Sahyadri Conservation Series 38

AGRO BIODIVERSITY IN UTTARA KANNADA

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The Ministry of Science and Technology, Government of India
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'My Village Biodiversity': Students' Involvement in Biodiversity Documentation in Uttara Kannada District, South India

Following the Biodiversity Act, 2002 of India, many State Biodiversity Boards were constituted which in turn is involved in formation of Biodiversity Management Committees (BMC) for "promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and microorganisms and chronicling of knowledge relating to biological diversity." The **BMCs should prepare People's Biodiversity Register (PBR) containing local knowledge on biological resources and their usages. Nationwide preparation of PBRs,** is expected to be a mammoth exercise for India, a megadiversity country.

A decade is past since the Biodiversity Act, but only tardy progress made in relation to PBRs. Major hurdles hampering the process appeared to be concepts and formats unfriendly for grassroots level people, paucity of taxonomic expertise, low funding and lack of motivation and guidance. Model PBRs prepared were at enormous expenditure, and through the deployment of experts and not easily replicable.

Looking for alternatives to current model of PBR preparation, we attempted the deployment of student community from high schools and colleges to document biodiversity under the banner 'My Village Biodiversity' in the Uttara Kannada district of Karnataka State as part of ongoing "Integrated Ecological Carrying Capacity" assessment of the district. Simplified formats, as understood easily by high school students and village communities, were used for data collection, carried out during 2010-11 and 2011-12. The teachers were given orientation programmes about biodiversity, Biodiversity Act, and on formats to be used. Competitions were conducted for students and nominal rewards announced for the best reports and good presentations. No financing of the educational institutions was done to carry out this model of work. The objectives included:

a. ***Sensitisation of students:*** The very use of data formats were also aimed at sensitizing students to biodiversity related issues. Notable among data to be gathered included forest types, landscape and waterscape elements, plant and animal diversity as the village community understand, crop diversity, preparations and uses of bio-pesticides, organic farming, traditional storage methods, NTFP, management of village environment, community health, wildlife, human-wildlife conflicts, domestic of animal diversity, production of honey and apiculture, energy sources, skilled and knowledgeable people in the villages, sacred groves etc.
b. ***Recording observations:*** Study and understand data formats necessary in the contemporary contexts of conservation and sustainable use.

c. ***Vital information on crop diversity:*** Stress laid on documentation of local varieties of crops.
d. ***Low cost methods to assist PBR preparation:*** No money was paid to partner institutions and students except for meeting the travel expenses for attending workshops.
e. ***Creating ambassadors of goodwill:*** Students, with their unbiased minds were expected to merit greater acceptability in the households, as the villagers otherwise tend to be more reserved with outside agencies like NGOs engaged in such work.
f. ***Expertise in communication:*** Students were expected to gain good communication skills.

Results and discussion

About 580 students from 116 high schools and 6 colleges representing the 11 taluks of Uttara Kannada took part in the two year exercise. Biodiversity documentation covered about 190 villages of the total of about 1200 villages in the district. Considering the sluggish scenario of PBR progress, with only 212 panchayats of Karnataka covered by 2008, comments on their merits pending, the cost was high for the Biodiversity Board in its infancy to bear, but at the same time funding considered small by the agencies catalyzing the PBRs at panchayat levels.

The poor quality performance of some schools was mainly on account of teachers missing the orientation programme. If the education departments, make suitable changes in the syllabi to incorporate biodiversity documentation, with due credits to the performers, the outcome would be more fascinating. The students in general found greater acceptability in the villages, got first hand learning opportunities and often turned out to be communicators of good order.

To highlight some results, notably, of 232 villages where rice cultivation was reveiwed, 181 varieties were recorded; out of them 101 were native varieties (Table 1, Figure 1). Sample survey with regression analysis gives expectation of finding around 492 native varieties in the district (Figure 2). Countrywide adoption of the method will benefit rapid documentation of traditional varieties, feared to have dwindled from around one lakh down to 8-10 thousand, mainly due to unregulated introduction of new varieties. Documentation also covered local varieties of banana, pepper, mango, jack, sugarcane, arecanut, coconut etc.

The villages have rich wealth of traditional knowledgeable knowledge holders like herbal healers specialized in treating ailments like rheumatism, paralysis, migraine, kidney stones, bone fractures, eye and skin problems, jaundice, herpes, paralysis, infertility, epilepsy etc. and cattle diseases. Medicinal plants were exhibited during workshops and their uses documented. Information on persons with knowhow on biopesticides, earthworm manure, water divining, organic farming etc. also is available.

Villagers gave good account of local wildlife, on occasional visiting animals like tiger, leopard, bear etc. Local names of fishes available in the fresh water bodies were recorded. The students provided indications on the presence of hundreds of sacred groves in the villages. They would be interesting places from biodiversity and cultural angles. On the whole pastoralism is on the decline due to fodder scarcity and cattle manure, inevitable for high rainfall agricultural soils, is getting scarce. This can undermine the very farming system of the district.

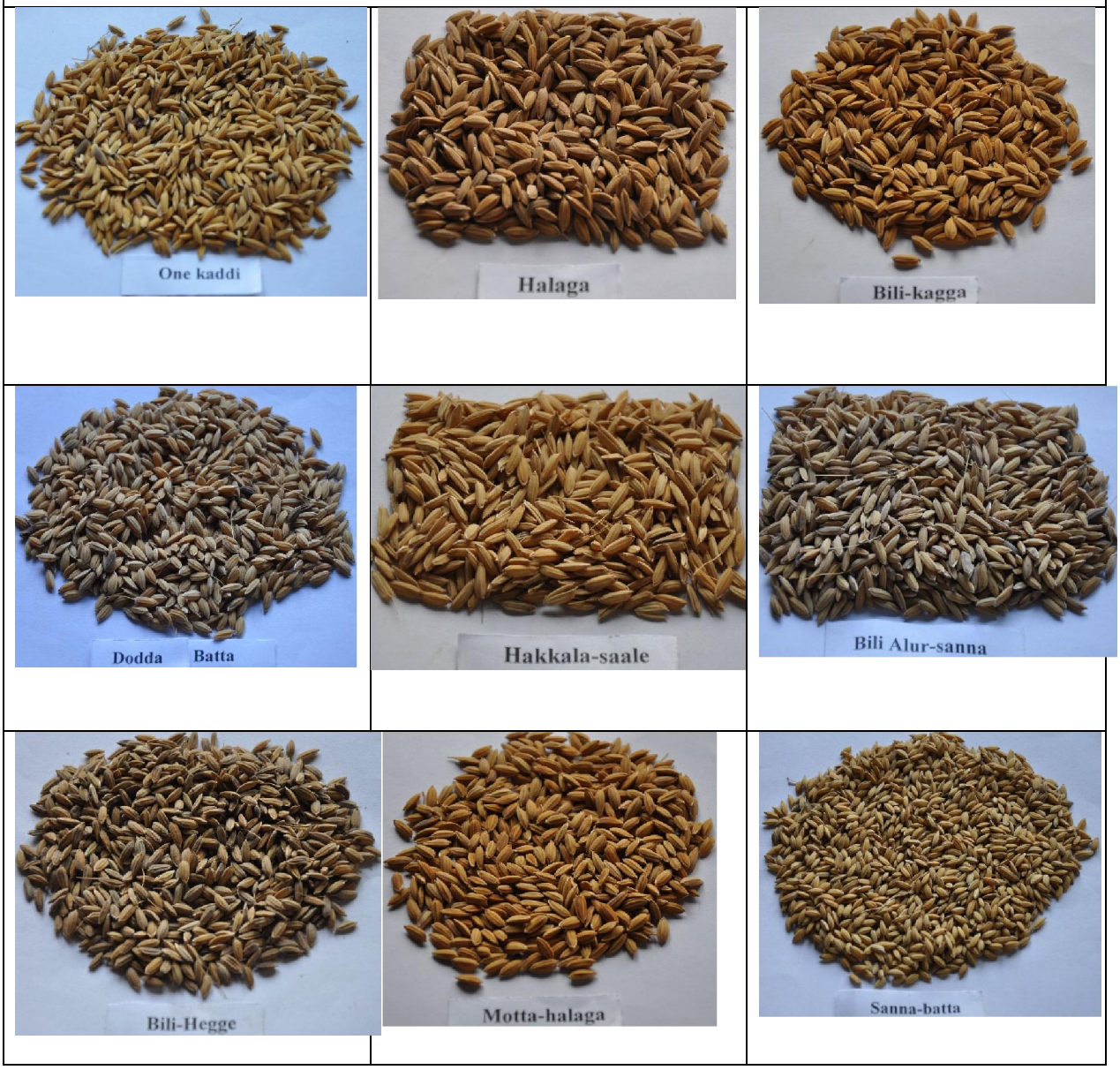
Our experiment shows the huge potential for harnessing the student power for documentation of the immense biodiversity of the country. Biodiversity awareness creation among the younger generation is a paramount necessity for the successful documentation of the immense biodiversity of India, a megadiversity country with two biodiversity hotspots. The educational system has to be restructured to institutionalize biodiversity documentation, especially using student power from high school and undergraduate levels with due academic credits given to the participants.

In Situ Conservation of Traditional Rice Varieties of Uttara Kannada

Before the start of Green Revolution there were over 100,000 native varieties of rice in India. These were the results of selection and propagation by the indigenous farmers through 5000 years of efforts. It is feared that over the last few years, due to the introduction of high yielding new varieties from elsewhere and hybrids bulk of Indian varieties have gone extinct. This is unbelievable loss for the gene pool of rice, prime staple food-grain of the world. There is still hope that through field surveys, especially in places of high landscape heterogeneity, the remaining native rice varieties can be located in farmers' fields and saved from extinction through promotion of *in situ* conservation. As a preliminary exercise we carried out a field survey in about 232 villages of Uttara Kannada to prepare an inventory of rice varieties grown, through interviews with the farmers. Data was gathered also about the notable characteristics and desirable features of these varieties. Out of about 181 rice varieties inventorised about 101 were native varieties (Table 1, figure 1). Most of these are taller to hybrids and other new varieties, over 5-6 in height and yield more fodder for cattle. Though their yields are relatively lower they have more resistance to pests and diseases. Their grains are bolder and longer and the rice comes in white, red and brownish colors. Some like Sannakki and Jeerigesali are fragrant. Doddabatha and Kagga are good for making rice flakes. Chitagya, Doddagya, Halaga, Hasadi etc. are attributed with medicinal properties. Salinity tolerance is found in Bilikagga and Karikagga grown in estuarine fields. Lot of choice exists for selection of rice of different durations, such as Jaddubatha and Kannuru of 90-100 days, Bantwala, Mullarya and Mysore Sanna of 100-120 days, Dibanasale of 120-140 days and Aloorsanna, Honnekattu etc. needing over 140 days. Long duration varieties are good for places with prolonged rainy periods and short duration for lower rainfall areas and irrigated fields. As most of native varieties are grown with organic manure and least or no use of pesticides they are good for human health and their fields ideal for fishes and frogs and other aquatic fauna as well

as for birds which feed on them. In this poster GIS maps on the distribution of the native varieties are given along with pictures of many of them. The poster highlights the need for encouraging the growers of native varieties through honouring them and providing subsidies for conservation of rare ones.

Figure 1: Some traditional rice varieties in Uttara Kannada



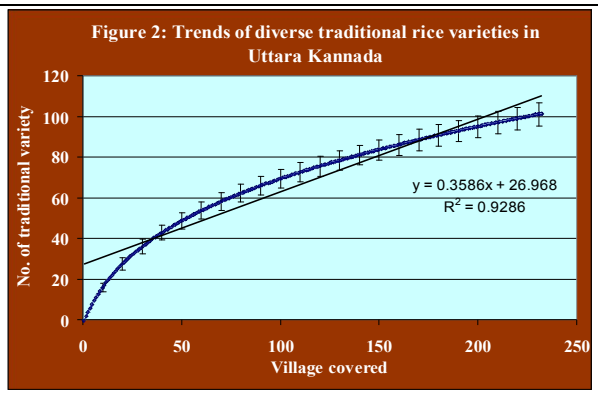


Table 1: Traditional rice varieties with expected varieties in 11 taluks of Uttara Kannada

Taluks	Village covered	Rice varieties		Total varieties encountered	Expected traditional varieties
		Traditional	New varieties		
Total	**232**	**101**	**80**	**181**	**492**
Ankola	17	18	14	32	**81**
Bhatkal	16	14	15	29	**45**
Haliyal	20	15	12	27	**92**
Honnavar	21	25	15	40	**93**
Joida	2	1	10	11	**-**
Karwar	11	9	10	19	**45**
Kumta	42	39	17	56	**112**
Mundgod	10	8	10	18	**68**
Sirsi	45	35	28	63	**155**
Yellapur	11	20	13	34	**218**
Siddapura	36	33	34	67	**165**

IMPORTANCE OF TRADITIONAL VARIETIES

- ✓ High diversity at genetic level.
- ✓ Diverse qualities for rice- height of plant, colour, size, aroma, maturity and habitat.
- ✓ More fodder (5-7 ft height unlike new dwarf varieties).
- ✓ Disease, pest, drought and flood resistance more.

CONCLUSIONS

- ✓ High landscape heterogeneity and strong in agriculture traditions make Uttara Kannada a stronghold of genetic diversity of rice and other crops
- ✓ The gene pool of rice was neglected all the while and even the agriculture department does not maintain data on local varieties
- ✓ Widespread introduction of dwarfish new varieties, considered high yielding, is a major threat to rice gene-pool.
- ✓ New varieties are susceptible to high disease and pest attacks and marginally high yield is often eclipsed by these drawbacks
- ✓ Introduction of new varieties has caused fodder crisis in the district which is adversely affecting milk production and availability of cattle dung for manure
- ✓ We have predicted using the sample survey method and regression analysis the talukwise numbers of local varieties available in Uttara Kannada; with nearly 500 expected varieties

AGRICULTURE, HORTICULURE AND LIVESTOCK DOMESTICATION

Unlike anywhere else along the flatlands of the maidan areas the traditional Uttara Kannada farming sector is a combination of rice fields, multi-cropping orchards of betelnut, betelvines, pepper, cardamom, nutmegs, bananas etc. and specially maintained leaf manure cum fodder growing forests called bettas. Cattle and buffaloes are essential parts of the system as producers of milk, manure and gobar gas. Farmyard manure of cattle dung and leaves is very critical for soil fertility, gradual release of nutrients and for soil protection from erosion in the heavy rainfall zone.

This ideal traditional system is changing drastically these days due to various reasons. The district used to be a great reservoir of hundreds of traditional rice varieties with wide array of qualities for the rice and the suitably of the varieties for different soils and water conditions. The tall straw provided much required dry season fodder for cattle. The widespread cultivation of dwarfish new varieties of rice in the recent decades has seriously affected cattle straw production. As a result, especially along the coastal taluks, particularly in Honavar, Bhatkal and Kumta taluks, where the cattle number is high (4 to more than 5 per hectare of sown area) fodder scarcity is very serious. The coastal hills and plateaus are of exposed laterite rocks with very little fodder production. Many farmers are compelled to purchase rice straw from other taluks, mostly from other districts, at high cost. This situation is compelling farmers to sell cattle or release cattle for free grazing as they cannot afford purchase of straw and other expensive feeds. The decline in cattle can create serious consequences on the farm sector, which has been by and large organically carried out. The decline of cattle has created scarcity of farmyard manure and most people are compelled to purchase packaged milk from elsewhere. To prevent the farm sector collapse we make the following recommendations:

- We have estimated that nearly 500 traditional rice varieties are likely to surviving in Uttara Kannada. About 100 have been already documented, many are extremely rare and on the verge of extinction. The Government should take steps to promote Uttara Kannada as an organic district, promote through subsidies in situ cultivation of traditional rice for the sake of cattle straw and for safeguarding the gene pool of rice.
- Farmers be given guidance and subsidies to grow suitable fodder grasses for own use and sale in the wastelands, benas and fallow fields.
- Panchayat level fodder farms should be started for helping manure and milk production especially by the landless.
- More than loans or subsidies for purchase of cattle such assistance be extended first for fodder production on priority.
- In the malnadu taluks farmers be encouraged in growing fodder plants in portions of bettas, for own use and sale.
- Dairying be promoted as an employment generating sector which is also crucial for supply of manure and for meeting village level energy needs through gobar gas.

SEVERE FODDER SCARCITY NEEDS TO BE SOLVED FOR SAVING AGRICULTURE AND LIVESTOCK

Uttara Kannada district experiences only five to six rainy months (>100 mm/month), remaining period having with scantier or no rains. During the dry months, mainly from November to May period grasses and herbal fodders dry up making the livestock keepers rely heavily on dry grass (karada) and paddy straw and small quantities of jowar straw in maidan taluks. During the rainy months, particularly June to September period, exceptionally heavy rainfall, from South-west Monsoon is experienced by especially coastal and malnadu taluks, where exposed soils and free grazing pasturelands tend to be eroded of top soils. The grasses start rapidly drying up from November onwards with practically nothing for foraging left for the cattle almost up to the end of May. During this long and difficult period the cattle are fed mainly with paddy straw and green grasses available, if at all, from fallow rice fields, and wetlands. The cattle keepers store straw for the lean period by purchasing or storing the straw from their own fields.

Straw scarcity: Dry straw (hay) used to feed cattle has become scarce due to decline in area under rice cultivation. Until 1960's the rice fields were cultivated mainly with hundreds of native rice varieties, most of which produced tall plants (5-7 ft) with lengthy straw, which was dried and stacked by the farmers. Any straw scarcity was hardly experienced. The widespread introduction of hybrids and improved varieties of rice, most of which are dwarf, not exceeding 3-4 feet, is the major cause for fodder scarcity in the district. Many cattle keepers are forced to purchase straw from places of surplus, including from neighboring districts. The cost of straw and transportation are becoming prohibitive,; so also the prices of cottonseed, oil cakes, and

company made concentrates. Average cattle keepers are either compelled to sell their animals or leave them for free grazing in lands often impoverished of grasses.

The worst crisis is felt in the coastal taluks. Honavar with except Karwar. Honavar taluk with 5.4, Bhatkal with 4.5, Kumta with 4.14 cattleheads respectively, per ha of sown area, are the worst taluks facing fodder crisis. Karwar with 3.16 cattleheads per ha of sown area is least affected. In the malnadu taluks Siddapur with 5.24 cattleheads, Supa with 4.5, Yellapur with 4.49 are under high stress. All these taluks come under high rainfall areas, where fodder production needs specially maintained *bena* lands. Mundgod and Haliyal, the rice bowls of Uttara Kannada, are better placed with 2.71 and 2.94 cattleheads respectively **(Figure 3)**.

Our sample survey with the cattle keepers in the villages of 10 out of 11taluks (Supa excluded due to inadequate survey) indicates that in Mundgod, the rice bowl area of Uttara Kannada there seems to be no import of straw from other taluks or outside districts. Karwar follows next, in all probability due to decline of about 1918 ha of sown area between 1997-98 and 2010-11 (**Figure 4).** Abandonment of rice cultivation would naturally enrich fallow fields with grazing resources for cattle. Honavar, Bhatkal, Yellapur and Siddapur have more proportion of livestock keepers importing fodder from outside their respective taluks.

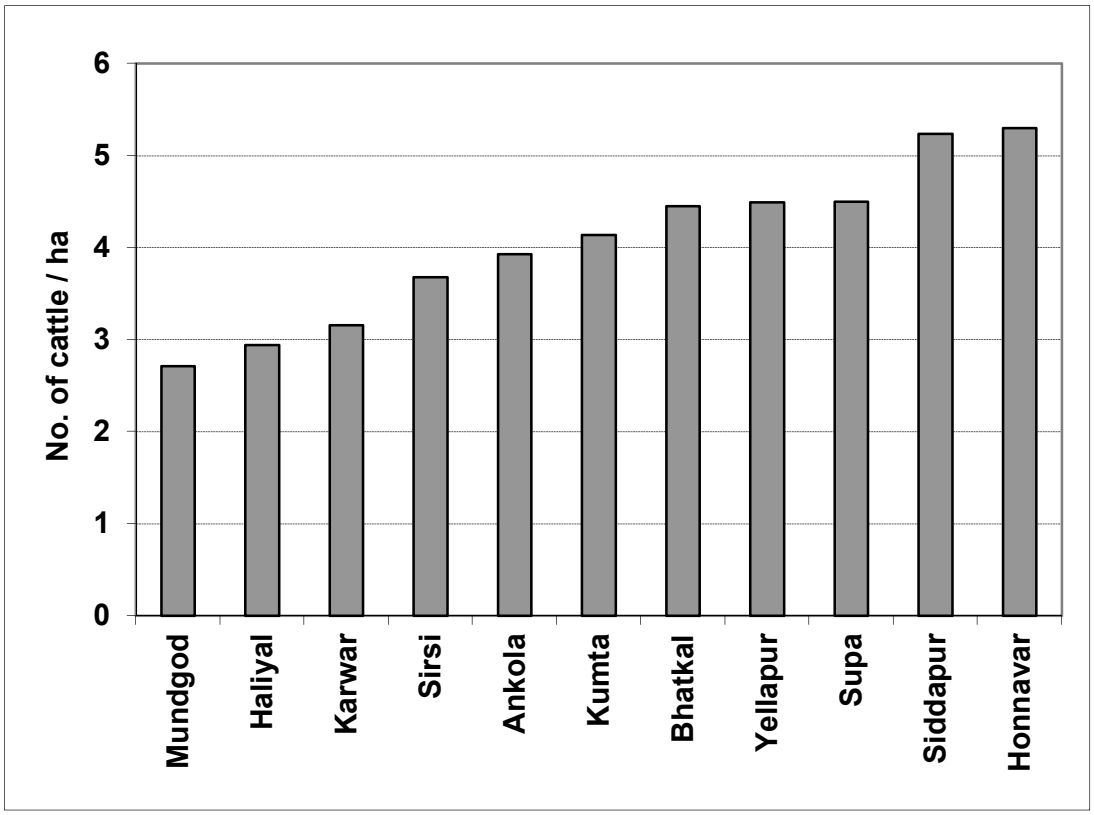


Figure 3: Taluk-wise number of cattleheads/hectare of sown area in Uttara Kannada

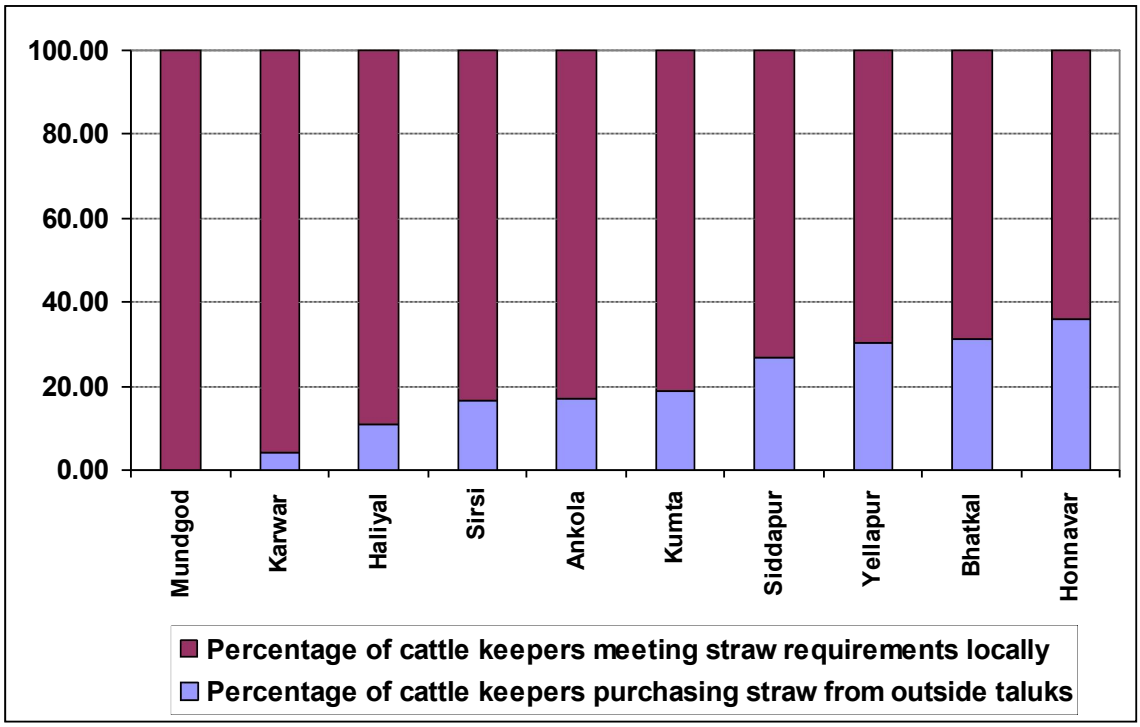


Figure 4: Talukwise percentage of cattle keepers purchasing straw from outside

Importance of developing fodder farms

Cattle wealth is critical for agricultural economy for milk, manure, traction and bio-energy. Most of Uttara Kannada's agricultural soils, receiving torrential seasonal rains are prone to severe soil erosion and rapid nutrient losses in the absence of organic manure, bulk of which is traditionally composed of cattle manure. Cattle manure has become dearer these days compelling farmers to even neglecting farming operations. This will have serious implications on farming, and dairying, which together constitute largest sector of employment in the district. It is a dire necessity for dairy farmers to start growing green fodder (grass) if they desire to run their unit profitably. Mere distribution of milch animals by the Government is of no use to farmers. Along with the animals they must be also made aware of the importance of growing their own fodder for the animals. Buying several commercial feeds available in the markets today is not profitable for a small farmer. Green fodder production and sale by farmers has to be developed into a major enterprise. We also recommend that the government start fodder farms, particularly for production of green fodder, mainly grasses and leaves. Priority areas for fodder production, preferably panchayat-wise are Honavar, Bhatkal and Kumta taluks along the coast. Farmers of Siddapur, Sirsi and Yellapur may be assisted in fodder production especially in the bettas, which are under their control. Fodder farms may be started for user groups in these taluks and in Supa taluk, who do not have betta privileges, in common lands. Taluk-wise potential area available for fodder production is given in the **Figure 5.** The area is based on total of barren lands, cultivable wastes and permanent pastures. Some of the

promising grasses recommended for cultivation are Congo Signal, Guinea grass, Hybrid Napier like CO1, CO2 and CO3. Recently CO4 has become a much sought after, profitable, nutritive and productive grass in southern Kerala.

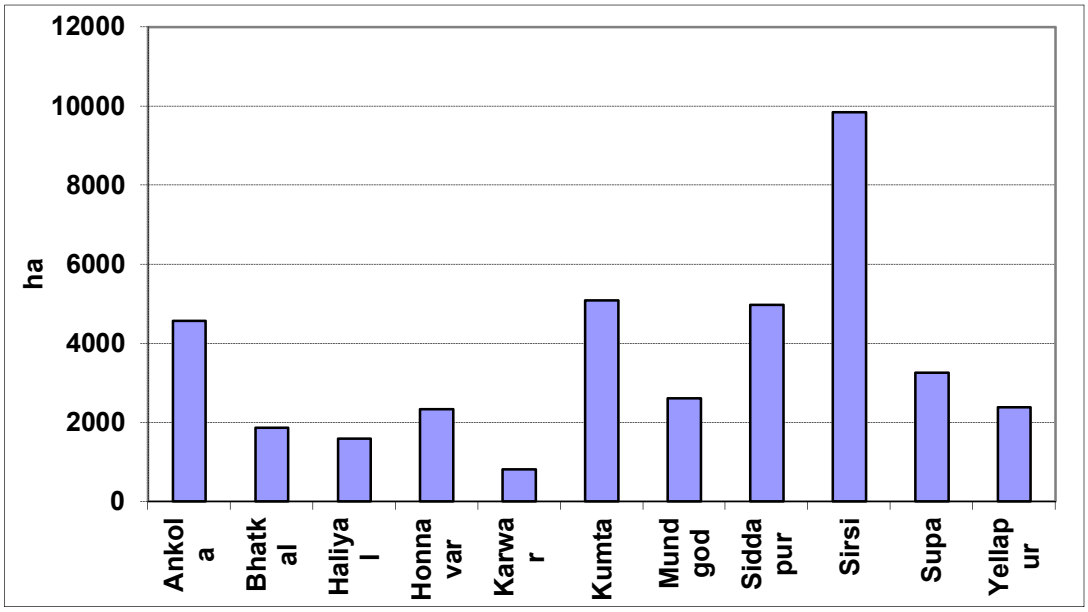


Figure 5: Talukwise potential area for fodder production

AGROBIODIVERSITY IN SHARAVATHI RIVER BASIN

ABSTRACT

India is one of the world's eight centers of crop plant origin and diversity. Agricultural operations intensification during recent years has contributed to environmental problems, including the accelerated loss of biodiversity In order to assess the impact of modernization in terms of mechanization and seed varieties, the present study has been carried out in the central Western Ghats region. The region is endowed with the diverse cropping system, with paddy as one of the major crop. The investigation of crop cultivation practices showed that traditional methods are cost effective and environmentally sound, while intensification in agriculture with high input has contributed marginally to yield. Considering the ecological richness of the region there is a need to proritise the region for conservation of agro-biodiversity

INTRODUCTION

India is one of the world's eight centres of crop plant origin and diversity. At least 166 food/crop species and 320 wild relatives of crops have originated in India. The rice species (*Oryza sativa*) has been diversified into at least 50,000 distinct varieties (Kothari, 1999). At least 166 species of crops and 320 species of wild relatives of cultivated crops are believed to have originated in India. Similarly high diversity has been accounted for crops like mango (1000 varieties), sorghum (5000 varieties) and pepper (500 varieties) (http://home.graffiti.net/rustom/kv/nbsap _/kv_nbsap_summary_ch04.html). Himalayan region shows that crop diversification (through fruits and vegetables) have a positive effect on agricultural growth and productivity (Chand, 1996). The diversity of crops and livestock is the outcome of thousands of years of deliberate selection, planned exposure to a range of natural conditions, field-level cross-breeding, and other manipulations which farmers have tried out (Jain et al., 1993). The earliest archaeological evidences, found throughout the tropical and subtropical areas of southwestern and southern Asia, northern and central Africa and Central America, suggest rapid and large-scale domestication of plants and animals approximately 10,000–7000 years BP (Gupta, 2004). The origins and processes of crop domestication have created an entirely new way of life (Brush, 1999) over the time.

Indian Agriculture has witnessed dramatic changes during the last five decades. The agricultural policy after independence (1951 – 1961) incorporated agrarian reforms by enacting the tenancy laws to remove the hindrance in modern agriculture. Second phase of the agricultural policy (1961–1980) to secure a quick breakthrough in domestic production to mitigate food crisis resulted in rapid spread of high yielding varieties and fertilizer intensive cropping. Third phase (1980 onwards) adopted steps for modernization for further progress (Rao, 1996). The introduction and use of new technologies like, HYV (high yield varieties) seeds, fertilizer, irrigation and public

investment in agriculture has helped to achieve self-sufficiency in food grains and improved the productivity of resources in agriculture (Baghel and Gupta, 1997). Consequently, multi-species agro-ecosystems changed rapidly as a result of farmers' decisions to adopt the modern agriculture and at a broader scale, the major trend has continued towards reducing the complexity in agriculture (Vandermeer, 1998). Intensification of agricultural operations that focus on short-term economic gain often triggers their own set of environmental problems, including the accelerated loss of biodiversity (Srivastava et al., 1996).

Although, the loss of its biological and genetic resources of India, the basic wealth of the country, and the biodiversity based knowledge of our local communities (Shiva, 2004) is enormous, the information available on the extent of decline is patchy in Indian context. While over the global scale, dramatic declines in both range and abundance of many species associated with farmland have been reported. A study by WCMC in Sri Lanka, found that, the number of rice varieties has dropped from 2000 in 1958 to less than 100 in 1992 (Koziell, 1998). Similarly, it is estimated that there are 4000 or so rare breeds of livestock throughout the world. (Gollin and Evenson, 2003) and individual farmers throughout the world are abandoning many breeds that have been locally adapted over thousands of years in favor of new exotic breeds (Mendelsohn, 2003). This is mainly attributed to the extension of markets and economic globalisation. The decoupling of animal husbandry from surrounding natural environmental conditions is further eroding the stock of genetic resources (Tisdell, 2003). Out of the environmental concerns voiced about genetically engineered plants, those associated with the escape of engineered genes into the populations of wild relatives have received the most attention (Ellstrand, 2003). Gene flow is a potential concern associated with the use of transgenic crops because it could affect genetic diversity of related landraces and wild relatives (Gepts and Papa, 2001). The claims of genetic technologies and transgenic crops benefitting the 'humanity' ignore that their effects are mediated by social institutions, especially markets, and that they cannot be predicted without taking cultural, political-economic, and ecological dimensions into account (McAfee, 2003). Purportedly sustainable farming systems such as organic farming are now seen by many as a potential solution to this continued loss of biodiversity (Hole et. al., 2005).

However lack of proper documentation is the major constraint in quantifying the impacts of the recent changes that took place in Indian agriculture. In the wake of these realities a study has been undertaken in the Linganamakki catchment area of Sharavathi river basin to document the extent of agro diversity with the traditional knowledge base associated with the agricultural system in order to understand the effects of agriculture modernization.

METHODOLOGY

Study area: River Sharavathi has its origin at Ambutheertha, near Kavaledurga in Theerthahalli taluk, flows northwesterly direction and joins the Arabian Sea near Honnavar. The Linganamakki dam has been constructed across the river constitute the upper catchment (1991.43 km^2). The present study has been carried out in the upper catchment area of the Sharavathi River basin. The western part of the study area is formed of mountainous terrain while eastern part is relatively flat. The western part is replete with dense tropical forests stimulated by heavy rainfall. The eastern area consists of an open country with some fine lakes and stony hills.

Strategy for data collection: A structured questionnaire was prepared for data collection about the types of crops and cropping pattern. The questionnaire was restructured after the preliminary survey with necessary modifications. For the sampling 42 villages were selected over the study area considering landholding categories (small, medium and large land holdings). A total of 447 households were surveyed.

RESULTS AND DISCUSSIONS

Area under different crops in the catchment area is shown in Table 1. The data reveals that the paddy crop accounts for major area in the region. It can be observed that the area under high yielding varieties in the case of paddy, ginger, finger millet, coconut, groundnut and cotton crops are more dominated. It is mainly due to the orientation of farmers towards high yielding varieties, while conserving the local varieties. In other crops like betel, sugarcane, horse gram, etc. high yielding varieties have failed to establish against the native varieties.

Table 1: Area under different crops in the region (year 1999)

Type of crop	Area under local crops (Ha)	Area under high yielding crops (Ha)
Paddy	5971.96	9494.25
Betel	2159.63	595.31
Ginger	149.19	724.15
Sugarcane	136.50	86.20
Banana	779.41	560.82
Horse gram	44.23	0.00
Ragi	46.02	783.85
Coconut	188.14	400.62
Groundnut	0.00	63.15
Cotton	0.00	112.56

Source: Taluk Revenue Departments

Major area is allotted for paddy cultivation, which is the staple food of the region. The entire study area has sufficiently enough rainfall to cultivate paddy (>1500 mm per year). The land with good

irrigation facilities like command areas of lakes and ponds, and valleys of the hills are selected for betel cultivation. The betel orchards are excellent example of inter-culture. During early stages of the betel plants, inter-culture is done with banana plants in order to compensate the delayed yield of betel plantations. Inter-culture of cardamom and coffee contribute to the farmers' economy significantly. Betel plants support betel leaves and pepper to climb upon them and farmers find another source of income. Recently farmers have started inter-culture vanilla in the betel orchards. Thus crops like betel, banana, cardamom, coffee, betel leaf, pepper and vanilla commonly share the land without requiring special attention for cultivation as compared to other cereal crops. The rain-fed land that had paddy during monsoon is used to cultivate sugarcane, horse gram, ragi groundnut and ginger. Dry regions, with no irrigation facilities are used for cultivating ginger and cotton.

Crop diversity and cropping extent

Table 2 shows the diversity of each crop in the study area in terms of number of varieties and extent of cropping. It can be seen that there are about 59 varieties in paddy, which include both traditional and high yielding varieties. Similarly banana and mango crops are rich in varieties. Based on the number of farmers having each crop in sampled villages, cropping extent has been calculated. It shows that paddy betel nut, banana and coconut are the major crops of the region.

Table 2: Extent of cropping of various crops

Crop Type	Number of varieties	Number of farmers	% of farmers
Paddy	59	300	85.47
Betelnut	3	252	71.79
Banana	12	208	59.26
Coconut	4	199	56.70
Sugarcane	1	122	34.76
Ginger	7	117	33.33
Betel Leaf	5	68	19.37
Pepper	6	60	17.09
Cashew	2	37	10.54
Cardamom	2	36	10.26
Coffee	5	14	3.99
Mango	11	-	-

Minor crops like four types of fruits, vegetables, four types of pulses, and crops like garlic, sesame, finger millet, nutmeg, lemon grass and gooseberry also include in the diverse agricultural system of the region.

As evidenced in table 1, cropping in the region is influenced by both traditional and high yielding varieties. Table 3 shows the extent of cropping under these two categories for different crops of the region. Despite having 59 varieties, paddy seems to be sensitive to the recent changes in the form of green revolution. About 92.3 % of the farmers have shifted to high yielding varieties. About 28 traditional varieties are conserved by just 18.3 % of the total paddy cultivators. While within this data about 10.6 % of the paddy cultivators have both the traditional and high yielding varieties. Thus it can be argued that traditional paddy cultivation in the study area is severely threatened by the modernization of agriculture. In case of betel the introduced varieties like 'mangala' have failed to influence the farmers. Similarly, banana betel leaf and pepper cultivation prefers traditional varieties although there is slight influence of improved varieties. Other crops like coconut, ginger, sugarcane, cashew, coffee, cardamom and mango are dominated by improved varieties.

Table 3: Extent of farmers using traditional and high yielding varieties under different crops

Crop Type	Traditional varieties			Introduced varieties		
	Number of varieties	Number of farmers	% of farmers	Number of varieties	Number of farmers	% of farmers
Paddy	28	277	92.3	31	55	18.3
Betel nut	2	252	100.0	1	3	1.19
Banana	8	208	100.0	4	36	17.2
Coconut	1	95	47.7	3	124	62.2
Sugarcane	-	-	-	1	122	100.0
Ginger	1	8	6.8	6	109	93.2
Betel Leaf	4	42	61.7	1	35	51.5
Pepper	5	56	93.3	1	12	20.0
Cashew	-	-	-	2	-	-
Cardamom	1	-	-	1	-	-
Coffee	-	-	-	5	-	-
Mango	4	-	-	8	-	-

The concept of diversity can be seen in case of large farmers. These farmers have land of different features wherein the availability of water as well as the soil characteristics varies significantly.

This drastic difference is due to the undulating terrain of the region. Naturally for each type of landform they use suitable varieties. Thus large farmers use two to three varieties under each crop.

Traditional farming versus modern agriculture: The earlier discussions reveal that paddy cultivation is severely altered by modern techniques. Understanding the outline of traditional and modern agricultural practices considering the benefits of the two may be crucial.

In traditional agriculture, seed selection for cropping involves enormous amount of experience and associated indigenous knowledge. The quality of the seeds is determined by their purity and maturity. Similarly the criteria involved in selecting the variety are season, type of soil, water availability, water logging, disease resistance and the market demand. The farmers are well worse with the information about the varieties they use. This cropping also involves the low cost methods like use of animal power in tilling, use of organic manure, low cost irrigational facilities that are available locally. Indigenously developed seed storage devices like large earthen pots (locally called as 'Kanaja' and 'Panatha') and bins or baskets, made up bamboo are extensively used all over the region to store the grains. Insect attacks are tackled by mixing ash with grains. This is mainly to fill up the pores between the grains and to remove the moisture content. The manure usage is more of farmyard and less inorganic fertilizers although the study found that the amount of manure used is a function of natural resource availability and economy of the farmer.

Agriculture with high yielding varieties involves collection of seeds from the Agricultural Departments. These departments guide the farmers throughout the cropping. Seed purity and maturity are not at all a concern in this case, minimizing the burden of farmers. Aim of high yield is attained by heavily relying on inorganic fertilizers. Mechanized tilling practices, crops of short duration, use of irrigation facilities are closely associated with this kind of intensive agriculture. Farmers have switched over to rat poisons and insecticides such as DDT to safeguard the grains during storage. The manure usage is more of inorganic fertilizers and variation in quantity is dependent upon economy of the farmer.

Yield Comparison between traditional and modern agriculture

Table no 4: Yield Comparison between high yielding and local varieties

Cropping Season	Type	Yielding Range	Average Yield (Quintal/Acre)
July to December	Traditional	6.8 – 10.7	8.6
	Improved	7.1 – 14.8	10.6
January to March	Traditional	8.6 – 8.6	8.6
	Improved	8.6 – 13.3	11.1

A comparison between yields of traditional and high yielding varieties has been made in table 4. Modern varieties show marginal increase in the yield compared to traditional varieties. However, the yielding range is more in modern cropping, which indicates that the yield is fluctuating, wherein traditional yielding range is relatively stable. It is due to the sensitivity of improved varieties to the changes in their environmental conditions. Improved varieties require optimum conditions to give high yield, which is highly difficult for the farmers to provide. The crops experience irregularity in water supply, changes in nutrient content, temperature, etc. to which improved varieties are sensitive. Moreover the farmers are unaware of the methodologies that they have to follow for the improved varieties while in case of traditional varieties, it is their long time association and the experience with traditional varieties and cultivation, they manage the crops in any kind of variations. This is evident by just marginal difference in yields between these two and the range of yield fluctuations. The modern technologies in tilling, transplanting, and paying prices for seeds, pesticides and fertilizers can yield about 2 to 2.5 quintals more compared to traditional which seems to be irrelevant. From the present study, it is quite clear that modern agriculture in the region can increase the yield but on the expense of high input from farmers side.

Input output mechanism: The modern agriculture involves frequent external interventions such as seed, fertilizer and pesticide purchase, mechanized tilling and irrigation practices and importantly the constant guidance by the technical experts. Most of the farmers in the study area are small land holders with less than 2 acres of land. Being economically the weaker section of the society, these farmers cannot afford for these interventions efficiently. The extra yield that they get comes out from whatever input they give. This could be the main reason for marginal rise in yield despite their enormous effort. Thus considering all these aspects modern agriculture is not a feasible option for the farmers here. Though it provides marginal rise in yield but at the same time the yield is not sustained and also requires more inputs which makes the farmers to spend more than what they benefit.

Conservation of traditional agriculture

The present study clearly shows that the traditional agriculture is under the threat of extinction in this region due to blindly following the modern agriculture.

1. In-situ conservation of the inter-species diversity of crops like paddy, coconut, ginger, pepper, betel leaf, is the immediate requirement considering their status and association with traditional agriculture.
2. External interventions need to be critically evaluated prior to implementation. The surrounding environmental variables are the integral part of agriculture for any region. Thus most simplified and generalized system of modern agriculture may not work to the fullest potential in all the cases. In present case the farmers and the guiding authorities have blindly followed modern

agricultural system. In this region it is the traditional agriculture that is more appropriate considering the lack of affordability to modern techniques, marginal yield and the extra input required.

3. Continuous support and incentives should be paid to the farmers, who cultivate traditional varieties. Farmers should be supported to develop their skills and systematically organize their activities. Introduction of any new practice should not contain any large cash investments.
4. The authorities should document the domesticated biodiversity at village level so as to monitor the continuous changes in agriculture. A well-established database on these aspects at village level is fundamental in assessing the amount of changes that are taking place in agriculture.
5. Villages on the eastern side of the Western Ghats are dependent on traditional agricultural practices and rich with interspecies diversity. These regions have to be considered as agro-biodiversity hotspots. Farmers need to properly guided in the new direction of old approach so as to prevent the further possible shift towards the modern agriculture.
6. The study area is one of the 34 biodiversity hotspots of the world. Considering the negative consequences of the modern agriculture on ecology of the region in terms of pesticides and mechanized operations, the study area has to be graded as region for biodiversity conservation than considering as a ground for agricultural production.

Conclusion

The study of agriculture in the catchment has brought to light many aspects. The region harbours diverse agriculture systems. Paddy is a source of food and areca the economy. Higher diversity exists in the agricultural system as a whole but influenced by the modern technologies. The rich genetic diversity of the crops is gradually eroding due to lack of adequate knowledge and improper guidance given to the farmers. The present study finds that it is the traditional agriculture that is more appropriate considering the sustained yield and amount of input required. The region has treasured 28 traditional paddy varieties, and could be an ideal place for conservation of traditional varieties and as a whole the traditional agriculture.

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INTRODUCTION

➢Rice is an economically important food crop. It feeds nearly half the world's population and accounts for more than 30% of their daily calorie intake (Maclean et al. 2002).

➢The world is losing genetic diversity of rice

➢Major reason for this loss is the steady replacement of native varieties with high-yielding new varieties in large scale.

➢India: Land of genetic diversity of rice (100,000 local varieties) and about 90% are feared to be lost

IMPORTANCE OF TRADITIONAL VARIETIES

✓High diversity at genetic level.

✓Diverse qualities for rice- height of plant, colour, size, aroma, maturity and habitat.

✓More fodder (5-7 ft height unlike new dwarf varieties).

✓Disease, pest, drought and flood resistance more.

OBJECTIVES

- To trace out traditional varieties remaining in Uttara Kannada
- To find out their special characters
- To estimate number of traditional varieties in the district using field survey and regression analysis for prediction of expected number in the district

RESULTS AND DISCUSSION

Altogether, a total of 181 rice varieties were inventoried from 232 villages, during this survey. Of these, 101 varieties were traditional ones, 80 were new varieties, considered high yielding.

Taluk-wise numbers found and numbers expected are presented in the table:1

HABITAT SPECIALIZATIONS

For flood tolerance Eg: Neermulka; Mysore mallige;

Salinity tolerance Eg: Bili-kagga; Kari-kagga.

Drought tolerance Eg:Jeddkempi; One-kaddi.

Variable maturity periods: Halga, Jeddubatha (90 -100 days); Dibrasaala, Bantwala (100 -120 days); Hegge, Aloorusanna (120 -140 days)

Figure 1: Map of Uttara Kannada district with 11 taluks

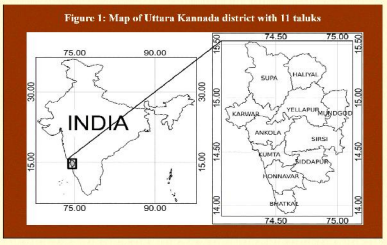


Figure 2: Trends of diverse traditional rice varieties in Uttara Kannada

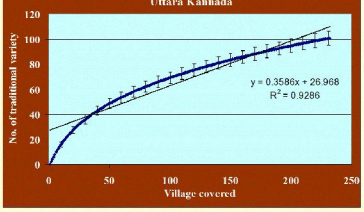
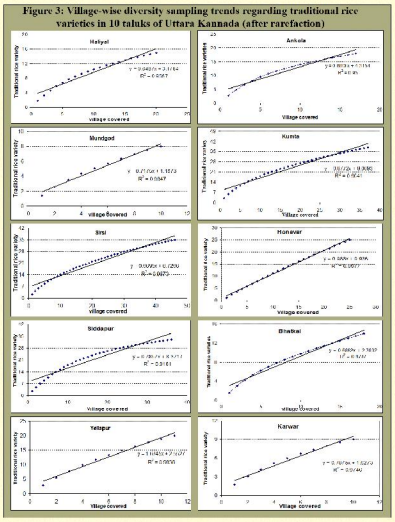


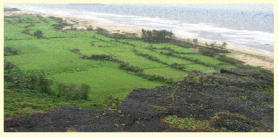
Table 1: Traditional rice varieties with expected varieties in 11 taluks of Uttara Kannada

Taluks	Village covered	Rice varieties		Total varieties encountered	Expected traditional varieties
		Traditional	New varieties		
Total	232	101	80	181	492
Ankola	17	18	14	32	**81**
Bhatkal	16	14	15	29	**45**
Haliyal	20	15	12	27	**92**
Honnavar	21	25	15	40	**93**
Joida	2	1	10	11	-
Karwar	11	9	10	19	**45**
Kumta	42	39	17	56	**112**
Mundgod	10	8	10	18	**68**
Sirsi	45	35	28	63	**155**
Yellapur	11	20	13	34	**218**
Siddapura	36	33	34	67	**165**

Some traditional rice varieties in Uttara Kannada

Figure 3: Village-wise diversity sampling trends regarding traditional rice varieties in 10 taluks of Uttara Kannada (after rarefaction)





CONCLUSIONS

✓High landscape heterogeneity and strong in agriculture traditions make Uttara Kannada a stronghold of genetic diversity of rice and other crops

✓The genepool of rice was neglected all the while and even the agriculture department does not maintain data on local varieties

✓Widespread introduction of dwarfish new varieties, considered high yielding, is a major threat to rice gene-pool.

✓New varieties are susceptible to high disease and pest attacks and marginally high yield is often eclipsed by these drawbacks

✓Introduction of new varieties has caused fodder crisis in the district which is adversely affecting milk production and availability of cattle dung for manure

✓We have predicted using the sample survey method and regression analysis the talukwise numbers of local varieties available in Uttara Kannada; with nearly 500 expected varieties

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