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Let me begin by expressing my sense of gratitude to the Indian Society of Agricultural Statistics for the privilege of delivering one of its Dr Rajendra Prasad Memorial lectures. Above all Dr Rajendra Prasad was a man of tremendous human sympathies for the people of our country. I have therefore chosen for this lecture the theme of how the depletion of the natural resource base of the country is affecting our people, the challenges that this has raised before our society, and the welcome new initiatives that are emerging in response to this challenge.

Resources : Gathered, Produced and Processed

All living organisms, including man, must maintain a continual flow of matter and energy through their bodies if they are to survive. Plant and animal biomass simply gathered from nature furnish both the matter and the energy thus required for the rest of the animal kingdom. But man, a tool using species *par excellence*, began not merely gathering biomass but processing it as well when he took to cooking it over fire several hundred thousand years ago. He then progressively took to not just gathering but producing the biomass, not only shaping stones, but fabricating metal tools, not merely extracting the energy from wood set on fire, but mining fossil coal and lately even splitting atoms and synthesizing all manners of complex molecules. Each of these achievements gave him greater and greater control over his environment and made possible an increase in his populations. They also meant ever increasing demands on the resources of the earth.

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Today man meets his wide ranging needs for energy and matter from a variety of sources which may be described through a three-fold classification; biomass or non-biomass (including fossil biomass), gathered or produced, and with little or considerable processing. The first of each of these three dichotomies imply lower resource demands and therefore sources more commonly used by individuals or groups with more limited access to resources. Hence the most primitive tribals depend heavily on use of gathered biomass subjected to little processing, while the rich in the Western countries extensively use biomass produced with heavy inputs as well as non-biomass resources, both after a great deal of processing. Hence, the richer countries, as well as the elite in the poorer countries, must make greater demands on the resources than the poorer countries, or the poor in any country. If there is adequate resource base within its own territorial limits to meet the demands of all the members, the society could organize harmonious and sustainable utilization of its resources. If the resource base be inadequate, however, the society may try to establish access to the resources of other countries, or curtail resource use by some segments of the society within its own country. This would inevitably lead to tensions and social conflicts. The lower the level of access to resources outside, and the greater the shortages within the country, the greater the possibilities of serious conflicts. Such conflicts can adversely affect the ability of the society to achieve disciplined and sustainable resource use and are therefore of great significance. Our country today finds itself in just this predicament of severe resource shortages leading to social conflicts, with resultant indisciplined resource use and rapid degradation of the capital stock of our natural resources. In this lecture I would endeavour to bring out just how severe the shortages are for the different categories of resources for various end uses, how these shortages affect the different segments of our society, what the consequences are for the system of management of these resources, and where the solutions lie. For this purpose I would like to use material based on a case study of the state of Karnataka.

The State of Karnataka

The state of Karnataka lies on the middle of the west coast of Peninsular India, with a narrow coastal strip, and a spine of the hill tract of Western Ghats that merges into the broad plains of the Deccan plateau. The state extends over an area of 1.89 lakh sq km and supported a population of 3.76 crores in 1981. Its 176 talukas can be divided into 6 ecological zones; coastal, crestline, northern transitional, southern transitional, northern plateau and the southern plateau. The coastal zone, occupying 2.16% of the geographical area receives on an average 320 cm of rainfall

every year. It has a human population density of 400 and a livestock density of 107 per sq km. The hills come all the way up to the coast in this tract, and most of these hills are today denuded of all vegetation cover. The result is that 46% of the land in this zone is wasteland, 25.5% is under cultivation primarily for paddy, 9.5% is under tree crops primarily coconut, 7.6% under forest cover and 11% under settlements. Ten per cent of the state comes under the crestline zone with altitudes ranging from 300 to 1800 m. This zone too receives high levels of precipitation, an average of 382 cm a year. It has human population densities of 103 and livestock densities of 60 per sq km. 61% of the area is under forest cover and another 4.9% under tree crops and groves. Cultivation, primarily paddy, accounts for 15.2% and wastelands 14%. Settlements take up the remaining 5%. The northern transitional zone occupying 4.1% of the geographical area of the state has a human population density of 181 and livestock density of 106 per sq km. This and the next transitional zone, at altitudes of 300 to 900 m, receive an annual rainfall of 160 to 200 cm. Cultivation, paddy and sorghum, accounts for 48.4%, tree crops 1.5% forest 28% and wastelands 16% of this tract. The southern transitional zone is broader, occupying 8.6% of the geographical area of the state. It has human population densities of 144 and livestock densities of 106 per sq km. In both the transitional zones goats account for 15 to 20% of livestock numbers; they are negligible in the coastal and crestline zones. The southern transitional zone has 50% under forest and 2.5% under tree crops, 33.7% under cultivation for paddy and jowar and 7% under wastelands, the balance being under settlements. The northern plateau occupying half the geographical area of the state is a broad belt of black cotton soil ranging from 300 to 900 m in altitude. It receives an average annual rainfall of just 66 cm and is the most draught-prone zone of the state. It has human population densities of 166 and livestock densities of 100 per sq km. Of the latter 22 are sheep and 24 goats. Over 67% of this tract is under cultivation for sorghum, cotton and groundnut. 16% of the area is wasteland and only 3% is under forests and tree-crops. The southern plateau, occupying a little over a quarter of the geographical area of the state is a more hilly tract because of the spurs of Eastern Ghats running through it and has an elevation of 600 to 900 m. It is dominated by red sandy soils with 47% of the area under cultivation, largely under ragi. Wastelands cover 36.6% of the zone and forests and tree-crops 7%. It has over 9% under human settlements because of the large urban centre of Bangalore. Because of this it has human population densities of 300 per sq km. The livestock densities too are high, of the order of 160 with 42 sheep and 26 goats per sq km.

Karnataka is thus one of the middle-of-the-road states. It has human and livestock densities around the average for the country, and a fair

representation of the soil and climatic variation. The picture in the state is therefore hopefully of wide relevance.

Our interest lies in looking at the production and consumption of the various energy and material resources in the state. We shall focus on the needs of the rural sector and on biomass resources. We shall in particular take a close look at five basic needs; food, fuel, fodder, fabric and fertilizer. To arrive at this picture we have used information derived from a variety of sources. These include satellite imagery and maps based on its interpretation by the National Remote Sensing Agency, vegetation maps based on imagery and field work by the French Institute, statistics compiled by the Karnataka State Bureau of Economics and Statistics, the National Sample Survey and the 1981 census, statistics made available by a number of the departments of the state government, the University of Agricultural Sciences, Bangalore as well as original surveys in the Ungra cluster of villages in Tumkur district and Sirsi and Kumta talukas of Uttara Kannada district by the Indian Institute of Science. I am grateful to my colleagues, Dr. Madhulika Sinha and Dr. Malati Hegde for their interest and diligent assistance without which this work would not have been possible, to the various agencies and individuals that have so willingly provided the data and interpretations, and to my Institution and to the Department of Environment, Government of India for financial and other logistic support.

Food

The most basic of all human needs is food and we still entirely depend on biomass to meet this requirement. We need food to provide us energy, calories, as well as specific materials that our bodies cannot synthesize such as amino acids (that make up proteins) and vitamins. A minimum amount of calories is the most basic necessity, although there is still debate as to what this quantity is. There is even greater debate on the amount of proteins that are needed. Nevertheless, there is agreement on the order of magnitude of the need, and that is around 2000 kcal/day and 50 gm of proteins/day for an average member of the population. We have reasonably accurate information on the production of the various food crops and catches of fish in each of the regions as well. Using an average of 27 years of the most recent, reliable data we have the following picture for the Karnataka state.

Evidently, the state is just about self-sufficient in food production, both from the calorific and protein points of view. This is however not true of all the zones of the state, and the coastal belt is markedly deficient in calorific production. The crestline is highly deficient in protein production as are all other regions but for the northern plateau to some

FOOD PRODUCTION IN kcal/day/head

Zone	*Coast*	*Crest*	*N trn*	*S trn*	*N plt*	*S plt*	*State*
Grain	604	1274	2373	2475	2848	1584	1704
Pulses	19	15	56	19	152	27	79
Fish	386	130	1	73	2	2	30
Other	78	338	337	305	636	401	476
Total	1087	1757	2767	2872	3638	2014	2289

PROTEIN gm/day/head

Zone	*Coast*	*Crest*	*N trn*	*S trn*	*N plt*	*S plt*	*State*
Grain	4.2	9.2	30.0	29.7	35.0	22.0	31.2
Pulses	1.0	0.8	3.3	1.1	8.2	1.5	4.3
Fish	30.6	12.2	0.1	6.9	0.2	0.2	2.8
Other	4.0	8.9	5.2	7.9	14.7	10.0	11.0
Total	39.8	31.1	38.6	45.6	58.1	33.7	49.3

extent However this picture entirely hides the reality of access to the food produced within the state as well as imported from other surplus states such as Punjab It is that the vast majority of the state's population does not earn enough to gain access to the available food A careful study based on the last two rounds of the National Sample Survey for Karnataka by Dr. I. J. Nayak and Dr. Gladys Sumithra has shown that in 1983 fully 66.7% of the state's rural population and 82.2% of its urban population did not earn enough to purchase sufficient food to ensure adequate nutrition A very large segment of our population would then be involved in attempts to find some way of acquiring food. The easiest way to do so is to collect food that is produced naturally, the route followed by tribal populations Such sources of food are however limited to areas rich in natural vegetation, the forest clad zones of crestline, and to a limited extent coastal and transitional zones Now our development policies have been emphasizing industrialization, including that based on forest resources In the idiom we have developed above, this means devoting forest resources to production of fibre-based highly processed materials rather than permitting gathering of food or other resources such as fuel from them. One such fibre-based produce is

paper and Karnataka has been encouraging paper mills to the extent of making bamboo, the most desired of our raw materials for paper production an throw-away prices like Rs 1 per tonne in the initial stages. Now bamboo shoots are a highly nutritious food source, quiet abundant in the forests during the monsoon. The people dwelling near forests desire it greatly, the forested regions in fact being particularly deficient in food production Naturally this results in severe conflicts with resource managers attempting to reserve the resource for the industry.

But gathering of food from the forest can only make a marginal contribution to sustainance given the large numbers of people who are looking for a subsistence. The next possibility is producing food by bringing currently uncultivated land under cultivation Almost all the land so far thus uncultivated is in fact land which cannot be rendered productive very easily because it is either too hilly, or too rocky, or there are not enough rains and so on. To render such lands productive would require very substantial inputs, something most people have no resources to provide. The result is that people scratch such lands to eke out a meagre plant production in a process that ultimately leads to further loss of productive potential of the land Just to take one example, in the district of Uttara Kannda where the forest department legally controls 8000 out of total 10000 sq km of land, 40 sq km are under recorded and another estimated 40 sq km under unrecorded encroachments. This means that 1% of the legal forest land is encroached and probably sustains around 40000 out of the 1000000 i.e. 4% of the population of the district. This is a substantial enough number to constitute sufficient political pressure for regularisation of encroachments, which regularly occur at the time of every assembly election. This is an easy but not a particularly desirable way out since most of the encroached land is not put to good production, but merely continues to lose its productive potential. It is therefore important to ensure that people have open to them better ways of gaining access to food that they so desperately need.

Fuel

Well before our lineage reached the status of *Homo sapiens*, the modern man, our ancestors had begun to process food by cooking it over fire. This opened up to them a whole new range of food resources such as grass seeds which could not be digested unless cooked. But it also meant that besides food, man now needed another resource, something to burn. Dry wood gathered from natural vegetation has then been a part of human requirements since time immemorial. An adult human being consumes around 500 gm of food per day. To cook this on a

primitive stone hearth requires about 1 kg of wood. Primitive man must then gather twice as much wood as food from the environment. Since woody matter is so much more abundant than nutrient rich fruits, seeds and tubers that man feeds on fuel would be no problem for forest-dwelling hunter-gatherers. But when man shifted to production of food by cultivation of cereals, he would have begun to encounter some serious fuel problems for the straw of these grasses is a poor fuel source. But man tamed animals around the same time that he started cultivating plants and their dung was very good fuel. Nevertheless man valued it more for its fertilizer value and preferred to return it to the land rather than burn it. His tree crops however would provide woody fuel, as indeed the coconut does in excellent measure in Karnataka today. This would be the first major produced fuel. This was next supplemented by fossil biomass, coal, and still later by sources involving much greater processing, including kerosene and electricity.

In Karnataka as in the rest of the country the masses cannot afford to spend on buying energy to cook their food and therefore must resort to gathering it the best they can. The National Sample Survey data for Karnataka shows that only 36.5% of the urban and 17.2% of the rural cooking energy needs are met by these processed sources such as kerosene and electricity. This works out to be equivalent to 32 lakh tonnes of fuelwood. Almost double this amount of 61.5 lakh tonnes is available as produced fuel from plant wastes such as cotton stalks, paddy husk, groundnut shells and coconut shells and leaf rachis. An amount of 53.6 lakh tonnes of dry weight of dung is also estimated to be produced in the state, though the bulk of what is collected out of this goes for manuring the fields, only about 5.9 lakh tonnes being used as a fuel. To this must be added the 5 lakh tonnes of fuelwood collected from the forest but distributed through the forest depots. All these processed and produced sources add up to 104 lakh tonnes, 20 lakh tonnes short of the total domestic fuel requirement according to the National Sample Survey.

ANNUAL PRODUCTION AND USE, DRY WEIGHT IN LAKH TONNES

Zone	*Coast*	*Crest*	*N trn*	*S trn*	*N plt*	*S plt*	*State*
Domestic fuel demand	5.4	6.6	4.7	7.9	51.9	47.9	124.2
Plant waste fuel	1.8	2.8	2.7	2.3	33.1	18.8	61.5
Total dung	1.5	4.1	2.7	4.7	21.8	18.9	53.6
Dung used as fuel	0.26	0.34	0.23	0.4	2.5	2.2	5.9

This 20 lakh tonnes has to come from individually gathered firewood. The state has 11.8 lakh ha of protected, unclassed, village and private forest set aside for this purpose. Almost all of this land is so degraded today through overhacking and overgrazing that it cannot produce even half-a-tonne of fuelwood increment per year. The consequence is that it is getting progressively depleted. In coastal Uttara Kannada district where we have been working, for instance, people are now cutting down species which were earlier left untouched because of their poisonous latex and digging up the roots of the more desirable species. With the officially accepted sources of fuelwood thus drying up the people are increasingly turning to the so-called reserved forests to meet their requirements, as well as to earn a living by selling the fuelwood so collected in the towns. Thus a survey by the forest department of the town of Sirsi with a population of 40000 showed that as many as 700 headloads of wood a day, amounting to 3500 tonnes of wood annually came into town through unregulated collection, largely from reserved forest. In its attempt to regulate this the forest department is having to step up its own channels of supply through forest depots. This calls for increased working or already depleted forest areas. Since the forest depots primarily serve the urban populations the rural people dependent on gathering resources from these areas resent it. One such conflict, beginning in the village of Salkani in the Uttara Kannada district has become known as *Appiko*, the Kannada language version of *Chipko*.

The conflict itself as symbolised by *Appiko* however offers no way out of this dilemma. What is needed is good management of the forest areas set aside for fuelwood supply to the people. Under their present condition they are producing not even a small fraction of their potential, less than 1/2 tonne when they could be made to produce 15 tonnes or more a year. The main hindrance is the lack of any organisation of the local people capable of enforcing good resource use, and their lack of faith in the Government machinery because of the past experience that this machinery is geared to diverting the use of these resources away to the processing industries. Hence when the forest department attempted to raise fuelwood plantation for the first time in Uttara Kannada at a place called Kageri in 1981, all the seedlings were pulled away by the local villagers. Since then however substantial progress has been made and 6000 ha of minor forests have been brought under fuel and fodder plantations. It has been demonstrated that these could produce as much as 135 tonnes of fuelwood per ha over a five year rotation with an investment of Rs. 8000 in the high rainfall crestline zone. But such a system essentially implies a switchover to production rather than simple gathering of fuel wood. Such a transformation is an imperative today. Apart from much needed fuelwood this intensive production system can also generate substantial amount of

equally needed employment. However its produce will not go to the processing industries or the rich consumers, and hence its whole management needs a fresh approach. It also needs a willingness to make investments we have so far hesitated to make. Neverthless, it is a critical need of the day and organizations such as the National Wasteland Development Board are right steps in this direction.

Fodder

Husbanding of plants and animals has gone hand in hand almost from the beginning of the neolithic revolution ten thousand years ago. The livestock has served as a source of power for tilling and its dung has been an important source of return of nutrients to the agricultural land. On the Indian subcontinent the livestock has been very much an integral part of agriculture; fodder for animals has therefore been a vital basic need of our population. This need has traditionally been met in part from residues of agricultural crops and from grazing on uncultivated lands around the villages. There have in addition been groups of pastoral people to have entirely depended on grazing their flocks on uncultivated lands. The availability of these uncultivated lands has however been rapidly shrinking with the growth of human population, while the livestock population has continued to increase. We have estimated the current status of requirements and availability of fodder from the various sources of the state of Karnataka.

ANNUAL PRODUCTION AND DEMAND, DRY WEIGHT IN LAKH TONNES

Zone	*Coast*	*Crest*	*N trn*	*S trn*	*N plt*	*S plt*	*State*
Fodder demand	9.9	27.6	17.8	31.5	145.2	125.7	357.7
Crop residues	1.0	2.6	4.0	8.4	65.5	37.5	118.9
Uncultivated lands	5.0	30.2	7.0	18.6	21.7	37.9	120.3
Total available	6.0	32.8	11.0	27.0	87.2	75.4	239.2

It is evident that there are very serious shortages of fodder statewise as well as in each of the zones, except the crestline. Even here the bulk of the fodder is estimated to be available from grazing in extensive forest areas. Availability of this fodder declines rapidly after the monsoon so that it is not really available for grazing towards the end of the dry season. For every other zone of the state shortages amount to about 1/3 of the demand. The result is that animals somehow manage to find some grazing on uncultivated lands during the monsoon months of June to October,

and can pull on crop residues for one to four months thereafter. The real crunch comes from February to May when essentially no fodder is available except for the livestock maintained by the bigger landowners. All other animals are then wandering looking for that stray blade of grass that has accidently escaped grazing. They then browse on all sorts of shrub and tree leaves normally considered totally unpalatable. People also set fires in forests and grazing lands everywhere in this season hoping for a better flush of grass with the first pre-monsoon showers. Any traditional systems of regulated resource use such as rotational grazing have disappeared under these pressures, leaving no hope of recovery of the vegetation of these uncultivated lands unless the whole system of animal husbandry undergoes a radical transformation.

The transformation has to include better management of pasture and forest lands through systems such as rotational grazing or hand harvesting of fodder, production of fodder on farms or through inputs on forest and pasture lands, a reduction in numbers of livestock, and an improvement in the productivity of the livestock. Unfortunately little has been done along these lines; instead much of the effort has been diverted to promoting processing of either fodder or dairy products. Thus the Karnataka Forest Industries Corporation set up a green grass dehydration and pelletisation plant based on expensive imported machinery. The plant has been closed down since there is no demand for its expensive product, although there is indeed a great scarcity of fodder in the state. The other processing ventures, involving processing of milk have on the other hand been successful for there is considerable demand for the product from the elite.

One of the communities producing substantial quantities of milk for the urban consumers in northern Karnataka is called Gavlis. This is a group of forest dwelling buffalo and cattle-keepers who have migrated into the forests of the crestline zone after these were freed of malaria following the second world war. These people traditionally living in remote forest areas used to market ghee, consuming the buttermilk at home. When they first colonised the forests 30-35 years ago, the grazing pressures in the region were low and the Gavlis could comfortably produce large quantities of milk with herds of 50-60 animals per household. Machinery, including chilling plants and truck routes was soon set up to ensure the flow of their milk to the urban centres of Dharwad-Hubli and Belgaum, but no attention was paid to their fodder needs. So the Gavlis continued to graze in the forests and in the dry season lop tree fodder. The adversely affected forest resources inc uding bamboo for the paper mill then set up in an area close to Gavli concentrations. The mill and the forest department tried to move Gavlis out and for this purpose a large area was set apart and deforested as early as 1969. However there was no

real understanding of what the new system of animal husbandry would be that the Gavlis should adapt when they stop grazing in the forest areas. As a result the Gavlis continued in the forest areas with mounting conflicts with the paper mill and forest department, but to this day without any real change in their animal husbandry practices. Three years ago, the Bhartiya Aro-industires Foundation has prepared a project document outlining the new systems that may be adapted and it is to be hoped that the project will be implemented in near future.

In another part of the crestline zone however the changeover from the now no longer viable system of free range grazing by animals to one of production of fodder on farm as well as forest lands has been successfully accomplished albeit on a limited scale. This was pioneered by a group of better-off farmers belonging to the Hulgol Group of Villages Co-operative Society in Sirsi taluka. These farmers now grow fodder sunhemp in the rabi season in their paddy fields and *Leucaena* and *Calliandra* on their farm bunds. They have also fenced off and planted hilly lands, which they are entitled to do, but which were earlier open to grazing by all the local people. This exclusion of cattle, often belonging to farmers with smaller or no landholdings led to conflicts. The solution obviously lay in augmenting fodder production on the minor forest land that serves as communal pasture. Such an attempt was initially resisted by farmers of a neighbouring village, but has subsequently been successfully initiated. Nevertheless it leaves as yet unresolved important issues of how the Government machinery and local people can work together to protect and share the resources thus generated.

Fertilizer

The shift from gathering to production of plants meant that man was now removing matter from relatively small areas in a concentrated fashion. This would lead to continuing loss of nutrients from the agricultural land, loss that has to be made good if plant production is to be sustained. The most primitive device to ensure this was to leave a plot of land fallow for long periods. However, this would no longer be feasible once the land to man ratio declines as has happened all over Karnataka perhaps since several centuries in parts such as the thickly settled coastal tracts. Man then tries to organize the return of nutrients by adding organic matter brought from outside the agricultural land as dung or lopped leaf manure, or by producing green manure crops on the field itself. The next stage, which became possible only after the chemical basis of plant production was understood was to add synthetic chemical fertilizers. This shift to the use of fertilizer proudced through sophisticated processes has been quite incomplete in our agriculture, largely because a

large proportion of our farmers simply cannot afford synthetic fertilizers in spite of the subsidies. We have attempted an analysis of the nutrient budget of Karnataka's agricultural lands to appreciate the role of various inputs in restoring the nutrient status of the soil. I must confess however that here we are on somewhat unfamiliar and uncertain grounds.

Nutrient in lakh tonnes	N	P	K
Removed through harvest	4.25	1.65	4.61
Returned through crop remains/ green manure crops	0.53	0.47	1.41
Returned through dung	0.64	0.61	0.65
Returned through gathered leafy matter	0.56	0.19	0.65
Returned through chemical fertilizer	2.14	0.93	0.79
Total returns	3.87	2.20	3.50

It is obvious that while synthetic fertilizers are playing an important role in maintaining soil fertility especially with respect to nitrogen now, the dung as well as gathered leafy material are still of critical importance, particularly with respect to phosphorus and potassium. They would also be very significant in terms of the return of many other nutrients required in micro quantities and not returned through the synthetic fertilizers normally used. This is no doubt at the root of the practices of extensive lopping of forest trees to provide green manure throughout the coastal, crestline and transitional zones. This has led to a variety of conflicts in the past between the forest department wanting to convert the natural forests so valued by the people for leaf manure into teak plantations. It is now becoming clear that unregulated gathering of such leafy manure can no longer be sustained, and that its careful production on farm bunds, during fallow periods, as well as its well-managed harvest from the forest are essential. It is also essential now to introduce better treatment of dung as well as the vegetable matter to retain its nutrient value in the process of preparation of the manure.

Fibre

Fifthly, man needs fibre of structural material. He needs it to construct his shelter, his implements, and to serve him as clothing. Today, he also needs it on a large scale as paper and as material for a variety

of industrial processes. Gathered biomass has served him these needs in the past, and processed biomass is still significant in meeting his much expanded needs for fibre today. Bamboo has been one of the most abundant and versatile structural materials of our country and served our people since time immemorial in construction of shelters, hunting, fishing and agricultural implements, and storage bins. It has provided employment to large communities in the fabrication of these. Although there is a long tradition of growing bamboo in backyards in coastal Karnataka, people have been gathering it free from the forests since time immemorial. That is why there was great resentment when the British first levied a tax of Rs 5 per tonne of bamboo gathered from the forest around 1860 as recorded by Cleghorn, the first British Conservator of Forests in Karnataka. The forest management throughout the British regime emphasized the primacy of claims of the elite and the processing industry in use of the forest resources and the desirability of doing away with any gathering of forest production by the bulk of the population. As a result bamboo was prescribed to be removed as a weed in the early working plans, and became a resource in the eyes of the Government only when paper industry started using it as raw material. The broad approach was continued in independent India so that the paper mill was given bamboo in 1958, a century after Cleghorn at Rs 1/- per tonne when the market rate was around Rs 3000/- per tonne. The industry with its huge profit margins had little interest in sustainable use of bamboo, for they could always shift to other softwoods or go to other regions if the bamboo were exhausted, as indeed they have done. The local graziers and the basket-weavers gained nothing from the prosperity of the paper industry and also refused to co-operate in disciplined resource use. The result of all these pressures has been a near total exhaustion of this valuable fibrous material.

One may also mention here the conflict currently brewing over handing over large tracts of village common lands to a joint sector company with Harihar Polyfibres for production of *Eucalyptus* as raw material for synthetic fibre production. This is clearly a retrograde step in view of the huge biomass shortages for the basic needs of the rural population already documented above. It is also true that many of the lands thus proposed to be diverted to industry are quite unproductive today. What is needed is organization to render these lands productive first to fulfill local needs and only then to generate empolyment for the local population in production of industrial raw material.

Fortunately, there are new initiatives emerging in managing the forest resources such as bamboo with a transition from simple gathering to careful husbanding and production. Karnataka forest department has recently developed the technology of effective propagation of bamboo,

and begun to raise excellent bamboo plantations. Even more significantly the plantations are meant to generate raw material for the basket-weavers of Karnataka. In fact basket-weavers' co-operatives may now be given land to raise their own raw material with the new highly effective planting techniques. We have indeed come round a full circle.

The New Challenge

I would like to close by reiterating my main theme. This is that biomass, gathered or produced but with little processing continues to play a vital role in meeting the basic needs of our population. Furthermore there are enormous shortages of the biomass thus needed, and if we are to provide a decent quality of life for our people, ensuring adequate supplies of all the biomass needs must become amongst our highest national priorities. Augmenting biomass production to the levels needed will only be possible if we make the transition from simple gathering to careful husbanding and production. The pattern of resource use is also the only feasible path for generating employment on the massive scale needed in our country. Such a transition calls for tremendous efforts as well as investments, and shifts in priorities that would undoubtedly demand sacrifices on part of the elite. But along with the sacrifices will come the enormous satisfaction of becoming part of a just society in which everyone enjoys a minimum quality of life. The whole process too is full of intellectual, scientific and organizational challenges worthy of the best minds in our country.