply biomass for fuel, fodder, manure and supplementary foods, are known as minor forest and allowed to be used by the villagers as a privilege but not as a right. Most of the bigger patches of the forests are demarcated as reserve forests for exclusive use of state. Almost everywhere in the peninsular habitats, the minor forests close to the villages have been too degraded to meet all requirement of biomass of the village populations. As a result, villagers have to go to the minor forests in better shape further away, and/or illegally exploit the local reserve forests. Only in one village, Halkar (from coastal habitat) among all the 133 villages surveyed from five peninsular habitats, the forest patch attached to the village exists in good shape so that even today its inhabitants need not go elsewhere to gather their firewood etc. The Halkar community has been zealously protecting its village forest from external pressures as well as internal profligacy for a long period of time through a community based management system (Gadgil and Iyer 1989).

Traditionally, these currently state owned resource bases had been actually village common property resources' managed and used by the local village community as a whole. British rulers around the first part of the last century took over the ownership of these lands from the community and this was further consolidated in independent India. This resulted in village communities losing their control over their local natural resource bases and leading to the exhaustive use by outsiders (including the state) and increased local consumption pressure due to population increase (Gadgil and Iyer 1989).

CONCLUDING REMARKS

Traditionally, the rural people of the village communities studied here meet most of their demands for fuel, fodder, construction etc. from the production of a variety of biomass and minerals from the local natural resource bases which are contained in the diversity of local subhabitats. Cultivation remains the most commonly important mode of subsistence in all the habitats. The importance of different subsistence activities in different subhabitats (e.g. agriculture, horticulture, livestock rearing, fishing, gathering forest produces) in generating surplus that enable local populations to exchange for necessary materials or services not available at all or enough locally, reflect the evolution of the local economy in response to the ecological features of the habitats. Though the traditional patterns in these aspects are still remaining to a large extent, changes in it have recently been brought in mainly by two factors increasing links of the local economy with the bigger commercial market and invasion of new technology to exploit the natural resource bases. A trend of directing the exploitation pattern (often over exploitation) of local resource bases to non local market demands at the cost of local subsistence is setting in. The introduction of motorized fishing

boats and gears in coastal fishing, exploitation of 'Gajni' paddy lands more for prawn culture in the coastal areas, conversion of paddy lands into betel nut gardens in the hilltop habitats etc. as observed in the present study, demonstrate this trend. On the other hand, the state control of traditional CPRs has led to the overexploitation of the resource bases.

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