Thesis (3)

Nilambur P

Attapadi P

Coimbatore P.

Thesis Organisation

~~Thesis Chapters~~

Hypothesis

CV

Agents in NBR

Thesis Chapters

Essay on Ecological Change & Demography

NILAMBUR BIO PHYSICAL ZONE

Location: West of the Nilgiri Plateau.

Elevation: 300m ~ 400 m.

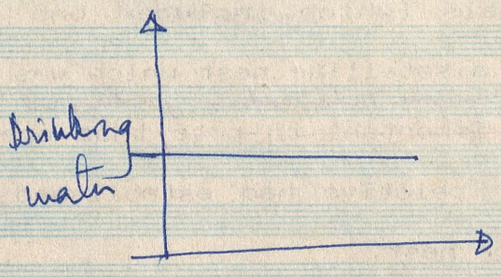
Rainfall: 2000mm to 5000 mm.

Soils: Thin / Highly Eroding Valleys.

Streams: Many swift flowing perennial streams of the Chaliyar Basin.

Water Resources

Subsistence

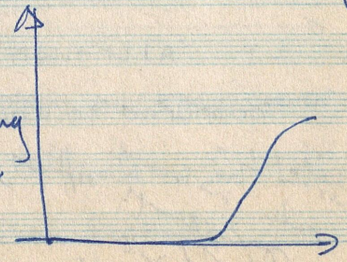


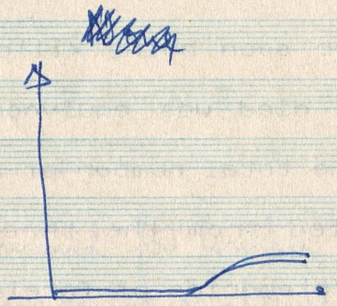
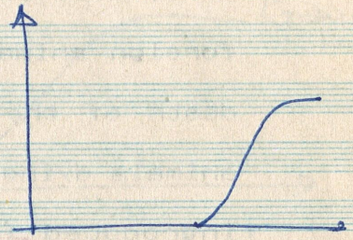
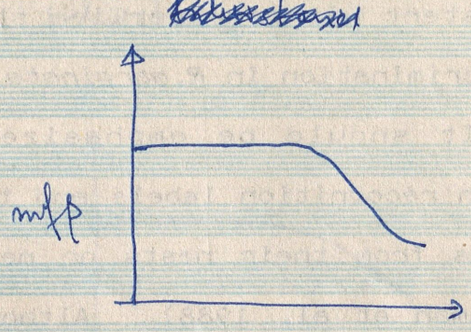
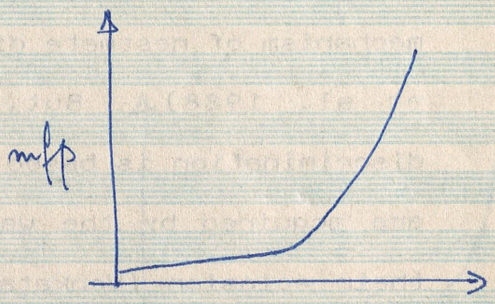
Drinking water demand constant and much below availability.

Commercial

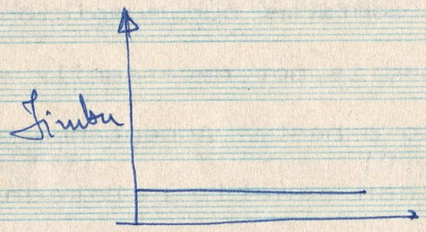
None.

Some drinking water supply to towns in the periphery increasing in the modern period



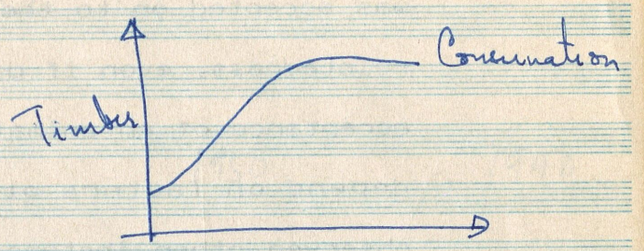
	Subsistance	Commercial
AGRICULTURE		
	little Subsistance Agriculture in the modern period brought in by the immigrants from Travancore, Cochin & Other areas of Malabar. Packets of shifting agriculture for growing forest plantations.	Increase in the modern period in the periphery of the area brought in by immigrants from Malabar & Travancore & Cochin
PASTORAL	None	Minimal. Brought in by the immigrants in the modern period.
FORESTS		
	Small hunting-gathering groups inhabiting the area and subsisting on hunting gathering only	Increase in commercial mfp collection in the modern period.

Subsistance



Low demand for timber and structural material for most of the period. An increase in the modern period because of immigration.

Commercial

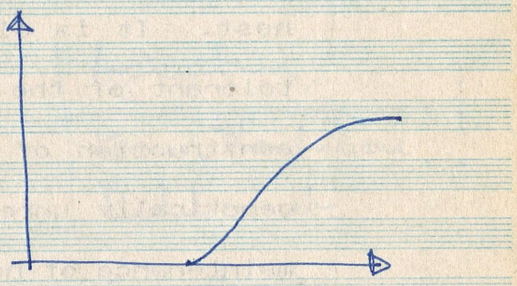


High demand for conversion of forests to timber plantations and extraction of timber species in Evergreen forests.
Clearfelling & Plantation.

WILDLIFE & FISH

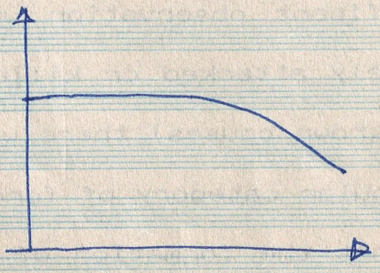


Constant ~~use~~ demand of wildlife & fish by the local communities for subsistance.

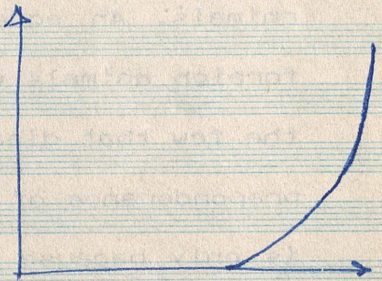


Increasing demand for fish by the immigrant population in the modern period.

PEOPLE



Subsistance Resource Use groups have remaind constant and in the modern period some have become partially wage labourers



Increase in market-oriented human groups in the modern period due to immigration.

Time Scale of Commercial Activity

1800 1850 1900 1950 1990

Timber & Plantations of timber

minor forest produce

honey, damman etc.

Agriculture;

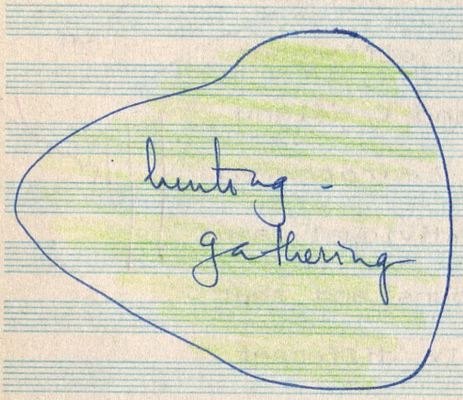
Mixed Plantations

Rubber etc.

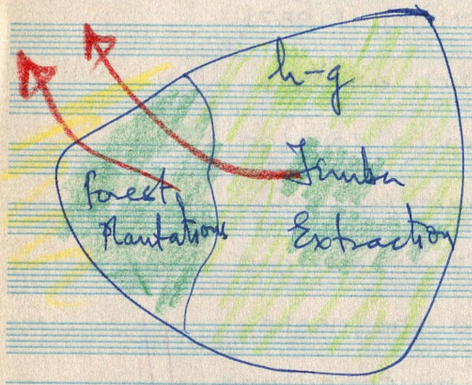
Time Scale of Subsistance Resource Use Activity

Small groups of hunting-gathering resource use.

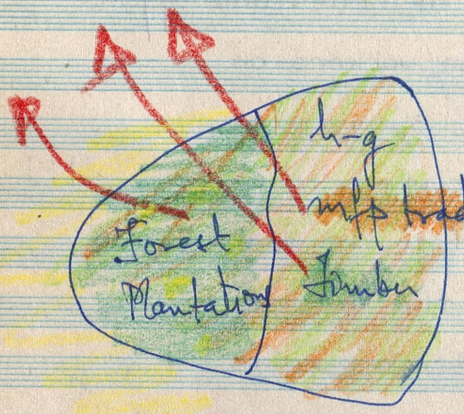
RESOURCE USE ON LANDS



1800



1900



1950



1990

Hunting - Gathering

Timber & Forest Plantations

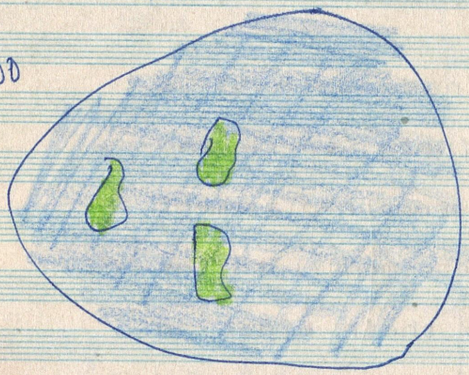
mfp collection for trade

Commercial Agriculture

Subsistance Agriculture

VEGETATIONAL CHANGES

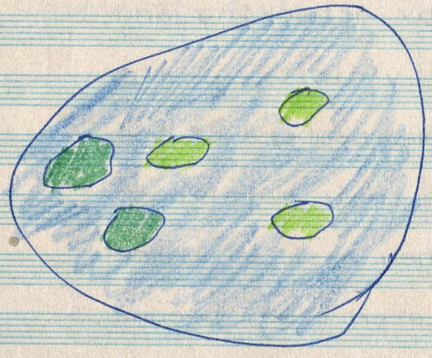
1800



Evergreen forests

Deciduous forests

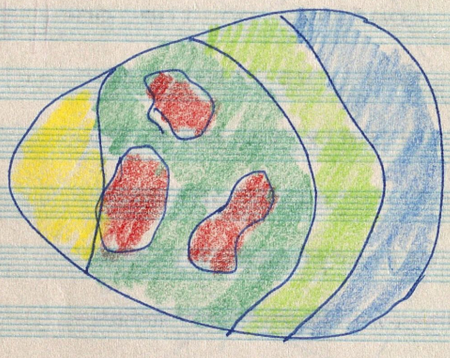
1900



Plantations (forests)

Agriculture

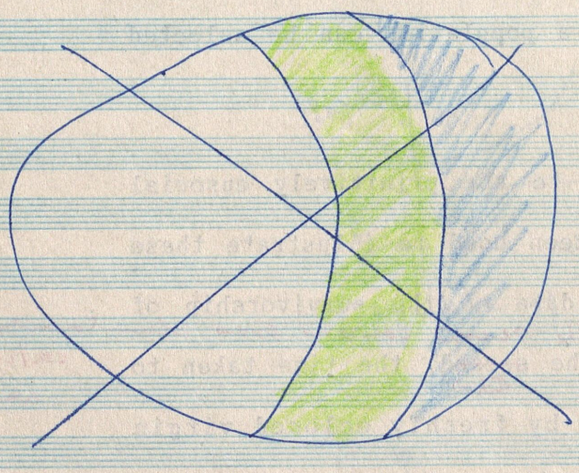
1990

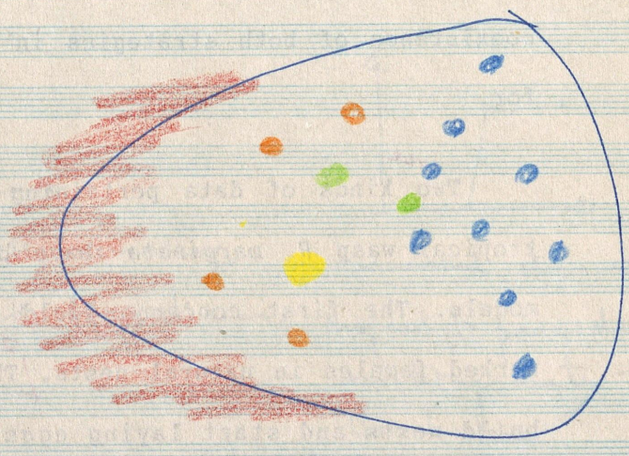


Sands

HUMAN GROUPS

Chola Naikens	h-g	h-g / commercial nfp collection
Padi Naikens	h-g	h-g / commercial nfp collection / wage labourers
Kattu Naikens + Betta Kurumbas	h-g	wage labourers
Ervadans	h-g	wage labourers
Immigrants	Agriculturists Horticulturists	Agriculturists Horticulturists.





ATTAPADI BIO PHYSICAL ZONE

Location: South of the Nilgiri Plateau

Elevation: 800 m ~ 1600 m.

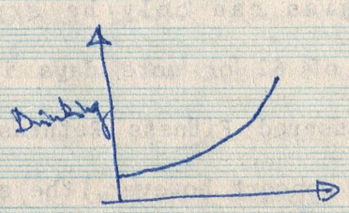
Rainfall: 3500 mm ~ 1800 mm.

Streams: few Perennial streams
Many Seasonal streams
Bhavani catchement
Bharatapuzha catchement

Water availability in this area has decreased because of (1) Hydro-electric energy in upper catchments (2) Irrigated land use in upper catchment (3) Restriction on access to water because of committed water use for irrigation in the lower catchments.

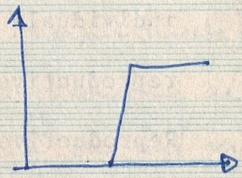
WATER RESOURCES

Substances

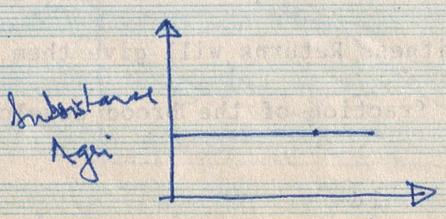


Increased with increasing population of the Attappadi area.

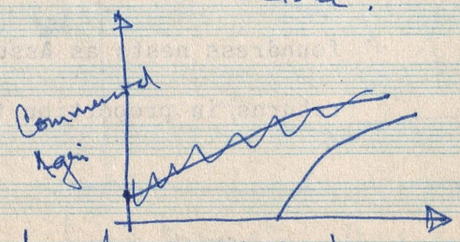
Commercial



Increased step-wise by a project to provide drinking water to Coimbatore.



Constant - Mainly rain fed agriculture



Increased in the modern period in stream sides, used by lift irrigation

for satisfying inequality (1) and equation (3) yields a value of

Subsistance

Commercial

Plans drawn and attempts made for tapping hydro-electric potential by failed due to Consumption priorities.

AGRICULTURE.

Subsistance Agriculture has been decreasing in the modern period because of (a) habitat destruction & non-availability of favourable agricultural sites (b) land use changes to commercial agriculture.

Commercial agriculture has increased exponentially in the modern period brought in by settlers (agriculturists) from the neighbouring areas and settling on the most favourable sites, displacing subsistance agriculturists.

High diversity - Low turnover.

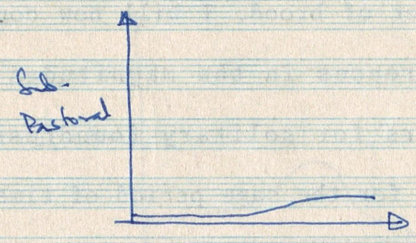
Low diversity - High turnover

rather different values for the demographic correction factors

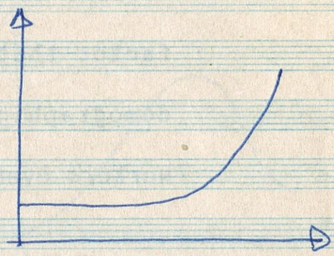
Subsistance

Commercial

PASTORAL



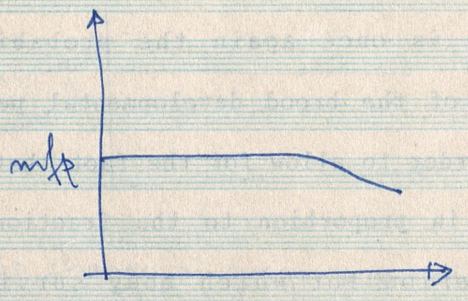
Low and negligible subsistance pastoral, mainly held by the settled agricultural groups for use in agriculture



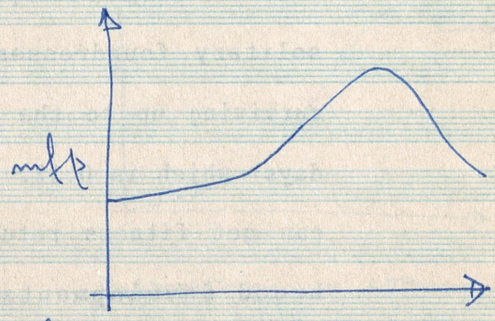
Increase in commercial pastoralism (a) & mainly by market-oriented groups in the Coimbatore plains, using the lands and cheap labour to keep cattle seasonally and perennially; for production of milk, meat and dung.
(b) Goverment sponsored programmes.

FORESTS

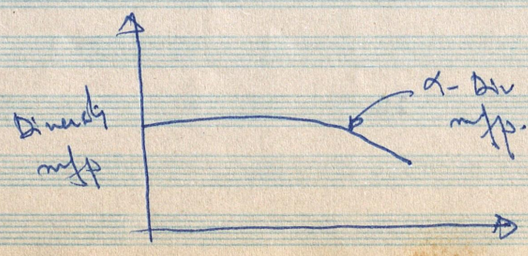
Evergreen forests
to
Dry Deciduous forests & Scrubs.

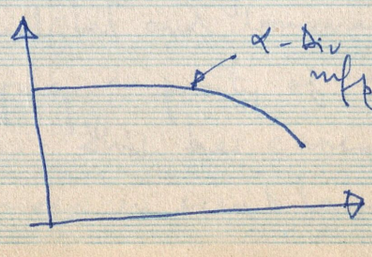


Significant mfp collection from forested areas & used for subsistance, decreasing in the modern period due to (a) loss of forests (b) restriction on access.



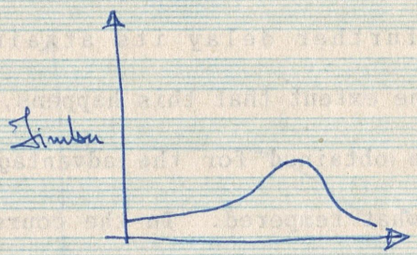
Significant mfp collection used for commercial medicines etc; decreasing in the modern period due to (a) loss of forest cover & natural areas.



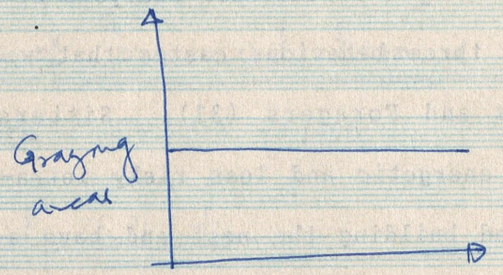


solitary foundresses and workers seen so far was due the

Subsistance

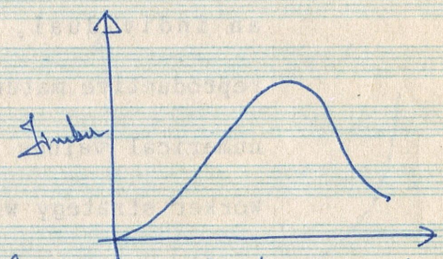


Structural timber ~~demand~~ constant, and ~~strong~~ increasing ~~dem~~ in the modern period due to influx of immigrants, and decreasing due to (a) loss of timber availability (b) restriction on access.

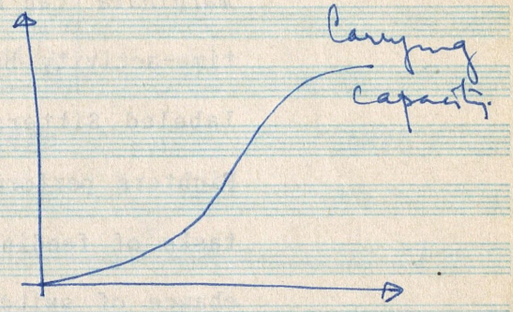


No change in grazing areas for subsistance pastoralism.

Commercial



Commercial timber demand steadily increasing in quantity and diversity and in the modern period decreasing because of (a) exhaustion of resource (b) restriction due to conservation priorities.



Increasing in commercial grazing areas due to ~~increase~~ (a) increase in commercial grazing (b) reduction in grazing habitat quality.

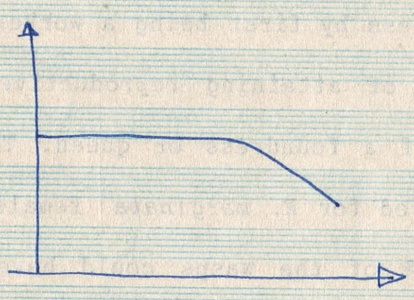
~~Overgrazing~~

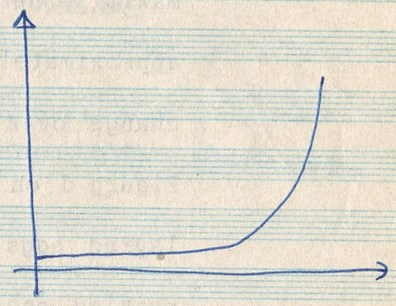
Thus, overgrazing has degraded the habitat and lowered the carrying capacity of the area. This has caused an increase in scrub lands.

Subsistance

Commercial

PEOPLE





Subsistance human groups has remained constant and decreased in the modern period having changed to wage labour and commercial resource use.

Commercial, market oriented human groups have increased exponentially during the modern period mainly due to immigration from other adjoining areas.

Time Scale of Commercial Resource Use Activity

1800 1850 1900 1950 1990

mfp collection

Estates
Tea / Coffee

Estates; Miscellaneous
Horticulture.

Commercial Agriculture.

Commercial Pastoralism.

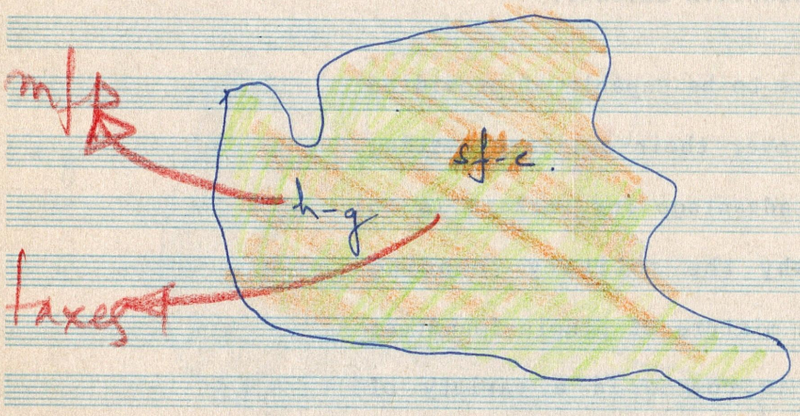
Time Scale of Subsistance Resource Use Activity

hunting-gathering ; shifting-cultivation;

settled Agriculture

worker and queen strategies. If there is little

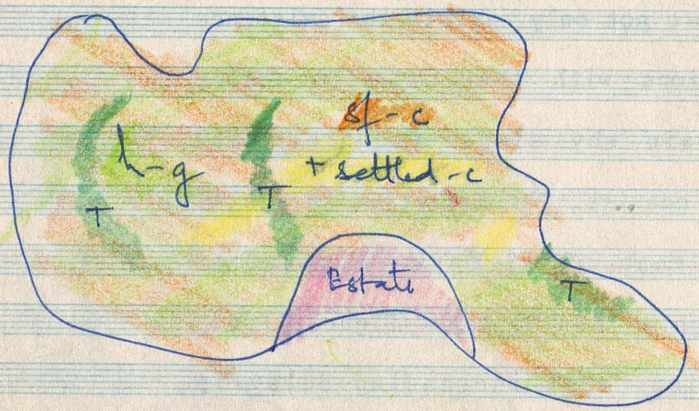
RESOURCE USE ON LAND



T Timber

h-g Hunting - Gathering

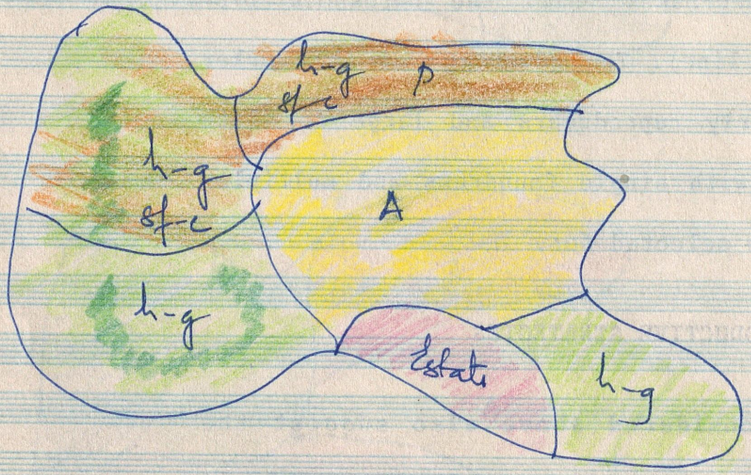
sf-c Shifting Cultivation



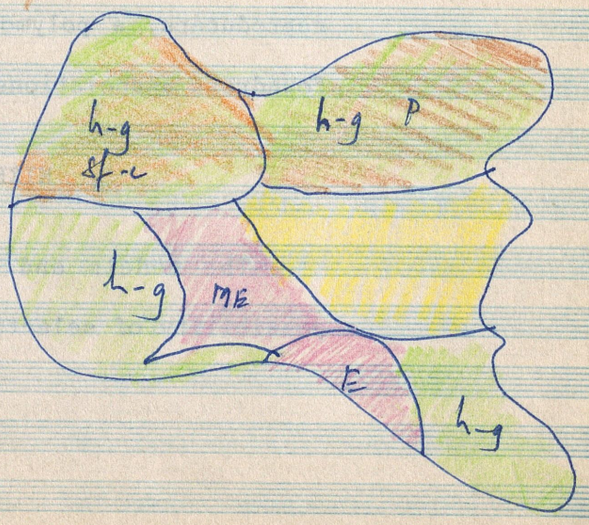
A Agriculture

E Estates

ME Misc. Horticulture



P Pastoralism.



sisters), Delayed Reproduction is thus 5.3 times more effective

VEGETATIONAL CHANGES

'0'

1900

1990

Ev Evergreen forests

D Deciduous forests

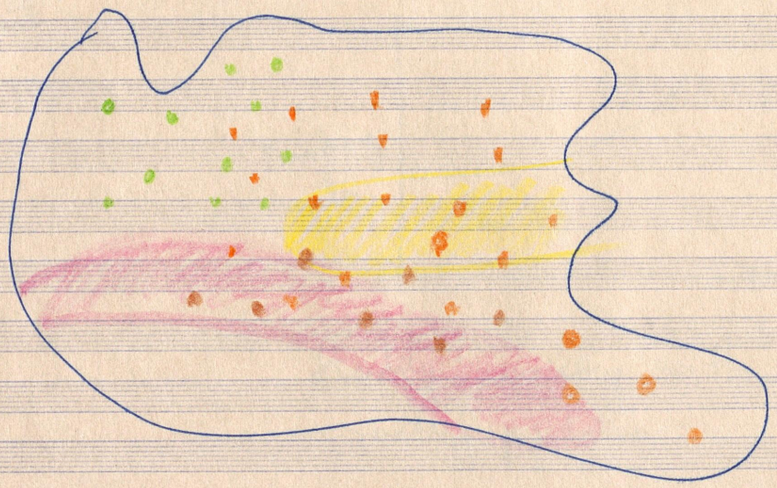
S Scrub forests

A Agriculture

Es Estates

HUMAN GROUPS

Kurumbas	h-g ; sf-c	h-g ; sf-c ; wage labour.
Irulars	h-g ; sf-c ; settled agri	wage labour ; settled agriculture.
Mudugas	h-g ; sf-c.	h-g ; wage labourers.
Tamil Immigrants	settled cultivation	settled agriculture.
Kerala Immigrants	comm. horticulture	comm. horticulture



COIMBATORE PLAINS BIO-PHYSICAL ZONE

Location: East of the Nilgiri Plateau

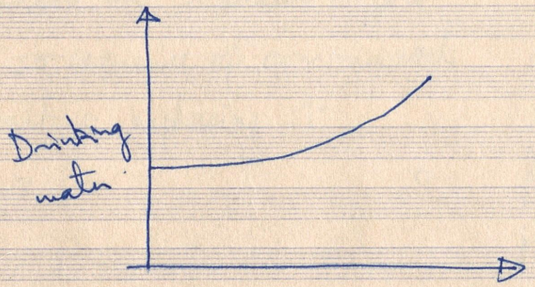
Elevation: 300 m ~ 600 m.

Rainfall: 1500 mm ~ 800 mm.

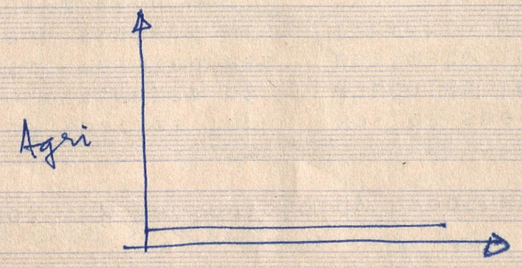
Streams: Many seasonal streams
Few Perennial streams of the Bhavani Basin

WATER RESOURCE

Subsistance

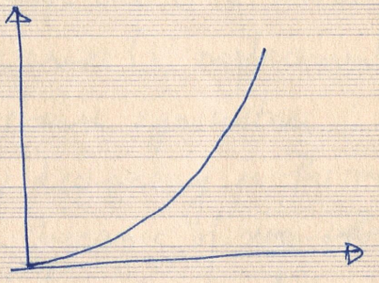


Steadily increasing with increasing population.

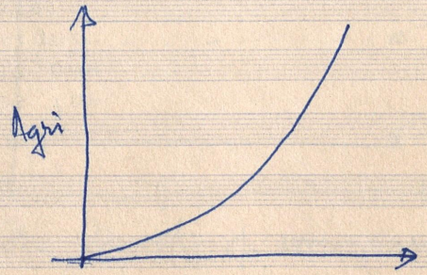


Low demand on subsurface water; mainly rainfed crops.

Commercial



Rapidly increasing to provide drinking water to commercial centres.



Rapidly increasing demand for surface & subsoil water.

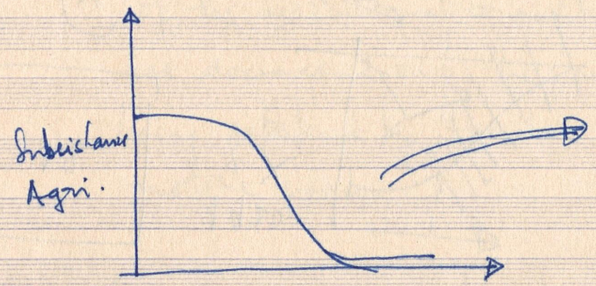
Subsistance

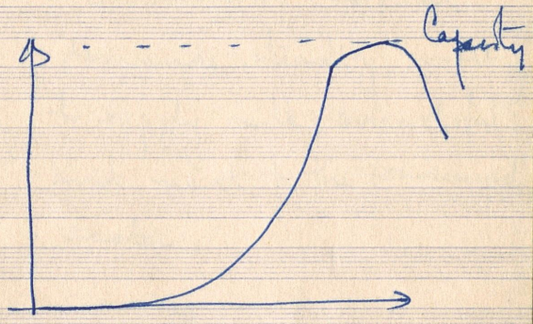
Hydro-energy: No utilisation

Commercial

Hydro-energy: Hydro energy tapped in the upper catchements of the Bhavani, but has already flowed into the Bhavani ~~in~~ before it flows through the Coimbatore Plains.

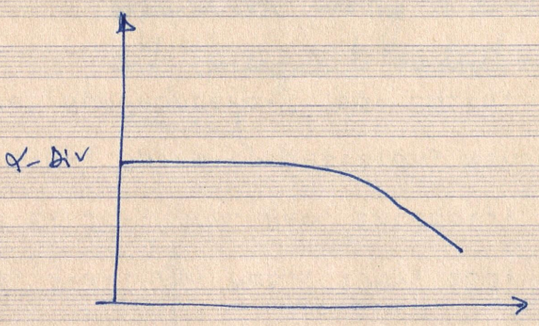
AGRICULTURE

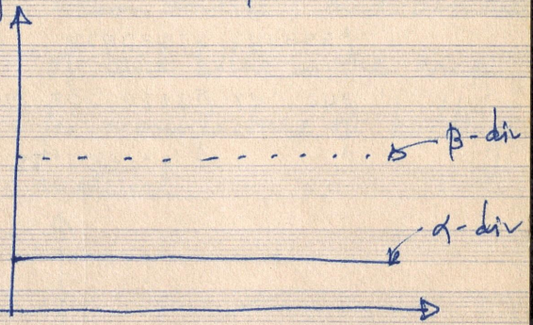




Subsistance Agriculture has decreased and reduced to zero as a consequence of commercial agriculture replacing it.

Commercial agriculture increased due to (a) colonising newer areas (b) replacement of subsistance agriculture; and finally decreasing in the modern period because of ~~non-extraction~~ depletion & exhaustion of ground water potential.





The diversity of subsistance crops has been high, and decreasing in the modern period

The diversity of commercial crops has been low; but the turnover may be high.

17. Nonacs, P., *Q. Rev. Biol.*, 1986, **61**, 1.

18. Boomsma, J.J., *Am. Nat.*, 1989, **133**, 517.

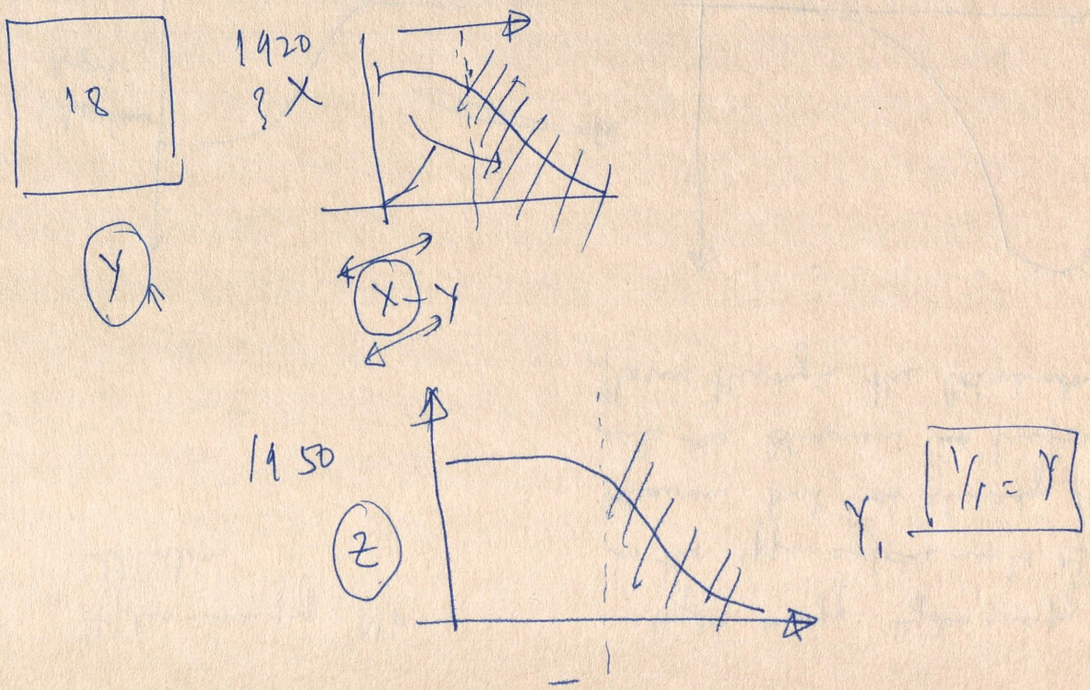
19. Page, R.E. Jr., *Ann. Rev. Entomol.*, 1982, **31**, 297.

20. Starr, C.K., *Sperm competition, kinship and sociality in the aculeate Hymenoptera*. (ed. Smith, R.L.), Academic Press, p.427.

21. Gadagkar, R., *Proc. Indian Acad. Sci. (A)*., 1985, **94**, 587.

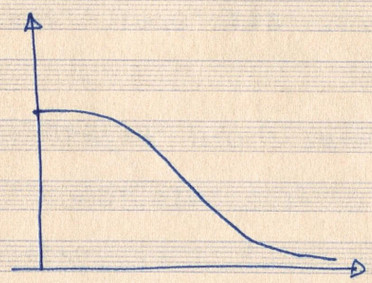
22. Muralidharan, K., Shaila, M. S. and Gadagkar, R., *J. Genet.*, 1986, **65**, 153.

ACKNOWLEDGEMENT. I thank N.V. Joshi, Madhav Gadgil and V. Nanjundaiah for many helpful discussions. Supported in part by a grant from the Department of Science and Technology, Government of India.



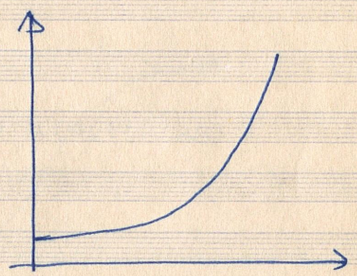
PASTORAL

Subsistance



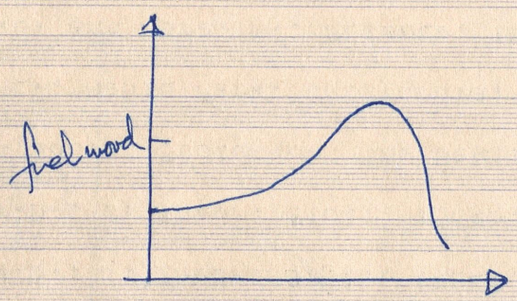
Subsistance Pastoral demands of the agricultural communities has decreased over the period being satisfied by tractor motive power.

Commercial

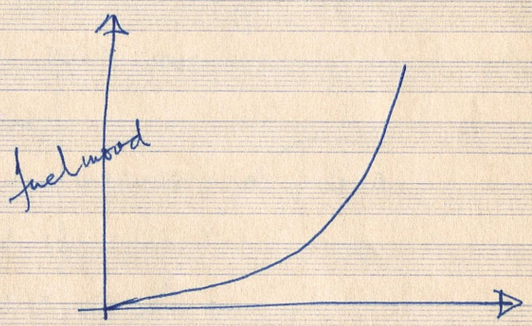


Commercial Pastoral demands steadily increasing to supply milk; animal fat; and meat to the commercial sector.

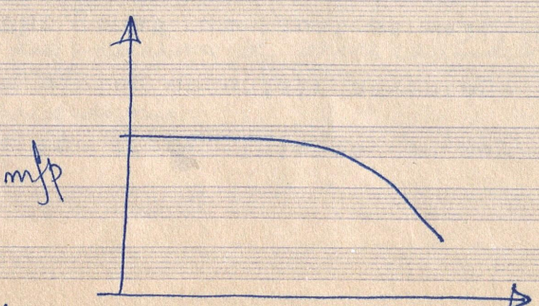
FORESTS



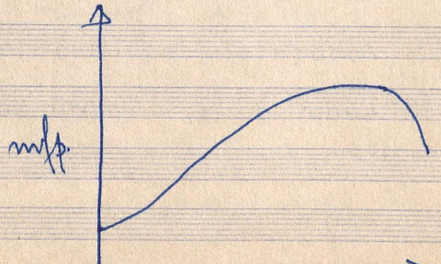
Subsistance fuelwood demand increasing with increasing population leading to exhaustion and consequent reduction in demand



Commercial fuelwood demands increasing with increasing demands from urban centres; and demands of brick kilns in the area for manufacture of building material.



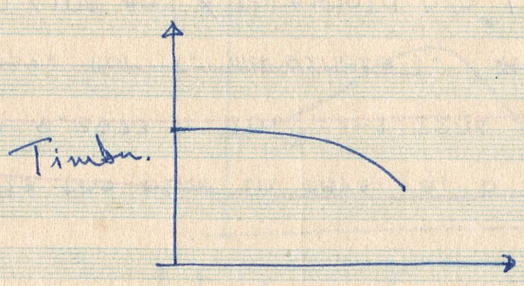
Subsistance mfp decreasing due to a) reduction in forests b) restriction on access. ~~and decrease~~



Commercial mfp. increasing.

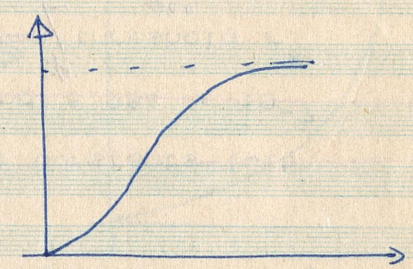
15. Joshi, N.V., and Gadagkar, R., J. Genet., 1985, 64, 41.
16. Alexander, R.D. and Sherman, P.W., Science, 1977, 196, 494.

Subsistance

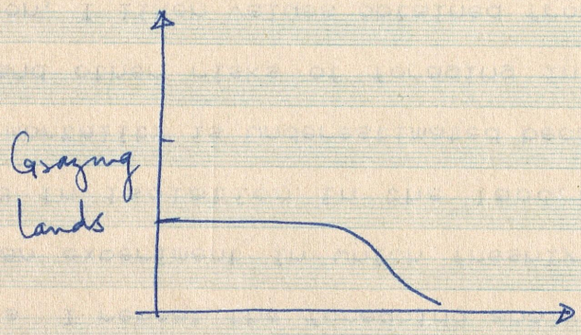


Structural timber use decreasing due to restriction on access

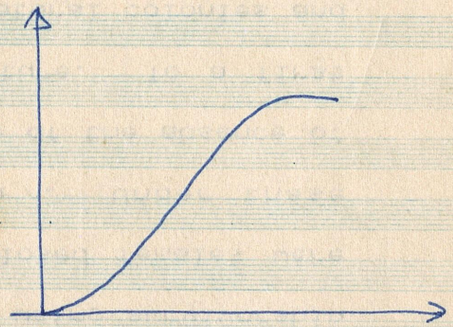
Commercial



Structural timber use increasing sequentially due to a) Expansion in area b) Plantations; inputs of low regeneration & exhaustion from many areas.



Grazing lands ~~are~~ constant and decreasing in the modern period due to decrease in
(a) ~~subsistance~~ livestock rearing and (b) restriction of access
(c) degradation of areas caused by overgrazing.

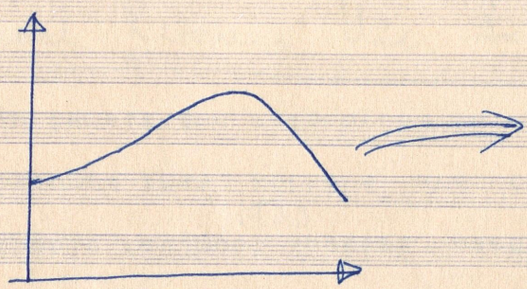


Grazing lands for commercial livestock rearing increasing due to (a) increased commercial livestock rearing (~~b~~) and (b) commercial rearing in more remote areas.

~~value of~~ 0.4108 and ~~a~~ threshold b/b^* ~~value of~~ = 1.2170 (see table 1).
These values are sufficient to satisty inequality (3) although
the potential advantage of working in shifts here is marginally

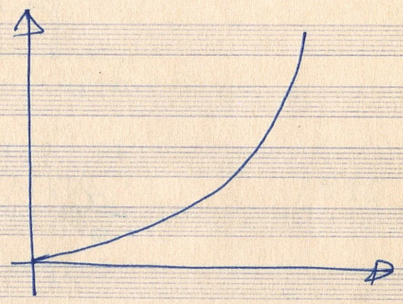
PEOPLE

Subsistance



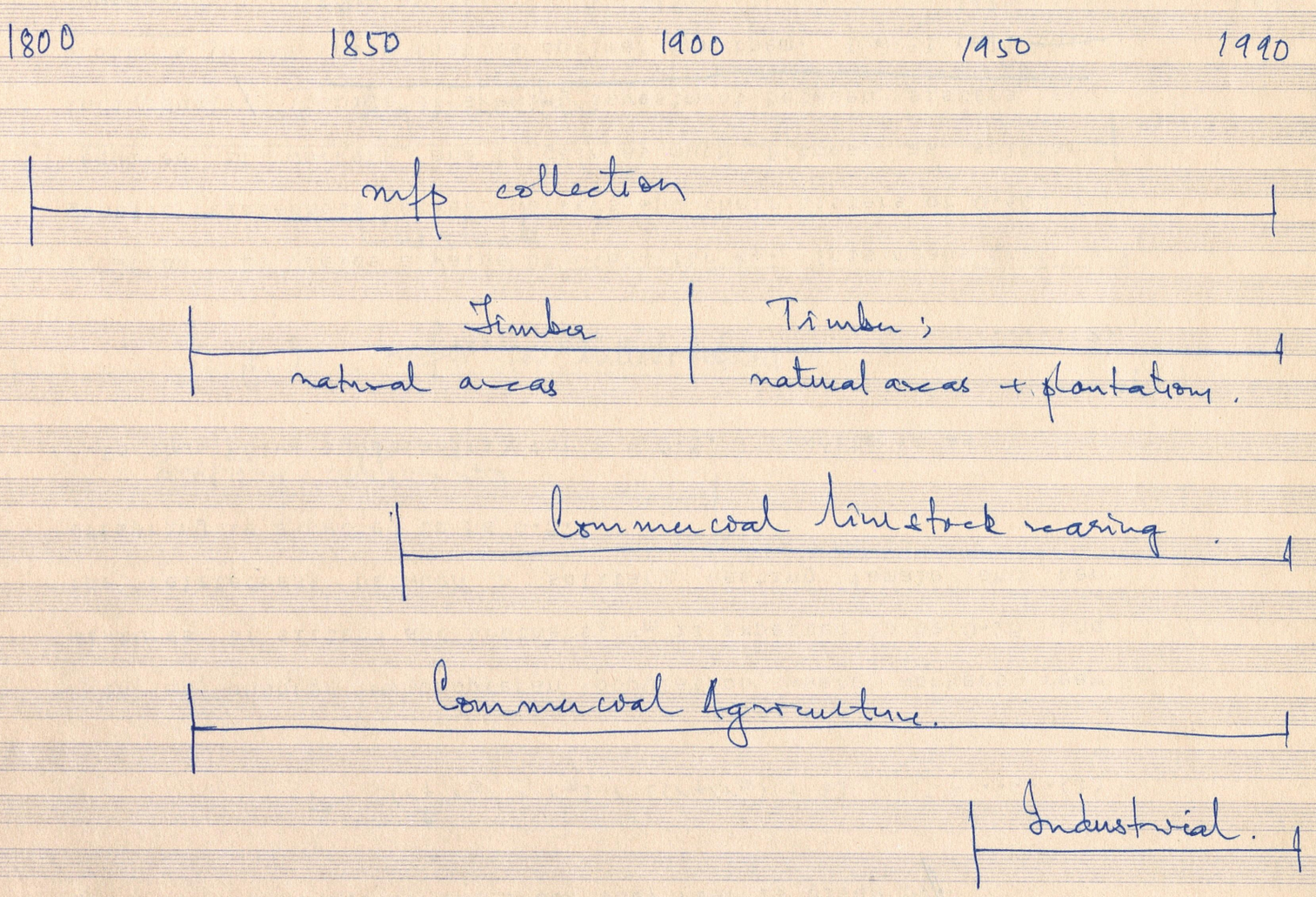
Subsistance human groups increasing due to population increase, and decreasing due to changing over to market-oriented activities as agricultrists & wage labourers

Commercial

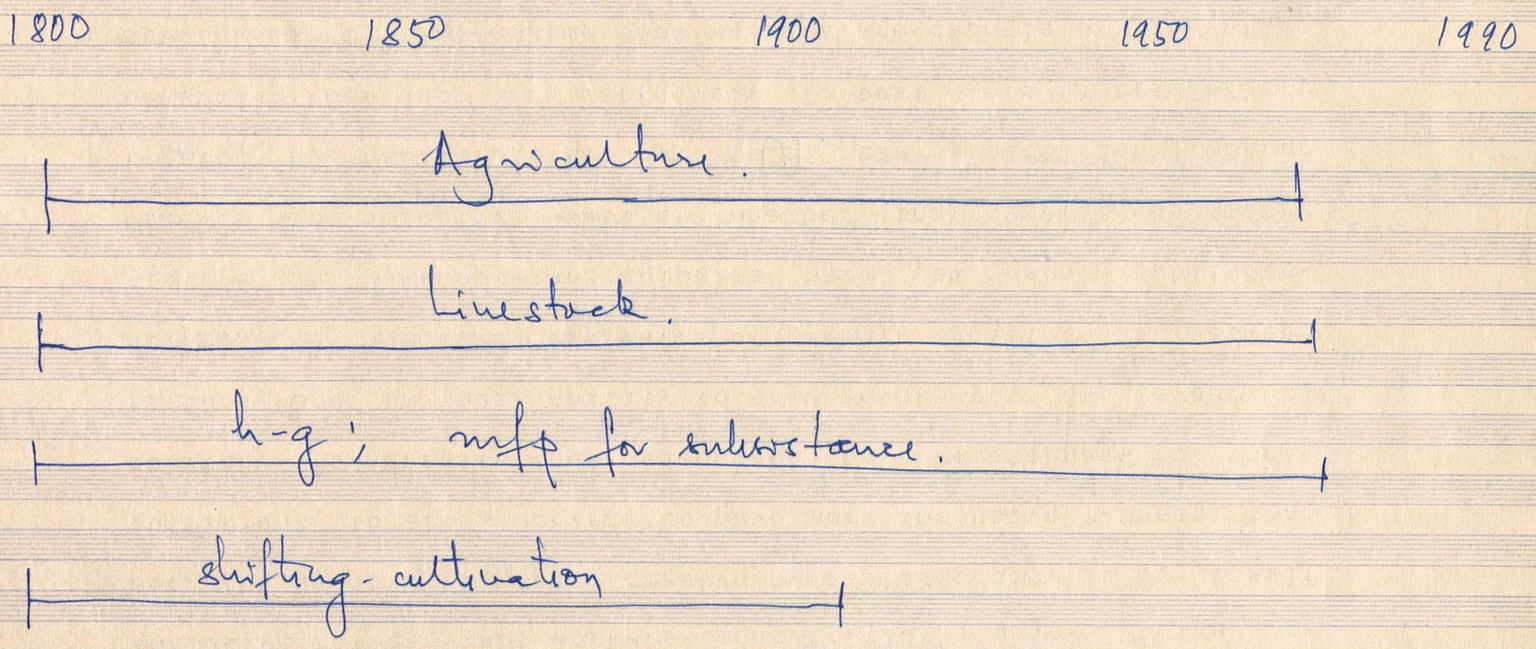


Commercial human groups increasing due to population increase; and recruitment from the subsistance human groups.

Time Scale of Commercial Resource Use Activity.



Time Scale of Subsistance Resource Use



6. Hypothesis of the Study.

Thesis Organization.

5% ① Motivation - understanding how human resource use patterns change over time, role of various forces.

② Value of an area Study - Depth & Linkages.
Thematic.
Linkages & Depth - Area Focus.

10% ③ Setting of Nilgiris. : Physical
Biological
human setting.

④ Methodology of Generating Data.

5% ⑤ Broad Hypothesis. put them down
discuss them in context of other academic work. etc

70% ⑥ Evidences / Biophysical zone / Commercial-subsistance / Resource type / Human communities.

10% ⑦ Patterns that have emerged. How they relate to the broad hypothesis that we start with.

⑧ Prospects.

Hypothesis 1 : Resource use in the Nilgiri area has been increasingly modulated and governed by commercial interests and market forces that are outside the Nilgiri area: However, these ~~have been determined~~ activities have been contrained and determined by the ecological and cultural situation of the Nilgiris area.

Hypothesis 2 : Resource use in the Nilgiri area has followed the pattern of sequential exploitation in the intensity and Spatial domain leading to sustainable resource use in certain cases, or ecological degradation and resource exhaustions in certain other situations.

Hypothesis 3 : Shifts in resource use and exploitation of newer resources have been caused by introduction of new biota; technological innovations; diffusions of innovations; and ~~xxx~~ commercial demands on newer resources.

Hypothesis 4 : Human groups have responded differentially to the the increasing commercial resource use. Purely subsistance culture ~~economy~~ based human communities, have not managed to hold their resource bases and have been reduced to serving commercial interests by providing labour and

not clear!

not clear!

resources for the market. Settled agricultural ~~communities~~ human groups have responded more readily to ~~market~~ commercial interests, and have held their resource base to provide commercial resources for the market.

Hypothesis 5 : Commercial resource use has been accompanied by an influx of human groups; One, providing labour ~~and resources~~ for the commercial exploitation of natural resources; the other, expanding their resource base into the Nilgiri area and subjecting them to commercial exploitation.

Hypothesis 6 : Commercial resource use has thus caused an increase in human population ...

CURRICULUM VITAE

Educational Qualifications:

B.Tech(Civil) 1976 / Bachelor of Technology in Civil Engineering from the Indian Institute of Technology, Madras. 1976. I[st] Class.

M.S. (Bio-medical Engineering) 1980. Master of Science in Bio-medical Engineering from the Indian Institute of Technology, Madras. 1980.
Thesis title: Mathematical Approximations to Auditory Evoked Potentials.

Ph.D. (Ecological Sciences), Doctor of Philosophy in Ecological Sciences, Indian Institute of Science, Bangalore.
Thesis title: Resource Use and Ecological Change: A study of the Nilgiri Area of in Southern India. (To be completed by June 1993)

Publications

* Prabhakar, R. and Madhav Gadgil. (in press) / Maps as Markers of Ecological Change: A case study of the Nilgiri hills of in Southern India. in Ram Guha & David Arnold (ed). South Asia's Changing Environment.

* Prabhakar, R. / A Vegetation Map of the Nilgiri Biosphere Reserve (in preparation) Scale 1:100,000. in collaboration with Institute Francais at Pondicherry.

* Contributed to Nilgiri Biosphere Reserve: An Overview Report. Centre for Ecological Sciences, Technical Report, Indian Institute of Science, Technical Report, 1986.

* Contributed to Nilgiri Biosphere Reserve: A Bibliography. Centre for Ecological Sciences, Indian Institute of Science, Technical Report, 1986

incorporated into the model. Another simplified feature of the model is that s and σ^* are computed by considering the actual

Experience

(6) 1971 - 1986 * Studies on Indian culture, philosophy and traditional health care systems during the period 1971 to 1986. ~~Worked as a~~ Teacher and instructor of traditional health care systems at the Krishnamacharya Yoga Mandiram, Madras from 1976 - 1986.

(5) * 1980 - 1986 Ecological Activism. Imvolved in the Chipko movement in the Tehri Garwal area of Himalayas. ~~Participated~~ Participated in the environmental conservation campaign of the Chipko movement in the Kashmir - Kohima march.

(4) 1980 - 1986 Member of the Madras Group of the ~~People Oriented Science~~ Patriotic and People Oriented Science and Technology (PPST), Madras, a People's Science movement examining the role of traditional Indian science and technology.

Personal Information
Education
Present Position
Academic Award.
1971 * National Science Talent Scheme
1971-1976 * MCM, Merit scholarship at IIT Madras.

(3) 1986 - 1988 : ~~Project~~ As Project Assistant in the project on ~~the~~ A State of the Art of the Nilgiri Biosphere Reserve ~~Programme~~ at the ~~the~~ Centre for Ecological Sciences, Indian Institute of Science, Bangalore.

(1) 1987 - 1992 : ✓ → Field work in the the Nilgiri Biosphere Reserve Area.

(2) 1989 - 91 : ✓ Archival work at the District, State and National Archives.
* Archival work at the Survey of India headquarters at Dehra Dun, and at the Forest Research Institute, Dehra Dun.

relative advantage to a worker will then be correspondingly higher.

(3) 1979-80 : Socio-economic data collection and data analysis of the Cumbum Valley in the Madurai District of Tamilnadu.

(2) 1976-79 : Mathematical Approximations and Signal Processing Methods applied to the model the Auditory Evoked Potentials of the Electro Encheplalo Graph (EEG) signal.

(1) 1976 : Time-series statistical analyses of rainfall data for a 100 year period for the city of Madras in Southern India.

Conferences Attended.

1992. Indo-French Workshop on 'Tropical Forest Ecosystems : Natural functioning and anthropogenic impact. 26-27th November 1992. French Institute, Pondicherry.

1991 National Symposium on Remote Sensing of Environment and Annual Convention of Indian Society of Remote Sensing. Dec 10-12, 1992, Anna University, Madras.

1992 South Asia's Changing Environment. South Asia's Changing Environment. Bellagio, Italy - March

The Rockefeller Foundation, Bellagio Study and Conference Centre, at Villa Serbelloni, Italy. 749th Conference, March 16-20, 1992.

Ropalidia marginata (Lep.) (Hymenoptera: Vespidae).
Anim. Behav. 31, 26-31.

1989-1992 : Satellite Image interpretation and Vegetation and landuse mapping of the Nilgiri Biosphere Reserve area on a scale of 1:100,000 using SPOT and LANDSAT TM imageries.

1991-1992 : Developing a Geographical Information System (GIS) database for the Nilgiri Biosphere Reserve using PC based softwares like IDRISI, ROOTS, MAPBOX, and ARC/INFO.

Membership in Professional Societies.

Life Member of the Indian National Cartographic Association (INCA) Since May 1991.

~~Research Experience~~:

~~Work Experience in the Nilgiris Biosphere Reserve~~

Research Exp.
Work Experience.

Research Experience.

- ✓* GIS.
- ✓* Ecological Field Research — Archival.
- ✓* Satellite Image interpretation
- ✓* Mathematical Approximations
- * Rainfall data analysis.

Work Experience

- * PPST
- * Cumbum
- * KYM.
- * Chipko.

Developing a Geographical Information System data base for the Nilgiris Biosphere Reserve using PC Based softwares IDRISI and ROOTS. The data base includes

* Analysis of the ~~Spatio~~-temporal patterns of resource use and ecological changes in the Nilgiris Biosphere Reserve and Southern Andhra using ~~GIS~~ Geographical Information System ~~software~~ software IDRISI & ROOTS. The data base includes topography, bioclimates and water resources of the area; and a historical time series of archived maps from 1847 to the present giving information on landuse, vegetation, settlement patterns, communications, water resource utilizations and demography of different human groups. This information is analysed for different biophysical zones and ~~data~~ during different historical periods.

will be obtained if there is need for a long and elaborate preparation for reproduction. This could be due to delayed

* Ecological field research in the Nilgiri Biosphere Reserve ~~involving~~ to understand the composition and patterns of distribution of plant communities; ~~and by sampling the vegetation~~ the patterns of resource use of the human groups inhabiting the area and their effect on the ~~ecology of the area~~. vegetation and land use of the area; Reconstruction of the ecological history and resource use changes from historical records and oral history.

* Vegetation and Landuse map of the Nilgiri Biosphere Reserve using Satellite Image interpretation: ~~of the vegetation and landuse of the Nilgiri Biosphere reserve~~. The whole area is divided into eight ~~ecological zones~~ bio-physical zones, and into 64 vegetation type categories based upon compositional, structural and life-form. A set of SPOT and LANDSAT imageries are used ~~to~~ ~~identify the~~ to delineate the vegetation and landuse types after confirming the spectral responses for field surveys. The final map ~~[illegible]~~ is drawn on a scale of 1:100,000.

* Mathematical Approximations to Auditory Evoked Potentials: ~~Ad~~ Auditory Evoked Potentials are extracted from the on going EEG ~~signal~~ record by signal averaging techniques. ~~to~~ The Evoked Potential thus extracted is fitted with a piecewise spline function, the cubic Bezier Polynomial. The ~~placed~~ placement of the splines is optimised by calculating the least square error in each spline segment and automatically splitting the splines to reduce the total error below a specified value.

Work Experience

* A teacher and instructor at the Krishnamacharya Yoga Mandiram. Studies on the Indian culture, ~~and~~ philosophy and traditional health care systems. Using Yoga and traditional health care techniques to help alleviate chronic psycho-somatic disorders.

* Member of the

To NW Visit

Mr B. J. Krishnan,

Suggest

* Mrs Pilgin
* Mr Tarun Chakkma
* Dr. Samraj (?)
* Rev. Fully. Coonoor.
* Prof. Basavalingam
* Palawappan
* Mr. Venugopal.

Mr B.J.K. would identify one or two village resource people

Cl. SNC,

B. J. Krishnan.

72 A, Hancock Rd

Ootty - 643001

phone (R) 2075 / (O) 3082

* Vehicle service.

* Suspension / Shock absorber change

* Break check. / Clean break cylinder.

PD / * A set of ~~background~~ documents for the foresters to be informed

* Zone maps.

* Check areas outside RE : what is our comment.

* Critical areas. - The Zoning gives waste areas.

* Critical areas to be Manipulated.

Watersheds.

52 watersheds. Copy in MWLS office by Agricultural & Engineering or HAPS office document.

Programme on contiguous watershed maps. one by one.

Monitoring.

Field team on watersheds. Included Integrated State Plan.

Gudalur: the Problems.

Revenue Survey of the Gudalur area which will be of real help. This is a critical area. So ~~NBR~~ to be included in NBR. This is essential. Also necessity of an enforcement machinery.

1980. Document: ✓

1 Boundary marking ✓

Scientific Programme ✓

1986. Brosphure Research declaration

Equation (2) yields a value of 0.604 for r_f. This means that a genetic relatedness of 0.604 between workers and their sisters is

Broader thinking.

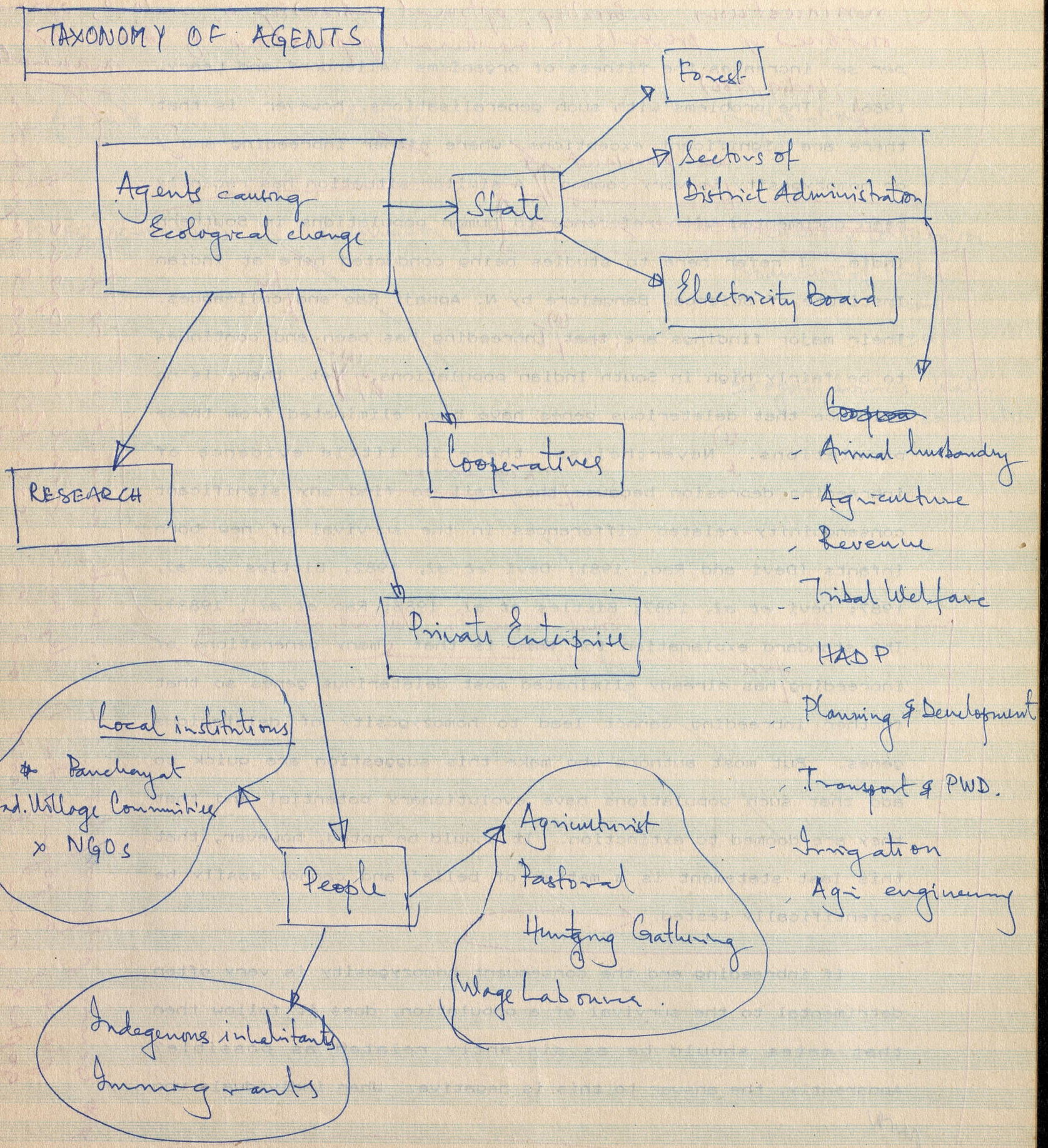
Not to offer advice,

Their suggestions.

Research

have a choice between (i) becoming solitary foundresses or (ii)

TAXONOMY OF AGENTS



Agents	Actions	Implications.
FOREST DEPARTMENT	Reservation of forests.	Biodiversity Conservation Production of timber, wood, NTFPs. Ecological Services: Water conservation

STATE / FOREST DEPARTMENT

Objective Function \ FD.	Reservation of land	Plantations	WLS	Revenue plantations	MFP	Grazing permits	Extraction felling
Biodiversity: Natural	M ✓		✓		✓		X
Husbanded		✓ E					
Biological product.: Natural	R ✓		✓		✓	✓	✓
Husbanded		✓					
Environmental Service: Watershed	✓		✓	✓		X	X
Carbon Seq.		✓		✓		X	X
Economic Service: Subsistence					✓	✓	
Earning		✓	✓	✓	✓	✓	✓
Benifits for larger economy: Legal	✓	✓	·	✓	✓	✓	✓
: Illegal	✓	✓		✓	✓		✓
Involvement.	X	X	X	X	✓	✓	

Reservation of land : 1850 ~ 1910 legal control over land, following settlements & rights & privileges

Plantations : Eucalyptus, Wattle, teak, & miscellaneous.

Wildlife Sanctuaries : Hunting Reserves, Large Mammal Conservation, Habitat, Bio-diversity, Biosphere.

Revenue Plantations : Revenue lands taken up by the forest departments.

MFP : mfp leases, tribal societies, harvesters, and harvest levels.

Enclosures should also be taken into account. Especially in the Coimbatore slopes. Largely remnants of shifting cultivation.

× denote negative impact

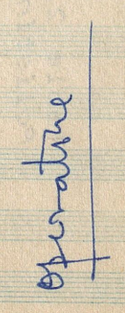
✓ denote +ve impact.

'blank' denote indifferent impact

M : Maintaining

R : Reducing

E : Enhancing



STATE / Electricity Board.

Objective Function \ Actions	Hydro-electric project const.	Hydro-electric power generation	Transmission & Distribution line const.	Servicing & Maintenance
Biodiversity Natural	X		X	X
Husbanded			X	
Biological Productivity Natural	X		X	X
Husbanded			X	
Environmental Services Watershed	X	✓	X	X
C. Sequestering	X		X	
Economic Services Subsistance	X			
Earning	~~X~~ ✓	✓	✓	
Benefits for larger economy: legal	✓	✓	✓	✓
Illegal.	✓		✓	✓
Involvement.	X W		X	X

This sector has very characteristic objectives like Economic services and benefits for the larger economy as energy. They are unmindful of the other objectives, but may be interested in watersheds, to reduce siltation rates.

State / Sectors of District Administration

	Agriculture	Agricultural Engineering	Animal Husbandry	Revenue	HADP	Tribal Welfare
Biodiversity Natural	X		✓	X	✓	
Husbanded	X		✓		✓	
Biological Productivity Natural	X		✓			
Husbanded	✓			✓	✓	
Environmental Services: Watershed	X	✓	X		✓	
C. Seq.	X		X		✓	
Economic Services: Subsistance	✓		✓	✓	✓	✓
Earning	✓	✓	✓	✓	✓	✓
Benifits for larger economy: Legal	✓	✓	✓	✓	✓	✓
Illegal		✓			✓	✓
Involvement.	✓		✓	.	✓/X	✓

Agriculture Sector: more economic, increasing commercialisation, and involving the people in major ways to serve this purpose;

Agricultural Engineering:

insect orders. While some localities are

STATE / Sectors of District Administration

Objective function \ Actions		Planning & Dev	Roads Transport PWD	Irrigation
Biodiversity	Natural		X	X
	Husbanded		X	X
Biological Productivity	Natural			
	Husbanded	✓		✓
Environmental Services :	W/s		X	X
	c/s			X
Economic Services	Subsistence	✓	✓	✓
	Earning	✓	✓	✓
Benifits for larger economy	Legal	✓	✓	✓
	Illegal		✓	✓
Inducement.			✓	✓

Cooperatives / Societies

Objective function		INDCOSERV	NDCMPU	LAMP
Biological diversity	Natural	X	✓	
	Husbanded	X		
Biological productivity	Natural	X	✓	✓
	Husbanded	✓		
Environmental services : W. Shed		X	X	
C. Seq.		✓	X	
Economic Services . Infrastruct			✓	✓
Earning		✓	✓	✓
Benefits for larger economy : Legal		✓	✓	✓
Illegal				
Involvement.		✓	✓	✓

PRIVATE ENTERPRISE.

Objective function \ Actions		Tea/Coffee plantation	Industry
Biological Diversity	Natural	X	X
	Husbanded		
Biological Productivity	Natural		X
	Husbanded	✓	X
Environmental services	W. shed	X	X
	C. seq.	✓	
Economic services	Subsistance		
	Earning	✓	✓
Benefits for larger economy	legal	✓	✓
	Illegal		
Inducement		✓	

dies even a few days before her first offspring reach the age of

PEOPLE

	Hunting gathering	Pastoral	Agri	Wage labour	Immigrant Encroach	Agri Encroach	NGO Propaganda	NGO Monitoring	NGO Development
Biological Diversity Natural	✓	✓	X		X	X	✓	✓	
Husbanded			✓		X	✓			✓
Biological Productivity Natural	✓	✓	X		X		✓	✓	
Husbanded			✓			✓			✓
Environmental Services w/s			X		X	X	✓	✓	X
c/s					X		✓	✓	
Economic Services Subsistence	✓	✓	✓	✓		✓			✓
Earning			✓			✓			✓
Benefits for larger economy legal		✓	✓	✓	✓				✓
Illegal									
Inducement	✓	✓	✓		✓	✓	✓	✓	✓

would break even in spite of solitary foundresses being capable

Thesis Chapters

1. Introduction:

1.1 Motivation for the Study

1.2 A Historical and Area Study

1.3 The Academic background for the study

2. The Setting

Map 2.1 The Nilgiri area and the bio-physical zones

2.2 : ~~The cultural landscape of~~ Climate

2.3 : Vegetation & Fauna

2.4 : The cultural landscape of the bio-physical zones.

Interchange with (4)

3. Methodology and Generating data: (Add diverse data bases needed for Ecological History + patterns etc of data)

3.1 Vegetation and Landuse mapping using Satellite imageries either in begin/end.

Map 3.1.1 Vegetation sampling for ground truth verification and diversity estimates.

3.2 Habitation survey Schedule, and its data components

Map (parameters)

3.3 Oral Histories and their value at reconstruction. (Don Vansina)

3.3.1. A culture-wise, bio-physical zone-wise summary ~~inventory~~ with persons and dates (Appendix)

3.4 Historical documents

3.4.1 Forest Working plans, Gazetteers, Ethnographic notes/accounts, scholarly works, Census, etc.

3.4.2. ~~Maps~~ Historical Maps

Interchange with (3)

4. Framework & Hypothesis.

4.1. The interplay of resources, environment, and culture of human groups

4.2. The parameters of resources, environment, and culture

4.3. The subsistence - commercial dichotomy.

4.4. The major hypothesis of the study.

4.4.1: ~~Inc~~ Monotonic increase in commercial

4.4.2: Sequential exploitation.

4.4.3: Resource Exhaustions and Shifts

4.4.1: Assumptions → Ecology determines Resource use
→ Ecology, Resources & History influence Culture

subsistence and expansion in resource use with popln growth

Commodification and continual expansion of resource use without popln growth

4.4.4 Response of human groups & demography

4.4.5. Concommittal ecological changes.

5. Evidences and Experiences.

5.1. The Nilgiri plateau : Resource, Ecology and Culture

5.2. The Sigur plateau : Resource, Ecology and Culture

5.3. The Nilgiri-Wynaad plateau : — do —

5.4. The Attappadi plateau. : — do —

5.5. The Coimbatore plains. — do —

6. The Broader Patterns

6.1 Patterns unilaterally seen.

6.2. Patterns by the comparative method

6.3. Spatial & Geographical patterns

6.4. Conformations ~~& Rejections~~ with hypothesis.

themselves did. This makes the head start hypothesis appear 3 to
12 times "stronger" than ...

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themselves did. This makes the head start hypothesis appear 3 to 12 times "stronger" than the haplodiploidy h

these species to be equal to 0.03, 0.09, 0.05 and 0.08, respectively. Presenting the same results in another, perhaps

7.0 Conclusions of the Study

8.0 Epilouge : 8.1 Conservation initiative.
8.2 Land & Resource use
8.3 Conflicts & Cooperations.
8.4 Prospects.

~~9.~~ Bibliography & References.

Glossary of terms used

Appendix 1 : Cartographic Data Base

: Maps of the area.

: Schedule for Habitation Survey

: Schedule for Vegetation Survey

: Satellite images used

: Schedule and Checklist for Oral Histories.

: List of Oral Histories.

: Legend of Vegetation & Land use map.

Queller (1989) has rewritten inequality (1) as

The subsistance / commercial dichotomy and human groups.

A study of Nilgiri area is used to understand the relationships between subsistance and commercial resource use ; and human groups, their culture and demography. Over the historical period, there has been a greater and greater commodification of natural resources. This has lead to increasing the population, mainly by way of immigrants that are themselves ecological or political refugees of another area. The earlier indegenous populations were on a subsistance life style, with minimum biological needs, whose per capita consumption does not change. Thus any greater demand on the environment is mainly by a change in population.

The Commercial resource exploitation would

have no relation with population changes, and by way of immigration
~~immigrant~~ populations have increased to facilitate
commercial expansion and commodifcation of natural resources.*

In the Nilgiri area, this is evidenced by the
the commodification of natural resources by Tea, and coffee Electricity,
vegetable cropping, and services for the commercial sectors.
These changes have been marked by increases in population,
mainly by immigrants from the Tamil plains, ~~and the~~
Mysore region, Srilankan, and people from ~~Kerala~~. Southern
Kerala.

The indegenous subsistance groups; agriculturists,
shifting cultivators, gathering and pastoral ~~in the~~
present in the Nilgiri area have responded varying to
commodification. The agricultural groups have changed to
~~are linked to the~~
~~market by~~ commodity production of Tea, and coffee, and vegetables.

* With the case study of the Nilgiri area, these consequences of commercialisation and commodifcation of natural resources are 'teased out' and environment changes evaluated.

(***(This increased population, induced by commodification have made increased demands on subsistance natural resources like)*

FIGURE 2

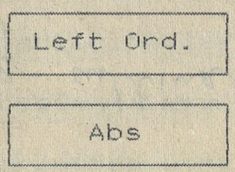


FIGURE 2. Survivorship curves for *R.marginata* females under field (solid line) and laboratory (broken line) conditions. The field survivorship curve was obtained by fitting the hazard function given by Hjorth (1980) to census data so that $l_t = [exp(-\delta t^2/2)] / (1+\beta t)^{\theta/\beta}$ where l_t is the probability of surviving to the age t and β, θ and δ are constants with values of 1.0×10^{-5}, 2.8281×10^{-2} and 1.8480×10^{-4} respectively. The laboratory survivorship curve was obtained by fitting a quadratic model given by Bain (1978) to census data so that $l_t = exp[-(at + bt^2/2 + ct^3/3)]$ where a, b and c are constants with values of 9.8973×10^{-3}, -1.2204×10^{-4} and 6.984×10^{-7} respectively.

FIGURE 3

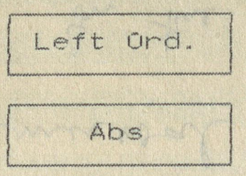


FIGURE 3. The *m.n* plot. Contour lines are shown in the parameter space of day-to-day probability of survival (m) and the brood developmental period (n) that separate the regions (i) where there is no advantage of assured fitness returns ($b/\beta^* < 1.0$)

FIGURE 3. The *m.n* plot. Contour lines are shown in the parameter space of day-to-day probability of survival (*m*) and the brood developmental period (*n*) that separate the regions (i) where

While the other groups have turned to wage labour or continue their subsistance gathering at a lower scale.

δ * (On Resources : Subsistance resource use has been steadily increasing with increasing populations, mainly in

** the area of fuelwood, fodder, structural material and water. These have caused, in many pockets of the Nilgiri resource depletions and degradation of the environment.

The commercial resource demands have shown no concern for long-term sustainability, and have followed the trajectory of sequential exploitation causing ~~exhaustion~~ ~~xx~~ resource exhaustions leading to shifts in resource use. In the Nilgiri evidences of

longer than n days because we are considering only one synchronously produced batch of brood. This is the reason for the flat portion of the curves beyond n.

such shifs are plenty; with ~~[illegible]~~ structural wood, coffee, vegetable crops, tea, etc. all having undergone simmular trajectories.

populations : (3) Subsistance ✓

Commodity productions ✓

populations demands. ✓ Consumer populations. driving resource export

→ immigration.

↓

pull for population to come into

Commo

Nitigins thus increasing subsistance demands.

Pushes into this area.

Interactions covering natural resource base.

Need for population needed for commodification

(4) Large scale demands

(1) Growth of ind. populatio ✓

(2) Immigration driving by population pr. elsewhere

→ (3) pull - need for commodification.

→ (4) Demand for com. being exported.

Resource Use & Ecological Change: A Case Study of the Nilgiri Area in Southern India.

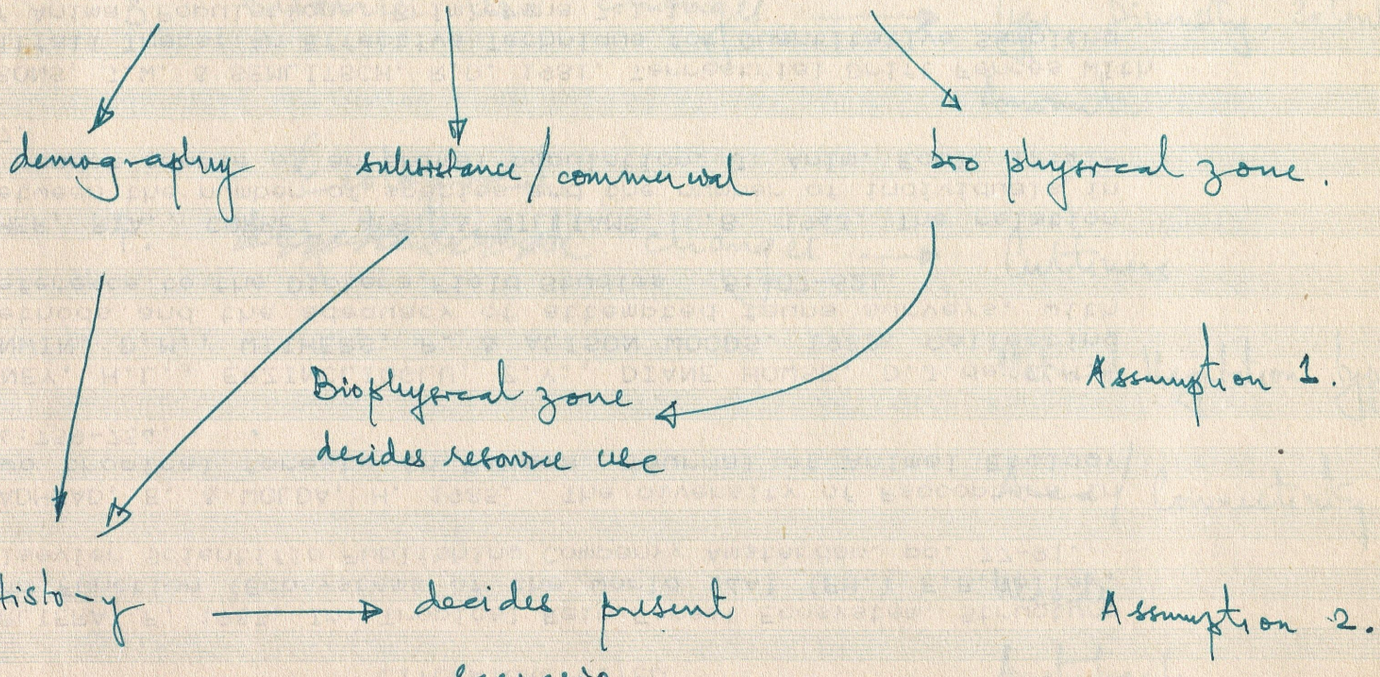
Summary:

Resource Use

Chapters of the Thesis.

Relation between humans and environment

The culture - resource - environment



LEVINGS, S.C. 1983. Seasonal, annual, and among-site variation in the ground ant community of a deciduous tropical forest: Some causes of patchy species distributions. Ecological Monographs 53:435-455.

Hypothesis:

1. Commercialisation has increased over the historical period.

Consequently,

2.

3.

2. Demographical changes → four factors

3. Resource Use changes → Type, Diversity, Extent
Amount.

4. Ecological changes → Cultivars
Natural Vegetation types
Area / Connectivity
Weeds
Artifacts

requirements, I repeat the foregoing analysis using survivorship data from an experiment in which freshly eclosed females were

"The time for the closed mind in biology is finished"

Peter Slefan.

"Consistency is the last refuge of the unimaginative"

Oscar Wilde.

P. M. Bodmer & D.A. Humphries. Protean Behaviour : The Biology of Unpredictability. Oxford Science Publications, Oxford 1988. ISBN 0-19-857170-4. pages xv + 339. (Bibliotech Connect Ltd, Bangalore)

Thesis size

~~250 w/page~~ ~~30~~ × 7 = 210 w/pg

210
× 200
~~4~~ 40,00 00

50,000 words ≈ 250 pages ~ 275 pages

200

+ Contents,
Appendix
References } 50 pages.

800 ~ 325 pages

Chapter (5) : Experiences & Evidences.

Introduction to the Chapter.

Attappadi P

Orientation of Broad Patterns -

2 Para

Spelt-out & Documented with fig - graph maps

Summary

Nilam P

Brief Statement on Current and Future Research/Work goals.

March 1993, Bangalore

My entry point to my current study is through an interest in conservation of culture & nature. The ~~[illegible]~~ motivation for this study is ~~[illegible]~~ to understand the relationships between natural systems on the one hand and human culture on the other. I have attempted to understand this through a framework of Ecology and Culture mediated by Resources and Resource Use. Each of these are detailed by various metric & non-metric parameters.

I have studied these in a spatial and temporal domain; the Nilgiri area of Southern India during the period 1800 - to the present.* ~~[illegible]~~ ~~[illegible]~~ The last 200 year human history has been very intervential in the ecological processess. And

my study would help understand the processes and reasons for our present ~~p~~ ecological ~~predicament~~ ~~sta~~ situation. *

During the course of this study, I have done done extensive field work in the Nilgiri area ~~over the past since 1988~~ during the period 1988 to 1993. I have a rich collection of and village surveys ~~and~~ oral histories to help me reconstruct the ~~ecology~~ environment, ~~and~~ resource use, and culture of the area. (**)

* ~~[illegible]~~ Due to the complex and ~~interrelated natur~~ dynamical ~~nature of~~ relationships between environment & human culture, which is more in the nature of a dialouge, a specific area study would yield more insights into the processes involved. The study ~~would thus have~~ has two major objectives, ~~[illegible]~~ (a) a theoretical objective: to generalise the relationship between natural

repeat the analysis for data on *R. marginata* without using the entire survivorship data. Instead, I use the probability of

resources, its commercialisation and intensification with ecological change and human culture. And (b) a conservation objective: to provide a scientific basis for endure strategies for conservation of biological & cultural diversity & sustainable development for the Nilgiri Biosphere Reserve Programme. This is an ongoing programme of the Department of Environment & Forests, Government of India since 1986, under the initiative of the Man and the Biosphere Programme (MAB) of UNESCO.

(**) Further, I have extensively used a Geographical Data base with details of land use, vegetation, settlement patterns, communications, water resources and access regimes from the historical maps of the Surveys of India & Revenue Surveys from 1847 to the present, as well as satellite imageries and its interpretation for the current land use & vegetation patterns. And finally, the Nilgiri area has an

exceptionally rich amount of academic work especially on enthnography, ~~and ecology~~, climate and ~~ecology~~ vegetation, that an ecological & cultural synthesis could be ~~also~~ fruitfully attempted for this area.

Given ~~such an extensive~~ this data base, and a comprehensive framework to understand ~~ecological change~~, ~~[illegible]~~ relationships between ~~culture~~ human culture, ~~ec~~ resource use and ecology~~[illegible]~~, one of the themes of my study is demographic changes with changes in resource use. Natural resources ~~[illegible]~~ during the historical period has been increasing commercialised. This has gone on sequentially ~~from~~ causing over exploitation, exhaustions and resource shifts to other natural resources. The demographic correlates of this is an increasing population caused mainly by migrations of human groups into the area.

One of my aims will be to formalise and model this relationship with parameters of Ecology, Resource Use, and human culture.

~~(xx) This has intern~~ has ~~caused ecological degration~~,

THE HEAD START HYPOTHESIS

Queller (1989) has rewritten inequality (1) as

1/1/93	Telephone	44.00
2/1/93	Petrol	548.40
	Cassettes	432.00
		41.00
	Film	1,050.00
	Vehicle Rep	857.15
		2,972.55
	Transport	22.00
		2,994.55

NBR – Mid-term appraisal

- Biodiversity — Natural / Husbanded
- Biological productivity — Natural / Husbanded
- Environmental services — Watershed; C sequestration

~~subsistence~~

Economic services — Subsistence / Earning — Local people ~~poor~~ ~~elite~~

~~Benefits for larger economy~~

~~Dignity for people~~

Involvement

Outsiders:
- Legitimate
- misappropriation

Maintaining / Restoring / Enhancing } short, long term sustainability

Intersectoral linkages

Productivity
Sustainability
Equity

List Activities

Harvesting,
Planting,
Protecting

Recreation

Encroachment

Forest, other state agencies,
Industry, Peasants,
Tribals etc.

Agents

Agents Actions Implications

NBR – Mod. term appraisal

- Biodiversity < Natural / Husbanded
- Biological productivity < Natural / Husbanded
- Environmental services – Watershed – C segrestation

~~subsistence~~

Economic services < Subsistence / Earning } Local people / ~~for~~ elite

- Benefits for larger economy

~~Dignity for people~~ Involvement

Outsiders: Legitimate / misappropriation

Maintaing / Restaing / Enhancing } short, long term sustainability

Intersectoral linkages

Productivity
Sustainability
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List Activities

Harvesting,
Planting,
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Recreation

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Forest, other state agencies,
Industry, Peasants,
Tribals etc.

Agents

Agents Actions Implications

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8888888888
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Thesis (4)

Chapter 5: Evidences & Experiences

The Sigur Plateau

1/3/93

Each Biophysical zone:

- Describe the Zone
  - Main features / Summary / Hypotheses etc.
- Spell out & Detail the process with
  - Maps
  - Figures
  - Tables etc.
- Conclude the B.P Zone.

Chapter 5: Evidences & Experiences:

5.1. Introduction
5.2. The Nilgiri Plateau → Describe the zone 2 paras
→ What ~~do~~ are the main processes 2 paras. } 2 pg
→ Details with Maps, Figures, Tables etc. } 6 pg
→ Conclude the main points. } ½ pg.
5.3. The Anaimalai Plateau

(18 × 6 = 60 pages)

5.1 Introduction: In this chapter ~~we spell out & detail~~ the environmental history of each of the biophysical zones of the Nilgiri area, is spelt out & detailed from the prespective of an interplay between Resources, Environment & Culture. ~~is spelt out & detailed~~. Based upon the topography and climate ~~of~~ the Nilgiri area, ~~the six~~ is divided into six biophysical zones that form geographic units in which human culture and their resource use patterns have ~~shape~~ interacted in a complex nature ~~and~~ to shape ~~the~~ the landscape of each of the biophysical zones. ~~Because of~~ Given this complex and interrelated interactions between ~~the~~ the elements of ~~&~~ Resource, Environment and Culture, ~~in each biophysical zone~~, we propose and ~~to~~ outline the main processes in each of the biophysical zones and substantiate them by detailing the environmental history of each zone.

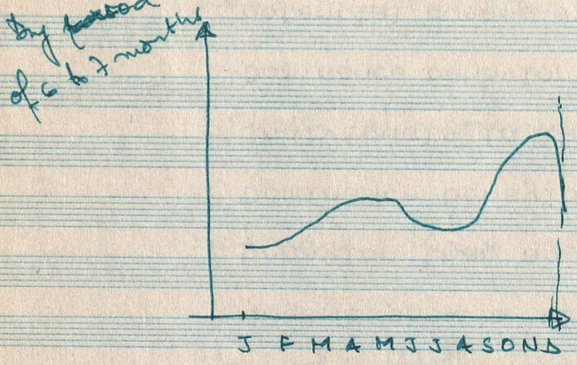
Relate it to framework & hypothesis add 1 para

The Sigur Plateau :

The Sigur Plateau, ~~is~~ situated north of the Nilgiri plateau is a part of the Mysore plateau of Southern India. However it is seperated from the Mysore plateau by the Moyar gorge, 300 m deep which is a geological fault as a consequence of block upliftment of the Nilgiri plateau in the Late Jurassic period i.e 160 ~ 210 million years ago. The Sigur Plateau ~~It~~ has an average elevation of 900 m, with the highest point being 1266 m. ~~The Sigur plateau~~ It is bounded by the Moyar gorge in the north, the Moyar river towards the east, the Nilgiri plateau rising steeply to 1800 m in the South, and the steep descent to the ~~[illegible]~~ Moyar Valley of the Coimatore Plains in the east. (~~Map~~ Biophysical Map)

The Sigur Plateau is watered by five major streams, originating in the Nilgiri plateau and flowing

into the Moyar river. They are the Moyar River, the Anarahalla, the Bogur River, the Kedarhalla, and the Gundathihalla. (Physical Map of the Bogur Plateau). Being in the rainshadow area of the monsoonal winds, it receives a part of the western portions receive a part of the spillover monsoonal rains, while the other areas of the plateau receive their rains mainly during the September-December period.



The average annual rainfall of the Bogur plateau ranges from 900 mm in the western portions to 500 mm in the eastern portions of the plateau. (Map - Bro climates).

The vegetation of the plateau varies from the typical Dry deciduous forests of Southern India to Dense scrub with a Savanna structure. The streams originating in higher rainfall areas and passing through this plateau

increase the soil moisture along the stream sides, giving rise to dense riparian forests along all the major streams in the area. Traditionally known as pānkadu, the area would conjour an image of scrub woodlands with pockets of cultivation and a population of demonstrated herbivores and ~~grazing animals~~. mammalian wild life.

The Sigur Plateau, being a low rainfall marginal land with poor soils, and a low population density, the process of commercialisation and intensification to enhance direct resource flows would be slower and later in the historical period. With limitations on agricultural expansion because of ~~low pop~~ limited ~~area of~~ water availability, and low population density, it would mainly be subsistance agriculture confined to the favourable sites on the plateau. But given the ecological conditions, vegetation with large tracts of savanna woodlands, and a low population density, it would

be ideal for commercialisation of pastoral activity, provided there would be convenient access to markets. Further, the highly malarial disease environment of the Sigur plateau and the recreational elite interests of shikar and game that was plentiful in the ~~Sigur~~ area were important factors in dictating the process of commercialisation of the Sigur plateau.

The Sigur plateau came into the possession of the East India Company after a prolonged and harassing battle with Tippu Sultan in 1799. Situated at the trijunction of the Mysore plateau, the Coimbatore Plains and the Nilgiri Wynaad, it was an important communication route in peninsular India (ref. map of 1822). Even the occasional routes to the Nilgiri plateau were from the edge of this area. Tippu Sultan had established Garrisons and

Forts ~~in this area~~, and ~~the~~ had laid out ~~a~~ many routes into and out of the area. (Ref. SOI, OH, field work, map). Our first contemporary documentary evidences of the Bigur plateau is after it came into the possessions of the East India Company. The early maps of the area, indicate perennial streams, many abandoned settlement sites and a few agricultural communities ~~in~~ ~~the~~ dotting the landscape. The area is noted as with pockets of dense jungle rich in sandal wood, and other forest trees. It shows rich drainage with dense riverine forests all over the lanscape.

The Archeological landscape of the area is rich with dolmens, menhers, cairns, and hero stones which show a long presence of human groups from the Neolithic ~~buff~~ cattle keepers, the buffalo cult, hunting-gatherers, and shifting-cultivators, and the coming in

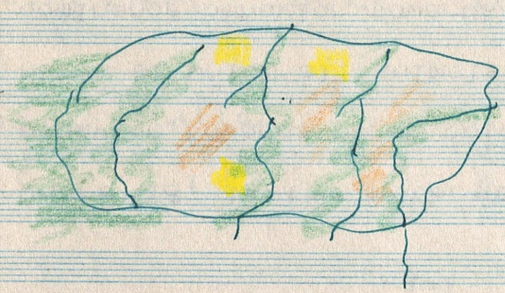
of settled agriculture. These cultural influences on the landscape would have come up from the Coimbatore plains, along the rivervalligs of the ~~Coram~~ Cauvery delta ~~plains~~; and ~~fro~~ later from the Mysore plateau. By the 1600s it was much more in cultural and political contact ~~and administration~~ with ~~from~~ the Mysore plateau.

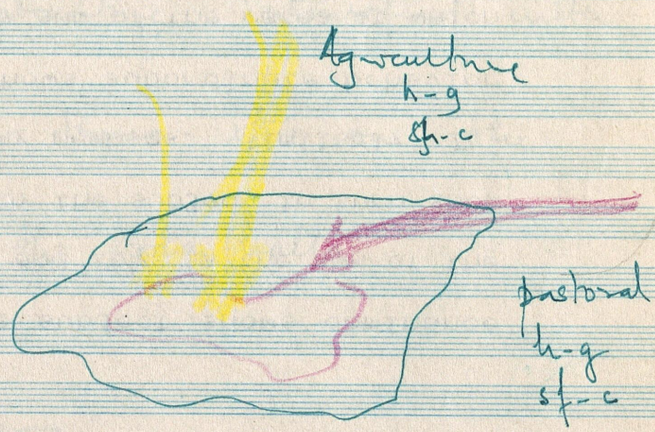
Add Iron & Steel industry

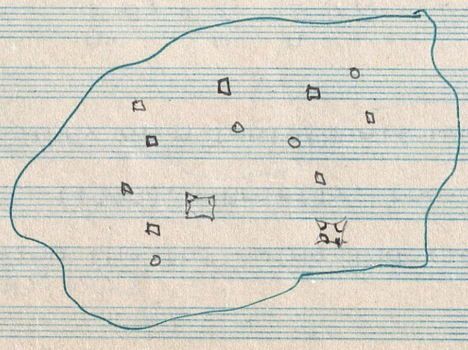
Kingdoms Epigraphy

Peasant State Temples

(Ref. Gigg...)

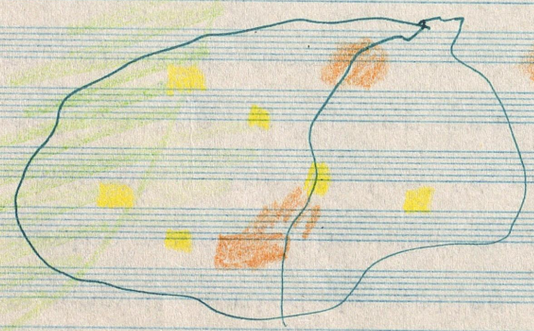






Hero Stones
Dolmens
Cairns
Forts

When the Sigur plateau came into the possessions of the British East India Company, the area had 4 villages of subsistance Agriculture communities, growing a variety of millets & pulses, and a significant hunting-gathering population of the Todas and Jain Kurumbas. The area has suggestive archaeological and oral history artifact/evidences to suggest a larger settled agriculture, intensified with irrigation works at two or three sites on the Sigur Plateau, mainly along the Kedar halla.



Intensive agriculture sites - abandoned

Subsistance dry land agriculture sites.

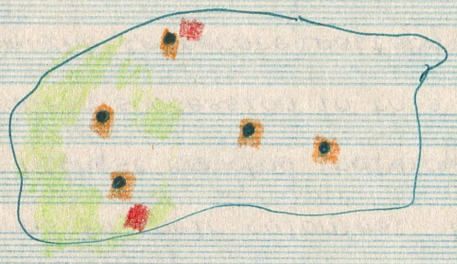
Hunting - Gathering
Shifting - Cultivation.

The British, seeing abandoned villages and a run-down landscape of a once prosperous area, attempted to integrate it with the Imperial State by commercialisation. The collapse of these agricultural communities could have been due to the prolonged battles between Tippu Sultan and the British; or could have been due to a natural calamity of unfavourable weather or epidemics and a changed disease environment. The British attempted to revive agricultural production in this area. By 1850s an Agricultural Station was established at Anaikatti and trials were made with horse drawn agriculture with crops like cotton & tobacco as cash crops. [OH .....]. These attempts at commercialisation of the landscape failed because of the low population density with few human groups culturally inclined towards commercial agriculture, an unfavourable disease

environment, and ~~a~~ political compulsions of mutiny and famine that subsequently followed.

The Irulas continued their subsistance agriculture in conjunction with ~~[illegible]~~ food gathering and livestock rearing in 5 settled villages in the area, Sirur, Anaikatti, Doddalingi, Masinagudi and Moyar. Each of these were well settled villages with an artifact continuum from Neolithic remains, and hero stones, to temples and irrigation works. It is however not clear if the Irulas were the long-term occupants of each of these settlements. In addition the area had other ~~g~~ human groups like the Jain Kurumbas practising shifting-cultivation and gathering, moving settlements from place to place. ~~and~~ They are confined to the western portions of Sigur plateau ~~&~~ the Nilgiri-Wynaad, ~~and the There were also other groups of settled~~ with 10 or 20 families living together and moving in gathering bands from place to place [OH . . . . .]. There were

also other human groups that were later immigrants into the areas like Kurumba Gowders, ~~the Boyans~~ agriculturists confined to the Moyar village, the Boyan, stone workers, and the Badagas, agriculturists from the Nilgiri plateau.



Irula agricultural villages.

Jain Kurumba areas.

Later immigrants
Badagas & Kurumba Gowders.

The Colonial attempt at increasing agricultural production for markets having failed, coffee ~~and~~ estates through private enterprise was started at favourable sites along the foot hills of the Nilgiri hills. By the 1900s, these estates ~~were well established and~~ ~~con~~ however small & limited in extent were well established. The total area covered by such estates was ..... (Refer 802 1908?, 58A/00)

The 19th century was also a period of significant ecological change. Along with attempts at integrating the area with the imperial state by commercial production, a lot of ~~exotic~~ exotic biota was introduced into the area. In addition to crop varieties of cotton, tobacco and coffee, weeds like Opuntia or the prickly pear and lantana both of South American origin were released into the area and proliferated weedily. In fact the Opuntia & the Prickly Pear fruit got integrated with culture of the gathering groups and the ~~Kaurumbas~~ & Irulas cultivators / as a source of food that even stood them out during periods of ~~famine~~ scarcity. The Europeans saw it as a weed that hampered growth of the indegenous Sandal fauna that was exhausted by over exploitation through the contract system during this period.

By 1900s, after debates on Forest Reservations, the Forest Law 1882 was passed and became effective in the Sigur plateau by the declaration of Sigur RF., Anarahalla R.F. Singara RF, and Bokkapuram RF. (ref. ------) comprising a total area of ------. that were excluded from local use. ~~with people~~ The human groups I, K, B, S and estates were confined within revenue areas.

The population of Irulas and Kurumbas have essentially remained the same, or may have even decreased because of restrictions on access to resources, and changes caused by export of resources out of the area.

While establishing state control over resources, it encouraged commercialisation of its resources by timber and minor forest produce. It also encouraged ~~the~~

commercialisation with pastoralism in an indirect way. The Badagas on the northern fringes of the Nilgiri plateau, started keeping herds of cattle in pattis ~~or~~ pens on the Sigur Plateau.* These were seasonal and also employed the Irula ~~comm~~ group to tend their cattle. They ~~would~~ had access to markets in Ooty to export Ghee from the area. Estimates of the number of such pattis in the past (SOI... 1950s) and the present (map...), and the cattle population can be made.

* The State derived revenue from them by the FD charging grazing & penning fees at ..... (gone figures).

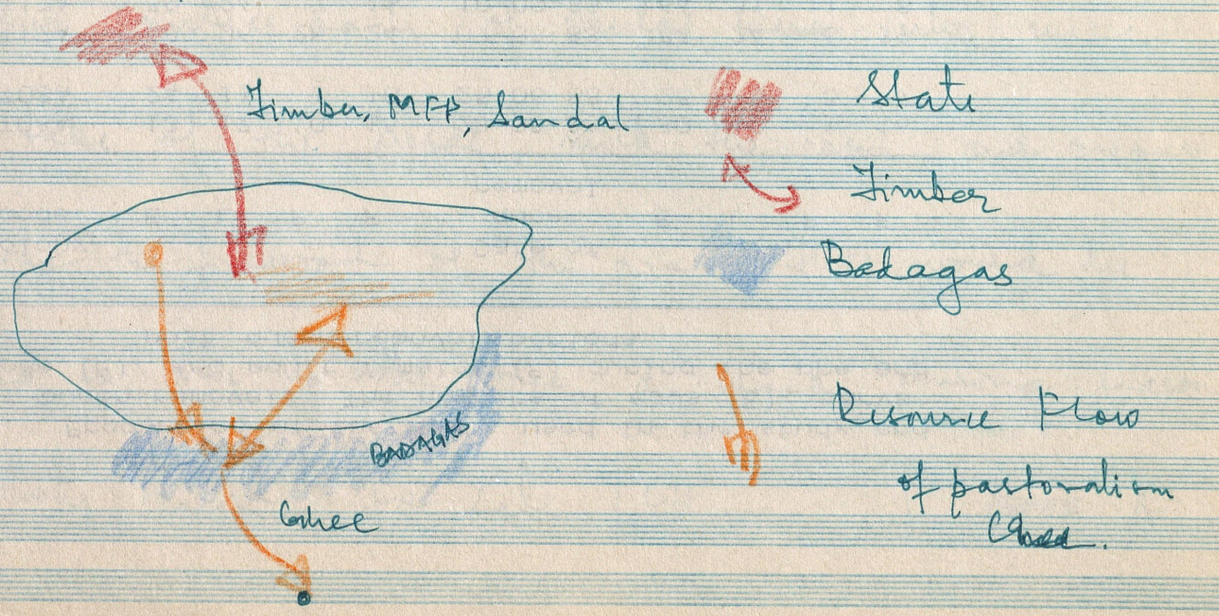
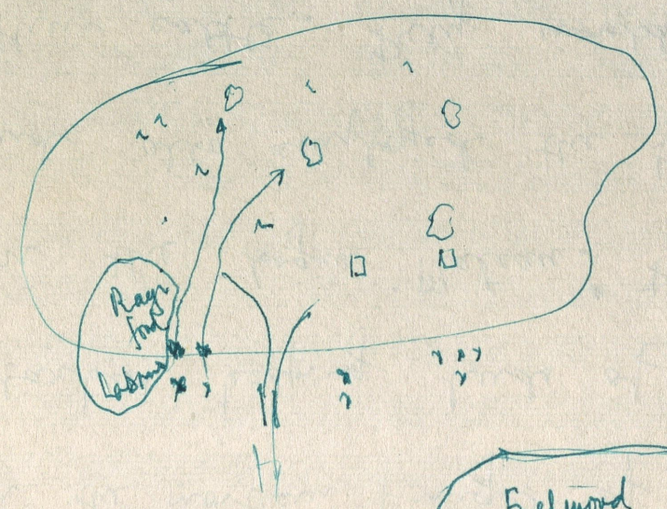


Table I. ~~Properties of the~~ Nests used in the study and dates of queen removal. The numbers of eggs (E), Larvae (L), Pupae (P), and adult females (F) during the pre and post queen-removal periods.

Expt. no.	Colony code	E	L	P	F	Date of queen removal	E	L	P	F
1	T08A	13	17	10	15	28-05-88	30	12	1	16
2	T08A	24	11	1	10	25-06-88	25	5	3	7
4	T17A	48	26	26	24	07-08-88	73	24	6	19
5	T17A	59	24	7	16	10-09-88	64	31	11	8
6	T18A	51	20	11	14	09-10-88	44	33	11	14
7	T18A	40	34	19	18	05-11-88	57	39	24	30
10	T18A	67	37	10	29	02-01-89	74	30	11	24
11	T18A	37	38	25	22	29-01-89	44	40	21	38
8	T22A	35	36	10	30	03-12-88	46	40	16	27
9a	T22A	41	36	21	24	23-12-88	38	24	32	33
9b	T22A	49	17	23	41	14-01-89	46	31	6	40
12	T22A	28	51	6	37	12-02-89	35	41	20	35



Fuelwood C
Graze C
Fuelwood S
Gathering S
~~Hunting~~ S

Inulas

Badagas

Cattle / Buffaloes.

Fuelwood
Grazing

Ecological elements
degrading / -
Sequentially

The Todas, a pastoral group confined to the upper Nilgiris had their presence in the Sigur plateau ~~[illegible]~~ at Bokkapuram (Kel Mund, Nadumand & Melmand ... OH) along with the Badagas of the Nilgiri hills.

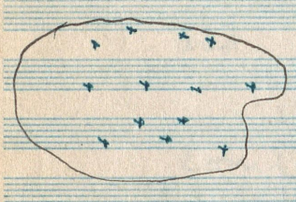
There were commonalities ~~among the different~~ ~~[illegible]~~ in the culture of this pastoral activity.* A few ~~[illegible]~~ Badaga agriculturists of the Ebanaad, Chinnakunoor, and Sholur area kept herds of cattle and buffalo on the Sigur plateau, employing one or two families each of Irulas ~~were~~ who were to care take of the herds, milk the cows, and prepare ghee using the firewood of the area. This would be transported in tins ~~to the~~ once a week during seasons to the Ooty market for sale. [OH ....]. ~~[illegible]~~ A

* They shared notions of the sacred site and salal for curing the produce & extracting ghee for sale.

few families of these Badagas came to even settle on the Sigur plateau (5 to 6 families) while the others operated from their villages on the Nilgiris Plateau. The Irulas derived subsistance in the form of ~~the~~ ~~[illegible]~~ supplies of grain (Ragi etc etc) or as wages. In addition they derived ~~additional~~ food from the occasional hunts ~~of~~, scavenges and gatherings from the surrounding forests. They had ampleful & excessive amounts of butter milk, a good source of nutrients which was a by product of Ghee making. (OH) ....).

The Badagas, had interest as agriculturists in addition to their commercial pastoral activity. While traditional agriculture on the hills was seasonal, with two growing seasons and a fallow period and

while grazing lands were available & plentiful, the herds of cattle would be driven up during the dry and agricultural period and driven down for graze during the rainy season. While in the village, they provided draught power for ~~plow~~ ploughing and organic manure for their fields.



Pastoral activity itself may have been a very stable and sustainable operation with seasonal movements and cattle penning sites distributed all over the larger plateau along the perennial streams that was plentiful in the area. Oral histories recollect a larger livestock population. Of accounts large areas of savanna grasslands in this area, and lesser scrub and thorny vegetation. [OH .....]

Agriculture on the Begur plateau was purely subsistance secondary activity during this period. It had even decreased ~~over this perio~~ over this period, being confined the villages ~~to~~ Begur, Anaikatti, Doddahingi, ~~and~~ Gurunegujjanahundi (later called Hoyar), and Mattnagudi. While the first 3 were Irula villages, Gurunegujjanahundi and Mattnagudi were villages of later settlers, comprising of Kurumba Gowdars, Boyars etc. who had migrated from the ~~Kanara~~ Mysore area. (Refer to map of distribution of human communities in ~~Kabbe~~ N / and on the Begur Plateau)

By the reservation of forests by the State, access regimes were changed and the local people were excluded from using the forests freely. This did not significantly affect ~~their~~ their subsistance food gathering

from the surrounding areas, but limited their expansion ~~for cultivation~~ and movement of cultivation sites. Further the state sequentially and opportunistically used the forests to derive revenue in the form of ~~grazing~~, sandal wood extraction and sale, timber extraction and sale, revenue from grazing permits, and collection of minor forest produce like bees wax, honey, horns .....

The State also gave privileges to the ruling elite for shikar and game in the Nilgiri plateau. Thus all game was controlled by the Nilgiri Game Association. who imposed restrictions on type of game, ~~and~~ closed seasons; and issued game licences to the ruling elite to ~~d~~ serve their recreational needs [04 .....].

The local groups were legally excluded from utilising

any of the ~~wild~~ natural fauna as food. However snaring small game like Veranus, Porcupine, ~~and some~~ fishing, ~~bo~~ and scavenging kills of predators ~~continued~~ by the local groups continued.

The Game Association monitored and controlled ~~fauna~~ the wildlife of the area, and sought to sustain, manipulate and enhance ~~a~~ certain species of wildlife ~~for~~ in the interests of the recreational needs of the ruling elite.* They set up an infrastructure of buildings and roads, and employed shikaris and game watchers to enforce their writ in the Sigur area. Their control was known to be effective and ~~well~~ maintained the area ~~in~~ well for shikar [OH.....]. ~~They~~ Although they could not elimite & exterminate the animals that they had termed 'vermin', they did help in maintaining healthy population of wild life

* Towards this end, they categorised certain predatory animals like wild dogs, panthers, ~~[illegible]~~, Others, Longal etc as vermin and offered bounties for their killing & extermination.

~~in the Sigur area.~~ that were game animals in the Sigur area. The game animals in this area were mainly Sambhar, Spotted Deer, Black buck, Gaur, Panther & Tiger, varieties of Jungle fowl and ~~fishing~~ fish.

The forests and Natural Vegetation were essentially stable during this period. There were no new biotas and weeds introduced into the area. There was an attempt and successful control of the Opuntia weed, which was thought to hamper sandal regeneration with the introduction of the fungi caetoblastis (Raven, Peter . . ?). But even after this weed was successfully controlled, the sandal that was a commercial crop and ~~had been~~ overexploited in the area. did not regenerate naturally or by plantation efforts. [Working Mans of F.D . . . .]. A major resource out of the forests during this period was the ~~event of~~ extraction of bamboo after flowing in the western portions of the Sigur plateau. This may

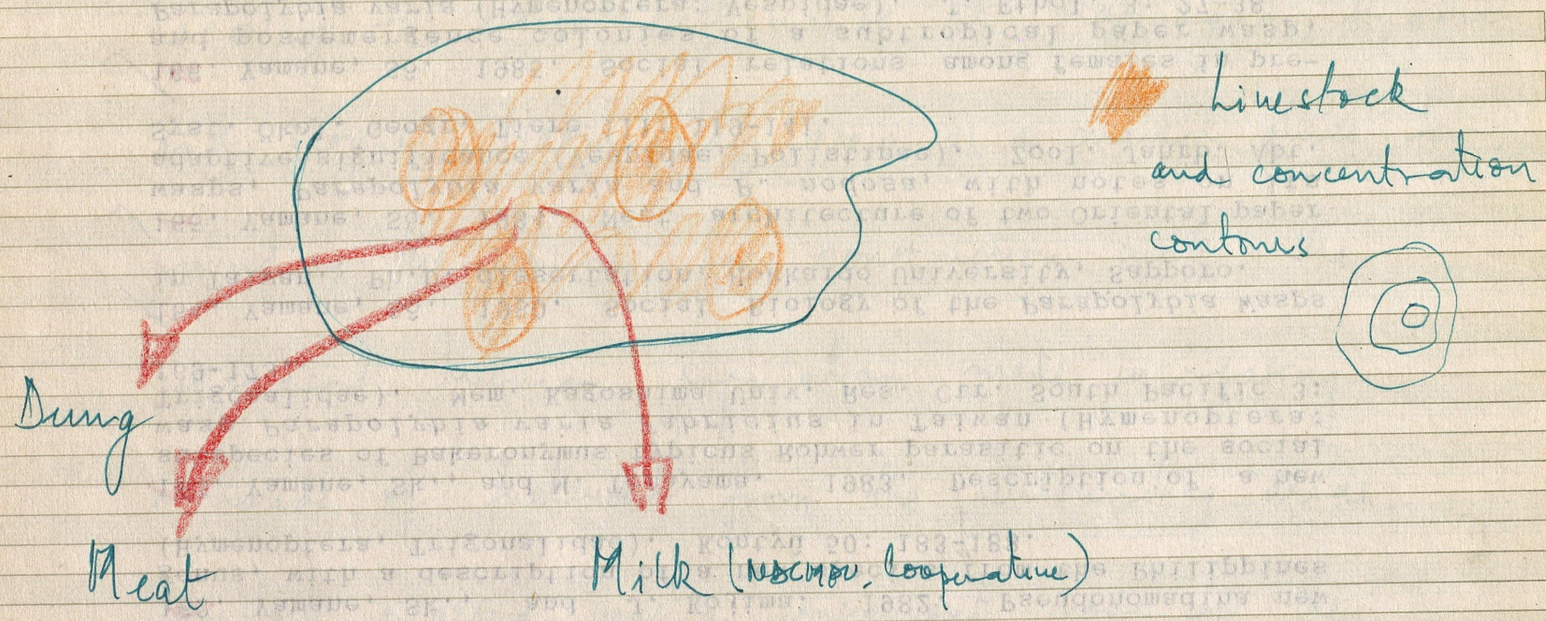
~~The Modern period~~

have ~~cos~~ caused vegetational changes by creating openings in large areas of the Sigur plateau. (FD s WP.....) (Map of Bamboo working circle)

The Modern Period is charecterised by an intensification of pastoralism and a greater commodification of its products. It has shown little interest in long-term sustainability in the form of either improving breeds, or maintaining sufficient quality grazing lands to support the yeild. The process has lead to an increase in numbers of livestock and ~~ex~~ export of a greater range of products like milk, dung, and meat. This has also caused ~~an~~ ecological degradation by increasing sunblands;

colonies. However, it is different from the tropical pattern in that the potential queens were not very high ranking individuals.

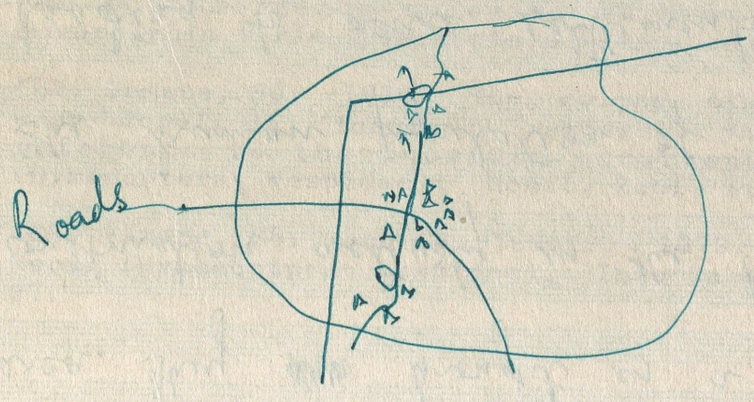
Soil degradation, by compacting the forest soils with hoofs; reducing regeneration of tree species by annual fires that ~~may be~~ were set by the graziers to enhance grass productivity; and an export of nutrients in the form of milk, meat and dung out of the bigur area.



The other major change during the modern period was an indirect consequence to the developmental projects ~~with~~ executed by the Indian ~~In~~ independent state. Developmental activity in the nature of

the construction of hydro-electric power projects increased the communicational infrastructure in the area. They brought in a large labour force for construction activity in the Pykara Hydro electric scheme. The human population of the area thus increased leading to dense settlements at Masinagudi, Singara and Moyar. Masinagudi grew as a market place for providing the services for construction work. The increased human population made increasing demands of fuelwood from the surrounding areas. Livestock rearing was a convenient mode for the immigrant population to derive monetary incomes from the sale of livestock products. This lead to an increasing cattle population and overgrazing around these townships.

Figure 4.5: Changes in the numbers of workers and brood of different matrilines in colony T01 are plotted against time to show the overlap between different matrilines of workers and the brood they raise. w_1, w_2, w_3, w_4, and b_1, b_2, b_3, b_4 represent four matrilines of workers and brood respectively.



The most significant factor that led to an increase in the human population of the Irgur plateau was a change in the disease environment of the area around 1950s. [OH .....]. As a part of the second World War effort, a jungle warfare training centre was established on the edges of Irgur plateau. During this time a malaria eradication programme was taken up on a war-footing. All the water holes and stagnant water bodies in the area were sprayed with lethal doses of DDT to eradicate the mosquitoe larva, the vector of the malarial plasmodium. Along with this effort, the water resources were ~~wo~~ being manipulated on an unprecedented scale, with seasonal streams made perennial, perennial streams made seasonal, and maintaining a steady water flow

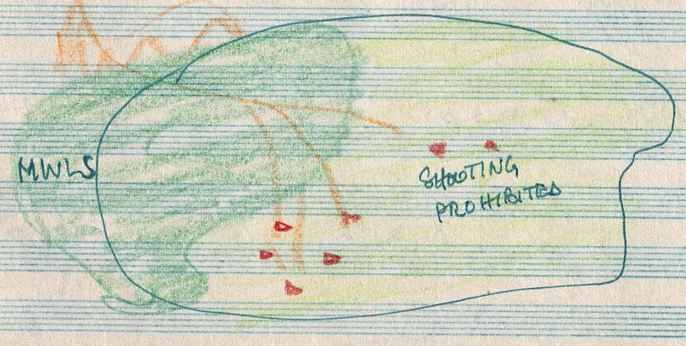
evolution of altruism. Evolution 33: 319-334.
Craig, R. 1983. Subfertility and the evolution of eusociality by kin selection. J. Theor. Biol. 100: 379-397.
Dantas de Araújo, C. Z. 1982. Bionomia comparada de *Mischocyttarus [sic] drewseni drewseni* das regioes subtropical

all around the year. The effective consequence of these on the disease environment of the Irgur plateau was a successful irradication of malaria by [OH, ...]. the late 1950s. This facilitated increased immigration into this area, which had significant ecological consequences.

During this period, a conservation ethic was also born. After an unprecidented increase in shikar by an Indian elite, causing depressions in populations and near extermination of certain species like black buck, the tiger, (the wild gai?), further the focus changed to conservation of mega-vertibrates. The Mudumalai wildlife sanctuary expanded its area into the western portions of Irgur plateau. These imposed restrictions on shooting, and the withdrawal of gun licences all over the Sigur plateau. By

evolution of altruism. Evolution 33: 319-334.
Craig, R. 1983. Subfertility and the evolution of eusociality by kin selection. J. Theor. Biol. 100: 379-397.
Dantas de Araŭjo, C. Z. 1982. Bionomia comparada de *Mischocyttarus [sic] drewseni drewseni* das regioes subtropical

Conservation and the MWLS also increased tourism and recreational activity by the urban ~~[illegible]~~ elite, who come in increasing numbers during seasons. ~~Revenue areas that had been abandoned after cultivation was bought~~ To provide them the recreational services, ~~private enterprises~~ a few resorts and lodges have come up. These were mainly on ~~the revenue lands~~ private lands where cultivation had been long abandoned.

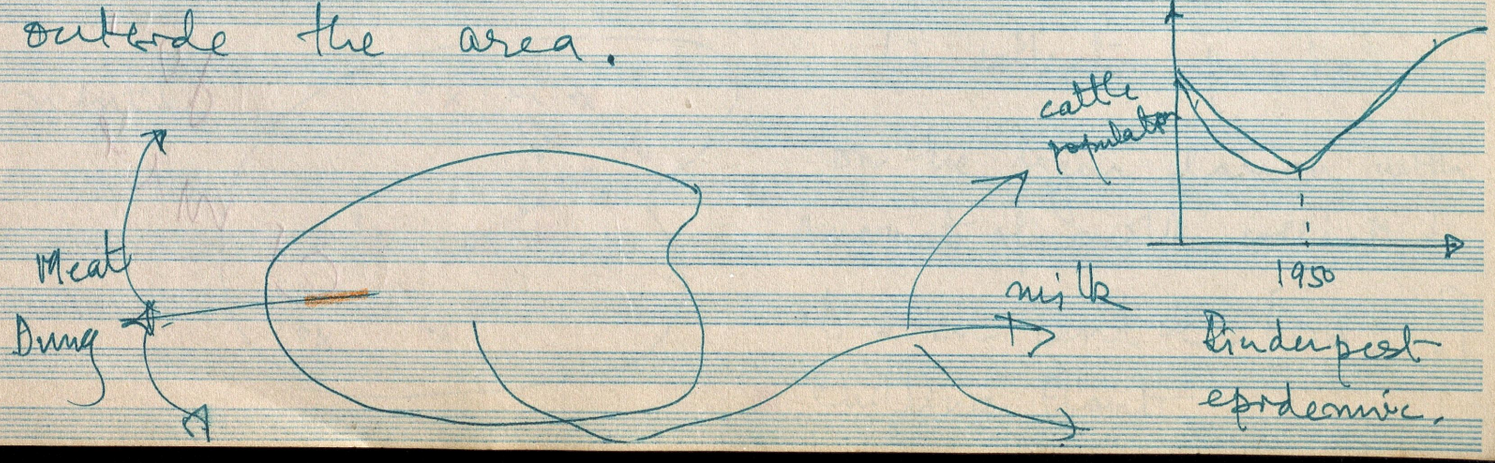


Resorts & Lodges.

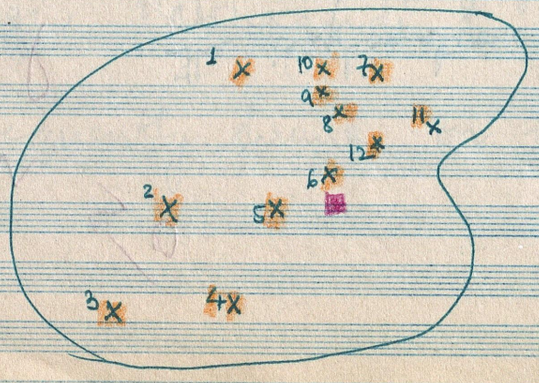
Recreational Tourism.

Livestock and grazing suffered a major slump, caused by ~~xxxxxx~~ a 'foot-and-mouth' rinderpest epidemic which affected the cattle, buffaloes, gaur, and other ungulates. This caused a decrease in population, and the ~~a~~abandoning of cattle pens in the area. Some ~~xxxxx~~ of these animals have since become feral.

Livestock populations have since revived. But there was a broader spectrum of resources drawn out in the nature of milk instead of ghee, cowdung and meat. These were transported outside the area.



This also considerably altered the natural resource use regime of the area. Fuelwood consumptions for processing the milk into Ghee would not exist. The local labour on this would also be saved (@ 2 persons/day/ ... estimate the labour required from fieldwork and Oral Histories), but they were deprived the nutrient buttermilk which was a by-product. Due to the perishable nature of milk, collection sites had to be accessible to markets. This cong caused a concentration of cattle at the collection centres and led to increased grazing pressures around those areas. The export of dung further deprive the area of nutrients.



12 collection points.

on the lower plateau with amount of milk collected at each centre. [OH ...]

■ Chilling Plant

The implications of these for the conservation of bio-diversity and sustainable developments are explored in Chapter 8.0. Problems & Prospects.

Figure 4.6: Changes in the numbers of workers and brood of different matrilines in colony TD8 are plotted against time to show the overlap between different matrilines of workers and the brood they raise. There were only nine matrilines of workers because the last queen failed to produce adult offspring.

The area was also more related to the larger economy in other ways too. The Water availability, in amount and seasonality underwent changes. With increasing commercialisation of the upper plateau, and specifically with the change in cropping patterns of upstream areas on the plateau to continuous vegetable cropping, water use intensified, causing less flow as well as greater silt into the river systems. This ~~a~~ affected the little subsistance agriculture that were carried out at the villages. Sigur, Anaikatti, Maninhalla, Doddalingi, Masinagudi, & Moyar. The agricultural area has consequently shrunk on the Sigur plateau.

The steady increase in population mainly of the immigrant population was caused by a change in the disease environment. livestock rearing provided a convenient means of cash incomes for the immigrants. It thus contributed and increased the grazing pressures surrounding human habitations. Subsistance fuelwood demands for the increased population has degraded the surrounding forests.

We thus see that over the historical period the set of subsistance demands on natural resources has been the same, consisting of fuelwood, graze, water requirements, and food-gathering. While the per family consumption of these would be constant, the amount has been increasing due to a nett increase in population.

the values for the non-queens (Average, Minimum or Maximum for the colony) using a two-tailed the Wilcoxon matched-pairs signed-ranks test. An asterisk in or on any bar denotes that that value

~~The Decade Patterns~~

Over the last decade, there has been an increasing concern for ecological degradation. On the Sigur plateau attempts have been made to ban the movement of cow dung from reserve forest areas, and to controlled grazing in the reserve forests. The area had been included in the Nilgiri Biosphere Reserve Programme (NBR) and developmental activities like road construction and industrialisation have been kept at bay. However, under the Pykara Ultimate ~~Electric~~ Stage Hydro electric Project (PUSHEP), construction activity has been renewed in the Masinagudi - Bongara - Moyar area, causing an increase in human population & pressure on water, infrastructure, natural resources.

The implications of these activities during the last decade for the conservation of bio-diversity of sustainable development, and explored briefly in later chapters (Chapter 8.0: Problems & Prospects).

The Broader Patterns on the Sagar Plateau.

Through the sweep of history, we infer and deduce the broader patterns of resource use, ecology and culture on the Sagar plateau.

On Resources & Resource Use:

From a subsistance resource use regime, consisting of gathering, shifting-cultivation, and settled agriculture during the pre-British period, commercialisation of natural resources commenced. During the historical period 1800 to the present, we deduce the processes of commercialisation of natural resource as by trials and failures; and sequential exploitation of natural resources leading to interruptions & exhaustion followed by resource shifts.

The early attempts at introducing new crops and

~~producing crops~~ intensive cash crop agriculture of cotton, chillies, and coffee, were trials at commercialisation of natural resources that were finally a failure because of unfavourable climatic conditions & human disease environment. There were other attempts at commercialisation like raising forest plantations, and sericulture farms that proved to be a failure and were abandoned.

The process of sequential exploitation is deduced from the commercialisation of forest produce and pastoralism on the Lower plateau. The commercialisation of forest produce was initiated by the State control over the forests of the area, restricting local access. Sandal wood in the eastern tracts & teak and hardwood timber on the western portions were sequentially exploited to exhaustion in the area during the period 1850 to 1930. (Ref. WP) Bamboo was another forest produce that was commercially

Literature Cited

queen status in the primitively eusocial wasp *Ropalidia cyathiformis*. Pp. 377-378 in J. Eder and H. Rembold (eds.),

exploited during the flowering period in 1940s (Ref. W.P) and did not regenerate adequately. These ~~exploitation of~~ shows sequential exploitation causing extinctions & followed by resource shifts.

The sequential exploitation patterns of pastoral produce show an intensification of resource use and a greater range of livestock products exported out of the area. From pastoralism being a combination of subsistence agriculture & commercial activity, over the historical period, this has intensified to increasing grazing pressure, and from an export of only Ghee, to Milk, Meat & Dung out of the area. Further the pastoral mode was the favoured one ecologically being marginal lands with poor soils and a low population density.

Literature Cited

1990c. The role of larval nutrition in pre-imaginal biasing of caste in the primitively eusocial [illegible]

related species. Psyche 95: 89-99.

The exploitation of water resources were events that set of a chain of infrastructural facilities in the Lagos area, which induced a large scale human immigrations. These set off demands on subsistance resources like bio-mass fuelwood, water which led to degradations in the environment.

This combination of subsistance commercial resource use, with Hoade & Fatueros, Sequential Exploitation and Events that have lead to the current ecological situation with its Problems and Prospects that are to be suggested later. (Chapter 8.0 ....

-Trigonalidae). Mem. Kagoshima Univ. Res. Ctr. South Pacific 3:
-169-173.

On Ecology and Environment.

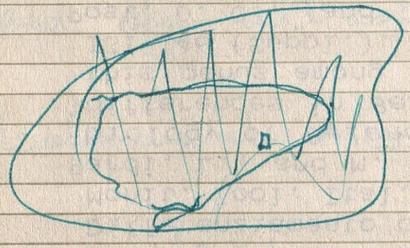
The vegetational changes during this period would be in the nature of periods of introduction of biota followed by changes in species compositions (husbanded biota) and the proliferation of ~~weeds~~ weeds. Due to ~~human resource~~ human resource use, the vegetation had changed from being rich in tandal and riverine vegetation, to a thorny scrub with Opuntia, ~~an invasion of thorny species and unpalatable species~~ as a weed prolifirant in the area.

Being marginal lands, with poor soils and low rainfall, the pastoral resource use of the environment, was best suited. The perennial streams provided a few habitats for settled agriculture. The rest of the area was grassland

Tinbergen, N., and W. Kruyt. 1938. Über die Orientierung des Bienenwolfes (*Philanthus triangulum* Fabr.). III. Die Bevorzugung

with a variety of wildlife and cattle & buffalo grass all over the landscape.

We see two major periods of introduction of biota, one in the 1850s with coffee, Lantana, cotton, Opuntia, Thistles etc. followed by a period of static, and then a second period of introduction in the 1950s with and cultivated plants. The natural forests were dominated by Eupatorium, fire resistant and thorny vegetation, and a decrease in grassland. These are summarised in the tables, time charts and maps (Tables, and Maps ..... detailed in the last pages).



London (A) 205: 411-424.
Roubaud, E. 1916. Recherches biologiques sur les gpes

On Human Communities and Culture:

The indegenous inhabitants of the eco-systems people consisting of Irulas & Kurumbas inhabited the area low populations and settlements. Over the historical period, they have maintained this same population (Coutes 1871 ..... 1981), but have been marginalized and their natural resource base restricted by the State. They continue gathering, ~~and have been entrenched as labour~~ and settled cultivation, pastoralism. and provide wage-labour for the developmental & commercial activities in the area.

An immigration wave during the 1600s brought in cultivators into the Nilgiri plateau from the Mysore area. This first wave of immigration

Ropalidia marginata (Lep.) (Hymenoptera: Vespidae). J. Genet. 65: 153-158.
Oster, G. F., and E. O. Wilson. 1978. Caste and Ecology in

We ~~see~~ discern two waves of immigration. The first wave of Kurumba Gowda & Boyas, were the ~~sepherds~~ sepherds and stone-cutters around c. 1600 (Ref. Hockings ....), who ~~contribute~~ extended cultivation in ~~primer areas~~ Bigur plateau. The next wave of immigration was only after a change in the disease environment and the ~~s~~ initiation of State sponsored development projects ~~a~~ in the area.

We see that under the sequential exploitation and commercialisation of natural resource use regime, the ~~development of~~ expansion of infrastruce, technological changes, and change in disease environment, ~~and~~ increasing migrations of human groups occurred. The eco-systems peoples population have been stable but they have been marginalised. The market-oriented human groups have been mainly immigrants ~~[illegible]~~

Kojima, J. 1983b. Occurrence of the rubbing behavior in a paper wasp, *Parapolybia indica* (Hymenoptera, Vespidae). Kontyû 51: 158-159.

from adjoining areas mainly involved as labour and services for the communal ~~resource use~~ and developmental activity. It was these factors that caused a population increase and had degrading effects on the environment rather than ~~changes~~ increase in the indigenous ~~po~~ population.

These changes are summarized in the tables, time-charts and maps.

social wasps (Hymenoptera, Vespidae). Proc. 12th Int. Congr. Entomol., pp 440-441.

MP Jos Plateau

1926-27	575	1954-55	3,304
28	650	56	3,518
29	650	57	3,335
30	~~650~~ 575	58	3,345
31	750 +250	59	3,420
32	400	60	3,194
33	450	61	3,615
34	250 +125	62	3,879
35	280 +132	63	3,614.
36	300 +142		
42	965		
43	1005		
44	1029		
45	870		
46	2050		
47	5000		
48	..		
49	5,300		
50	4,610		
51	5,800		
52	5,050		

(Hymenoptera: Vespidae). J. Aust. Entomol. Soc. 14: 309-318.
Starr, C. K. 1985b. Enabling mechanisms in the origin of sociality in the Hymenoptera - the sting's the thing. Ann.

Sandal

(20)

YR	T	CWT	BRS	LB
1954-55	63	17	0	17
56	151	12	0	26
57	78	2	0	12
58	12	16	0	19
59	44	11	0	29
60	23	9	0	19
61	20	12	0	20
62	50	0	15	0

@ 35 metric tons / yr.

72 ↓

Livestock grazed in the forests of Nilgiris Division

(1)

	B	C	S	O
1952-53 :	9,340	19,406	9,914	2
54 :	7,250	20,041	4,874	4
55 :	7,610	21,644	8,370	27
56 :	7,537	25,889	10,298	8
57 :	6,744	22,606	10,021	..
58 :	3,570	8,403	3,919	..
59 :	6,432	20,476	8.079	..
60 :	5,935	15,014	4,255	..
61 :	6,809	20,928	7,692	..
62 :	6,572	21,496	12,294	11
63 :	5,076	21,267	13,129	16
→ 1871 :	6,196	6,341 + 6,212	3,464	

Rinderpest

1865 ←

1948 ←

1968 ←

Sigur Plateau

	16 Sites	C	Buffaloes	G	S
~~1987-88~~					
1987-88		10,544	2,132	923	1473
1988-89		9,153	1,588	885	1337
1989-90		10,503	1,960	842	1562
1990-91		11,885	1,942	1242	1942

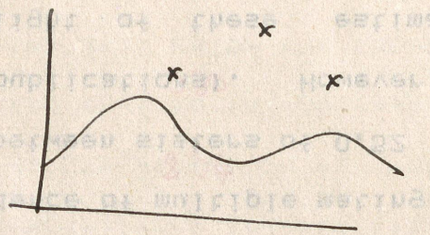
(Source : Chandrashaker, WII)

unless accompanied by other advantageous of group living to boost the inclusive fitness of workers (see items 20 and 47 in the above list of publications).

Grazing Revenue for Nilgiri Division

1925-26	9,351			1952-53	3,296	
27	8,611		RATES DOUBLED	54	3,983	
28	6,464		3,304.53	55	7,948	
29	6,201		3,518.97	56	8,607	
30	5,979		3,335.25	57	~~7,524~~	7,698
31	5,742	~~1,703~~	3,345.65	58	~~7,480~~	7,524
32	5,804	~~2,024~~	3,420.23	59	~~6,946~~	7,480
1932-1933	6,314		3,194.84	60	~~7,522~~	6,946
34	6,492	1,703	3,615.33	61	7,425	7,522
35	6,794	2,024	3,879.09	62		7,425
36	6,817	1,854	3,614.80	63		7,063.
37 → ?						
38	6,412					
39	3,624					
~~39~~ 40	3,309					
~~40~~ 41	3,344					
~~41~~ 42	3,460					
~~42~~ 43 →	3,235					
~~43~~ 44	3,061	898				
~~44~~ 45	3,040	887				
~~45~~ 46	3,012	940				
47	3,254	~~940~~ 818				
48	2,805	54				
49	3,105	139				
50	3,233	70				
51	3,263	126				
52	2,975					

RATES HALVED



Livestock WQ1

rear is given by

$$\bar{r} = [(r_f^2/r_m) + r_m] / [(r_f/r_m) + 1] \quad \ldots\ldots(1)$$

Cattle / livestock estimates for 1930-1950 are not available because grazing permits were issued for the whole Forest Division. However we can estimate livestock population from revenues.

	Sirgoi Plateau	Approximate livestock C+B
1944 -	898 - 10 - 6	5,388
45	887 - 1 - 5	5,322
46	946 - 4 - 0	5,640
47	818 - 12 - 0	4,908
48	54 - 12 - 6	330
49	139 - 12 - 6	834
50	70 - 12 - 6	420
51	126 - 0 - 0	756

(1)

Re 1/6 - 1

- 898 x 6 = 5,400 ≈

THE HAPLODIPLOIDY THRESHOLD – italics

A seldom stated achievement of Trivers and Hare (1976) is the

Grazing fees.

1887) : Grazing restricted.

~~1932~~

@ 0-4-0. Cattle.

0-2-0. Agricultural Cattle.

1895) 0-3-0 : for all cattle/cows

1932) @ Buffaloes 0-6-0

Cows 0-3-0.

Sheep. 0-1-6.

1938) @ Buffaloes 0-3-0

Cows 0-1-6.

Sheep 0-0-9

@ 1954) 35 pens on Sogen plateau.

with total cattle ?

... for worker behaviour. I have recently developed a method (discussed below) to ~~ascertain~~ assess this. It involves assuming that workers can recognise the sex of the brood and differentially invest resources in brood of the two sexes in the ...

Pastoral activity in Sogun P

Rates

	R-A-P.		
Bulls & Cows	0-3-0	Penning license	1-8-0 for 100 cattle
Buffaloes	0-6-0		+3-0-0. 100-200.
Sheep	0-1-6		4-8-0 200-300.
			⋮ etc.

Seasonal

Jan - June on the Sogun Plateau.

June - Jan

# of cattle pens @ 1930s. 35 pens in the area.

Permanent pens - 8 pens

~~Cattle: 3,432~~

~~Buffaloes: 2,305~~

~~Sheep. 147~~

5228

(1) ✓	C	B	S	For Slaughter C	B	S	Rs
1933-34	3,432	2,305	147	5,635	-	30,239	1,703-1-0
1934-35	3,681	2,850	92	5,178	-	37,246	2,024-2-0
1935-36	3,339	2,649	104	2,442	"	31,566	1,854-3-0

SERIAL POLYGYNY — italics

We have known for quite a while that queen turn overs are quite

Area

Arm — 5.5 × 2 = 11

A. Katta: 3 × 2 = 6

D. Moyar: 3 × 3 = 9

M. gudi: 18 × 2 = 18

M. halla. 8 × 6 = 48

Moyar. 5.5 × 2 = 11

C. nattam: 1.5 × 2 = 3

106 sq × 25 ha = 2650 ha

1 sq = 0.5 × 0.5 = 0.25 sq km

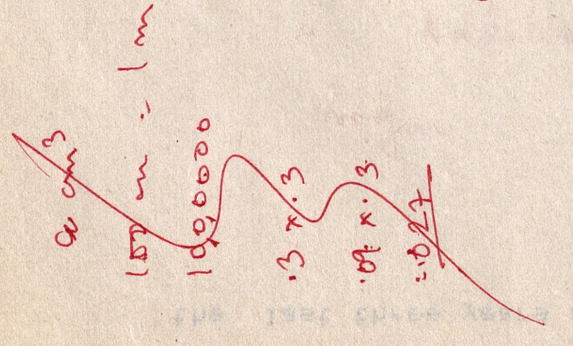
= 25 ha

(2)

At → 33856.028 ha.

Reserve L → 2650.

36506.028 ha



of the behavioural dominance hierarchies of their colonies. Instead, most of the dominance behaviour is shown by a group of workers, the Fighters. This suggests first, that fighting perhaps also has a role

30 x 3 : 900

~~10 x m = 2 m~~

~~5 x 1 = 500 kg~~

Rfs on Sirguru Plateau

		Recorded in
Anaraihalla	6,425.28	May 1900
Bokkapuram	1,974.48	March 1886
" Addition 2	5.11	1910
II	3.91	"
III	3.84	"
Kalhatti	4,925.66	1886
" Addition	87.99	1923
Kalmalai	896.00	1885
" Addition	40.73	1917
Moyar	13,237.76	1886
" Addition	342.22	1886
Northern Hay	3,997.60	1886
Singara	1,835.11	1886
" Addition	379.00	1905
Sirguru	49,484.00	1894
	83,595.13 acres	= 33856.028 kg
		± 2850

* During the period under review

3.1.4 Brief resume of research and Development work carried out during the period under review.

Sandal @ 1950

Sirgur R

Total area : 24,658 acres

No. of sandal trees :		1960s
Healthy	152,051	31,710
Spiked	16,219	2,940
Dead	34,464	8,460
Total	248,734	43,110

It is seldom that a sandal tree over 10" dia at breast height is found in this tract!

Average outturn @ 30 tons/yr.

@ 25 MT/yr

7.5 cms girth

Technical Report No.33.
(52) Gadagkar,R.(1986). Outlines of lectures given at the First National School on Conservation Biology. Centre for

1 ha = 10,000 m²
1 sq km = 1000 × 1000 m²
1 sq km = 100 ha

Sandal Extraction

2C

YR	T	CWT	QRS	LB	YR
30-31	22	11	1	24	31
32	18	7	2	26	32
33	13	11	1	9	33
34	18	5	3	26	~~24~~ 34
35	32	6	0	15	
36	54	16	0	12	
37	85	19	1	8	
38	55	16	2	19	
39	65	8	2	19	
40	17	19	0	5	
41	38	12	0	14	
42	36	14	0	16	
43	16	3	3	15	
44	9	~~4~~ 9	3	10	
45	23	9	2	2	
46	10	13	3	10	
47	13	14	2	23	
48	17	4	1	13	
49	38	6	2	15	
50	40	6	~~2~~ 5	4	
51	50	18	1	22	
52	28	3	0	26	52
1951			2		

	Tons	Cwt	Qrs	Lb
1926-27	5	8	0	21
28	8	11	1	21
29	6	10	3	17
30	20	24	1	

2B

the MAB regional training workshop on Tropical Forest Ecosystem conservation development in South and South-east Asia. Trichur, India, 1 to 13 May 1990. in press.

Sandal

1930: Antiforest regeneration a failure.

Sandal enumeration & yield.

Sogun plateau:

Total area: 74,658 acres of Sogun Range

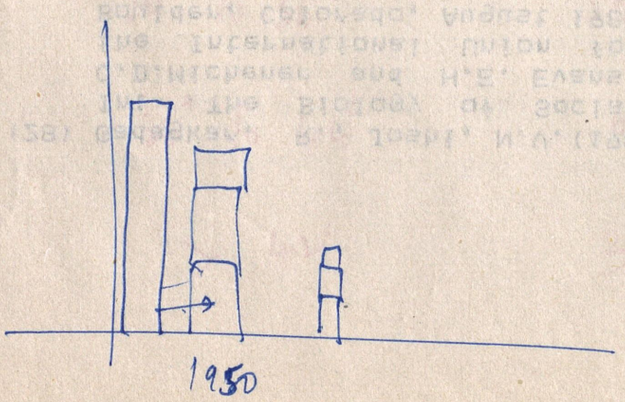
Dense (>25 trees/acre): ~~8,88~~ 594 =

Sparse (10-25 trees/acre) 1,232 =

Scattered (<10 trees/acre) 11,601 =

Total Sandal effective area 13,427 acres

(1938-48) → Felling cycle @ 3 yrs.
Extraction > 3" girth.
30 tons/yr.



Chandrashekara, K., and Gadagkar, R. (1990). Evolution of eusociality: Lessons from social organization in Ropalidia marginata (Lep.) (Hymenoptera: Vespidae). In: Social Insects and the Environment. (Eds.: G.K. Veeresh, B. [illegible]

Red Cross

	Acres	Revenue
1930-31	2	25-8-0
32	..	19-0-0
33	2	← Charcoal for Sangara HE School
34	2	20-0-0
35	2	20-0-0
36	3	25-0-0

Sandal enumeration in Sagar ▷ @ 1926

Girth classes	No. of trees
6" to 12"	15,734
12 to 18	18,189
18 to 24	11,089
24 to 30	1,885
30 to 36"	389
36" to 42"	66
> 42"	33

Proc.Symp.Ecol.Anim.Popul. (Family : Vespidae). contribution 50%) Zool.Surv.India, Pt.4, 49-61. (My

(27) Gadagkar,R., Joshi,N.V. (1982). A comparative study of social

Sandal Extraction @ 38 tons/yr 1880 - 1900

1880 - 1900 @ 38 tons/yrs.

1901 - 1907 @ 6¼ tons/yr. only dead trees.

1907 - 10 ~~cracks~~ crops.

1922 → >24" girth : dead & alive trees.

1923 → All available sandal ~~extracted~~ at Irgur & Kalhatti slopes extracted

1916 - 1921 → Extraction confined around Irgur.

1921 → Sandal plantations successful.

1923 → Extraction reduced to trees over 12" girth. 24 tons/yr.

1915 - 1926 → 108 tons of heartwood + 24 tons of chips & dust extracted.

1926 → Only 700 sandal trees in Bobbapuram area left.

1926 → onwards 36" girth for exploitation. to yield 4¼ tons/yr.

1928 → Spike disease strikes.

(2A)

	Heartwood		Chips & Dust	
	QR	Lb	QR	Lb
1915-16	503	5	83	.
17	309	15	89	7
18	284	9	65	21
19	249	25	..	..
20	291	..	75	16
21	186	10	53	7

	QR	Lb	QR	Lb
22	232	13	53	18
23	1059 (1918)	8	359	22
24	1614 (2002)	22	388	24..
25	1320 (1644)	1	224	16
26	2038 (2563)	27	525	12
	8,599	23 (?)	1,118	15

Maralidharan,K., Shaila,M.S. and Gadagkar,R.(1986). Evidence for multiple mating in the primitively eusocial wasp Ropalidia marginata (Lep.)(Hymenoptera:Vespidae). J.Genet. 65, 153-158. (My contribution 50%)

1865: Rinderpest (Ref. Ranganathan, pg 44)

Ref: Roberts et al ..... During export studies from the Morgan plateau.

the social wasp, Ropalidia marginata (lep.) (Hymenoptera:Vespidae) Curr.Sci. 49, 772-775.

Cfc Beeson, Prickly Pear & Cochineal Insect, Indian Forester, March 1934, Vol 60 - pp 203-205

Opuntiak dillenii, O. nigricans, O. monacantha. } South American Brazil / Argentine

Attempts were made in the latter half of the nineteenth century by distribution D. indicus to exterminate the prickly pear.

But the commonest spp. of prickly pear was O. dellenii & O. nigricans.

on which D. indicus does not feed.

→ feed on O. monacantha.

Dactylopius tomentosus feeding

O. dellenii that is prevalent in South India.

introduced into South India from Ceylon in 1926

In Australia it was the insect Cactoblastis cactorum, introduced by Australian Commonwealth Prickly Pear Commission.

M.Sc. NIL (Please indicate the number) NIL Thesis submitted

Masinagudi on Royatwari Settlement.

Changes in ~~Access~~ Control regimes / Communications / Settlements

from SOI maps. ⇒ (Maps as Markers of ...

Control Regimes.

Index of Communication

Settlement Patterns

Population ⟷ Links with ⟷ Culture.

Resource Use & Resource Flows ⟷ Links with ⟷ Resource

Table of Areas.

Agricultural

Forest

Rocky

Riverine vegetation.

Water Resources - Rainfall

Streams

~~Control Regi~~

of 48 ± 31 days it ranges from 7 to 217 days. I tend to be suspicious

Time Scale of Technological Changes:

1850	1950	1990
drawn.		
Animal/Wheeled transport.	Infrastructure	Infrastructural.
	Roads for hydro-electric construction. & transmission.	Road network enhanced
Export of Ghee		
Milk - Butter - Ghee.	~~Power~~ Hydro-electric	Milk collection/
Head loaded out of	power stations.	Refrigeration unit.
the area, to the weekly		
market at Ooty.	Water supply	PUSHED.

Transport / Communications Sector:

Animal drawn wheeled transport.	Roads. metalled construction vehicles. Infrastructure	Public transport Milk transport	Public transport.	Heavy traffic.

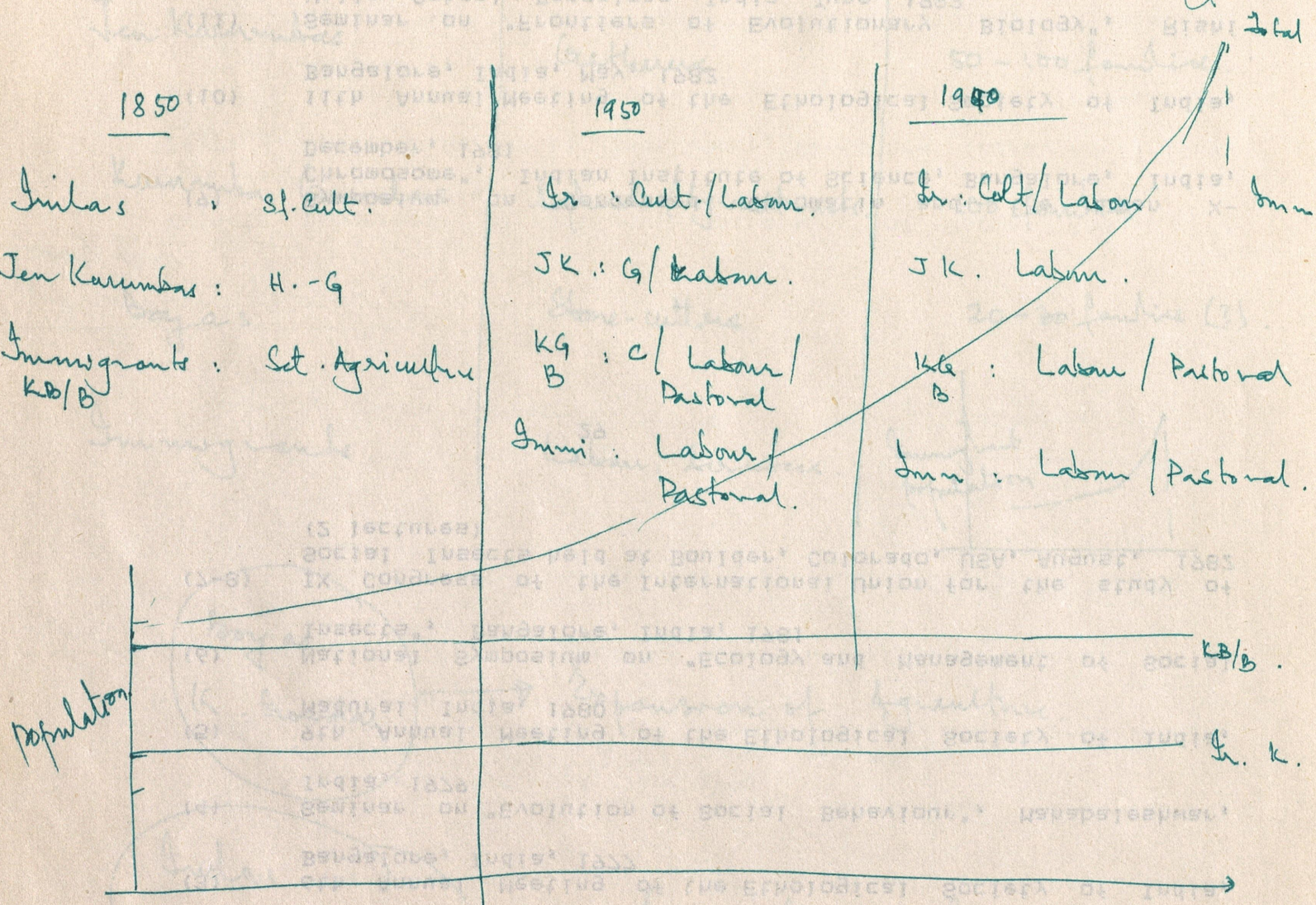
Collection Processing / Manufacturing Sector.

Ghee.
Human labour
Head load transport

Data from SOI

~~Eco systems group~~ | ~~Imla~~ ~~J. Kurumba~~ | ~~Population~~ ~~Constant or -ve~~ ~~Census.~~ | ~~Access to natural resources.~~ ~~Restricted.~~ ~~Data from SOI maps.~~

1850	1950	1990
Imlas : Sf. Cult.	Ir : Cult./Labour.	Ir : Cult/Labour
Jen Kurumbas : H.-G	JK : G/Labour.	JK. Labour.
Immigrants KB/B : Sct. Agriculture	KG B : C/Labour/Pastoral	KG B : Labour/Pastoral
	Immi : Labour/Pastoral.	Imm : Labour/Pastoral.

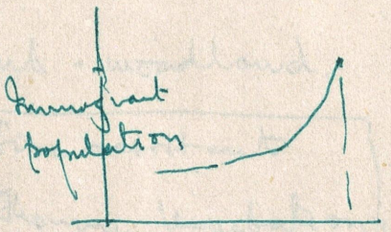


Census data 1871 .... 1991.

(16) IUBS/UNESCO Meeting on "Human Impact on Species Diversity in Tropical Rain Forest Ecosystems". Puerto-Rico, USA. 11-14 June, 1985

~~Occupations~~

Human Groups & their Occupations, Sizes, Area, etc.

Irula	Cultivators / Gatherers	4 villages on Sugar P. 300 - 200 families
Jen Kurumbas	Gatherers.	50 - 100 families.
Kurumba Gowdas	Sepherds / Agriculturists.	100 families
Boyas	Stone-cutters.	20 - 30 families (?).
Immigrants.	Labour, Services.	

Boyas
K. Gowdas → Expansion of Agriculture.

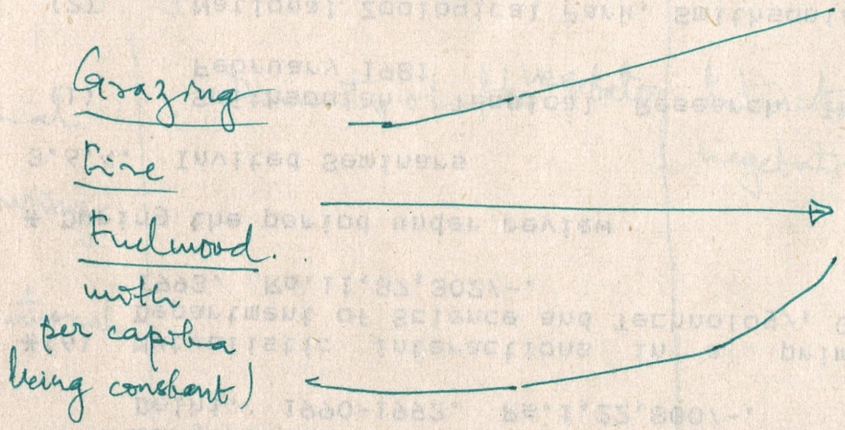
Irulas
Jen Kurumbas → Eco-system people.

*(36) Harvard University, Cambridge, Massachusetts, USA, December 1990

[Cont]

1850 1930 1950

Disturbance Regime



~~Forest Flora~~
Vegetational Structure

Tree & Shrub Savanna → Scrub - woodland.

Fire resistant
Thorny vegetation

Land Use Changes.

Area under cultivation	Forest Areas

1982

(8) University of Michigan, Ann Arbor, Michigan, USA, September 1982

Natural Resource Use Demands.

	graze, fuelwood, water	graze. fuelwood, water	
Pastoral Gathering Recreational	Diversity of ~~flo~~ vegetation	Intensity of vegetation use	Area considerations.

Time Chart of Vegetational Changes.

1850	1930	1950
Cotton		
Chillies		
Opuntia	Opuntia	
Sandal	Bamboo	Eupatorium / Lantana
Teak.		
Coffee	Coffee	Coffee
Lantana	Lantana	Subsistance crops.
+ Subsistance Crops. (Ragi...	+ Subsistance crops.	Thorny vegetation.

[cont]

3.6.1. Membership of Advisory Committee

(1) Member: Programme advisory committee in Animal Behaviour

Table of pastoral activity

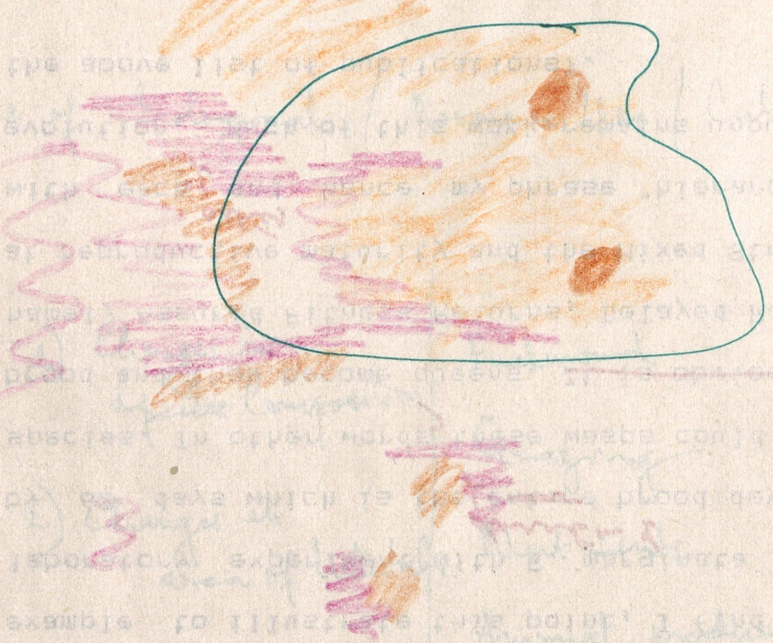
Map.

No. of families	No. of cattle/livestock	Products	Distribution Area. Natural Resources	
			Individual	Communal
20 - 30 Badaga. 100 - 200 Irulas	2000 - 5000	Ghee		Irrekuad Graze.
		Milk & Ghee		
		Milk Dung Meat		

3.3.1 Work done for the Faculty/Senate: NIL

3.3.2 Industrial Consultancy work: NIL

The Prodigy of the Weeds



Opuntia
1800 - 1930

Lantana
1830 - present

Eupatorium
1950s - present.

Opuntia: Controlled by cactoblastus

Lantana: Manually removed.

Eupatorium: No attempt.

problem of the evolution of social life in insects and the model
italics system of B. marginata . especially when sprinkled with some modelling

Table of Ecological / Resource Use / Cultural Changes.

1) Changes in Species Composition	Fuelwood	Human groups
	Grazing	Distribution
2) Changes in area of habitats.	Nutrients	Population
	Animal products	Culture) Relationships with landscape
3) Proliferent Weeds	Agricultural products	Relationship with nature
4) Introduced biota.	Forestry products	Resource Use: H-G / S. C / A
	Water resource use	Pastoral. - Labour

Competition & Cooperation for Resources

Notes & References

M. S. S. Pandian, The Political Economy of Agrarian Change : Nanchilnadu 1880 - 1939, Sage Publications, New Delhi. 1990.

p14) Productive forces : rainfall, topography, forms of cooperation.

Production relations. (in Marxian terms well treated).

p15) Micro-level studies : concrete situations, essence of the Indian agricultural reality

3.8.8. Ph.D thesis completed uner my supervision:

Venkataraman, A.B. Studies on the mechanism of nestmate

p 14) What is reproduced over time that keeps reappearing

Man-Nature relationships

p 27) Rainfall as a Natural Instrument of Production.

Topography and Productive forces.

3.0 Distribution of the Social Products.

State & Temples

Local Landlords

The Peasantry

Agricultural Labourers

~~Conflict & its P~~

*(40) MAB Regional Training Workshop on "Tropical Forest Ecosystem Conservation and Development ... Behaviour", Madurai, India, 15-17 April, 1989

Conflicts & its Resolution.

The provision of a remission

Common Property Resource

The time & Mode of Revenue Payment

The Plantation Sector ~~was the~~ Travancore provided European planters with extensive areas of land constructed roads etc and moderately taxed them.

Ref: Buchanan, D.H. 1966. The Development of Capitalist enterprise in India, London, Frank Cass and Co. Ltd.

p 128) (Ref Karl Polyani Ch. 4.) In societies where distribution is not mediated through markets, reciprocity (ie institutionalized exchange of gifts), redistribution (eg ... or householding is identified as the primary distributive mechanisms.

All our results were thus consistent with the following hypothetical framework. Nestmate discrimination labels have both exogenous as well as endogenous component and both have to be

p173) The mode of production → productive forces
↑ → production relations.
Internal conditions
External condition

p173) Instruments of production like tractors, etc. as productive forces, the
they often did not analyse these instruments in the context of labour
process. Here these instruments of production were treated in the
analyses independent of people & nature.

Monsoon cycle as a natural instrument of production.

p 174) After all the essence of any enquiry into the productive forces
is to disclose the relationship (interaction) between people & nature
in the process of production as specifically as possible! . . . . .
these man-nature interactions also have a bearing on understanding the
connection between productive forces and production relations, again in their concrete manifestations.
Sorokin, Pitirim, A 1975 Hunger as a factor in human affairs. also

Gainesville, The Univ. Press of Florida.

Polyani, Karl. 1957. The Great Transformation, Boston. Beacon Press