Thesis Component - III

BIOTIC COMPARTMENT
Analytical Results

Thesis Component III
Biotic Compartment

Unit - I

Autotrophic (Primary Producer)
Component

Sub-Unit A

The Vegetational System

Basic Conceptual Comprehension :

All life on this earth is supported by the stream of energy radiated by the sun and flowing into the biosphere. It is evident that relatively small amount of radiant energy bound in the form of latent chemical energy by the photo-synthesis of plants suffices to maintain the biomass and the vital processes of all members of the trophic train. It is this unique position of plants as energy transducers that gives them the title of primary producers. Plants are not

only the primary producers but they are also responsible for the flow and cycling of energy, water, mineral nutrients and bioelements within the ecosystem.

These primary producers may be the components of the natural vegetational systems or that of the managed agricultural crop systems. The morphological and functional characteristics of a vegetation result from interactions between the properties of the plant species contains and the environment in which they occur. The structure of vegetation determines much of the character of the landscapes in which the other organisms, including the human beings live and prosper. Mooney (1974) (quoted by Larcher, 1975), proposes that, "For any habitat condition there is a plant type which apparently represents the optimal form - behavioural strategy for carbon gain". It is thus clear that the physical and edaphic environment moulds the vegetation into a form which could be predicted if the vegetation - environment interaction were better known.

This unit presents the vegetation - environment interactional analysis and the inferences deducible from such (a) analytical study.

The component plant species of vegetational system at Chokari are scattered in the patches. There is no forest vegetation in the entire ecosystem area. The dominance of purely an agricultural environment in the ecosystem is noteworthy. The vegetation is sparsped as well as devoid of any structural organization in terms of storeys.

I. Analysis of Vegetational System :

Vegetational systems were analysed for the content of the floristic elements which formed the component part of the entire vegetational system. The qualitative analysis revealed interesting details. In all 104 plant species belonging to 35 families were recorded. The dominance of occurrence was calculated using the criteria of total number plant species on record as well as the total distribution of the genera in the families.

Qualitative listing of plant species

The families, genera and species are arranged according to Bentham and Hooker's System of Classification which is still in vogue in this country. Nomenclature has been brought up-to-date as far as possible in accordance with the International Code of Botanical Nomenclature (1966).

PAPAVERACEAE

Argemone maxicana Linn.

BRASSICACEAE

Lepidium sativum Linn.

CLEOMACEAE

Cleome viscosa Linn.

C. gynandra Linn.

PORTULACACEAE

Portulaca oleracea Linn.

TAMARICACEAE

Tamarix sp.

ELATINEAE

Bergia ammannioides Roxb. ex Roth

B. odorata Edgew.

MALVACEAE

Abutilon indicum (Linn.) Sweet

Hibiscus cannabinus Linn.

ZYGOPHYLLACEAE

Tribulus terrestris Linn.

RHAMNACEAE

Zizyphus mauritiana Lamk.

FABACEAE

Alhagi pseudalhagi (M. Bieb.)Desv.

Crotalaria retusa L.

C. juncea L.

C. medicaginea Lam.

Cyamopsis tetragonoloba (Linn.) Taub.

Dolichos lablab Linn.

Teramnus labialis (Linn. f.) Spr.

MIMOSAE

Prosopis cineraria (Linn.) Druce

VAHLIACEAE

Vahlia digyna (Retz.) O. Kuntze

LYTHRACEAE

Ammannia baccifera Linn.

ONAGRACEAE

Ludwigia perennis Linn.

AIZOACEAE

Sesuvium portulacastrum Linn.

Trianthema pentandra Linn. Mantiss.

T. portulacastrum Linn.

MOLLUGINACEAE

Glinus lotoides Linn.

G. oppositifolius (Linn.) DC.

APIACEAE

Anethum graveolens Linn.

RUBIACEAE

Dentella repens (Linn.) Forsk.

Oldenlandia corymbosa Linn.

COMPOSITAE

Ageratum conyzoides Linn.

Blumea mollis (D. Don) Merr.

B. obliqua (Linn.) Druce

Cyathocline purpurea (Ham. ex D. Don) Kuntze

Eclipta prostrata (Linn.) Linn.

Gnaphalium indicum Linn.

Grangea maderaspatana (Linn.) Poir.

Oligochaeta ramosa (Roxb.) Wagen.

Sphaeranthus indicus Linn.

Vernonia cinerea (Linn.) Less.

Xanthium strumarium Linn.

SALVADORACEAE

Salvadora persica Linn.

BORAGINACEAE

Heliotropium supinum Linn.

CONVOLVULACEAE

Cressa cretica Linn.

Convolvulus microphyllus Sieb. ex Spreng.

Ipomoea aquatica Forsk.

SOLANACEAE

Datura metel Linn.

Nicotiana tabacum Linn.

Solanum nigrum Linn.

S. surattense Burm. f.

SCROPHULARIACEAE

Bacopa monnieri (Linn.) Pennell.

Lindenbergia muraria (Roxb.) P. Bruehl.

Lindernia parviflora (Roxb.) Haine

Stemodia viscosa Roxb.

Verbascum chinense (Linn.) Santapau

OROBANCHACEAE

Orobanche cernua Loefl.

ACANTHACEAE

Peristrophae bicalyculata Nees.

VERBENACEAE

Avicennia alba Blume Bijdr.

Phylla nodiflora (Linn.) Greene.

LAMIACEAE

Leucas capitata Desf.

AMARANTHACEAE

Achyranthes aspera Linn.

Alternanthera sessilis (Linn.)DC.

Amaranthus gangeticus Linn. var. tristis Prain.

A. hybridus Linn. ssp. cruentus Thell. var. paniculatus Thell.

A. spinosus Linn.

A. viridis Linn.

Digera muricata (Linn.) Mart.

Nothosaerua brachiata (Linn.) Wight Icon.

CHENOPODIACEAE

Chenopodium album Linn.

Suaeda fruticosa Forsk.

S. maritima Dumort.

S. nudiflora Moq.

POLYGONACEAE

Polygonum plebejum R. Br. Prodr.

EUPHORBIACEAE

Chrozophora prostrata Dalz.

C. rottleri (Geis.) Juss. ex Spreng.

Phyllanthus asperulatus Hutch.

Euphorbia hirta Linn.

E. hypericifolia Linn.

E. microphylla Heyne

Ricinus cammunis Linn.

TYPHACEAE

Typha angustata Bory & Chaub.

Cyperaceae

Cyperus difformis Linn.

C. laevigatus Linn.

C. michelianus (Linn.) Link. ssp. pygmaeus (Rottb.) Aschers.

C. rotundus Linn.

C. tuberosus Rottb.

Eleocharis atropurpurea (Retz.) Kunth, Enum.

Fimbristylis dichotoma (Linn.) Vahl, Enum.

F. diphylla Vahl, Enum.

F. miliacea Vahl, Enum.

Scirpus maritimus Linn.

GRAMINEAE

Aeluropus lagopoides (Linn.) Trin. ex Thu. Enum.

Cenchrus ciliaris Linn. Mant.

Chloris virgata Sw.

Cynodon dactylon (Linn.) Pers.

Dinebra retroflexa (Vahl) Panz.

Echinochloa colonum (L.) Link.

Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.

E. japonica (Thunb.) Trin.

E. viscosa (Retz.) Trin.

Pennisetum typhoides (Burm.)Stapf & Hubbard.

Triticum aestivum Linn. (escapes of crop system)

Zea mays Linn. (escapes of crop system).

Table 17 : Families in order of dominance (total no. of plant species).

Family	No. of plant species
Graminae	12
Compositae	11
Cyperaceae	10
Amaranthaceae	8
Euphorbiaceae	7
Fabaceae	6
Scrophulariaceae	5
Solanaceae	4
Chenopodiaceae	4
Aizoaceae	3
Convolvulaceae	3
Cleomaceae	2
Elatineae	2
Malvaceae	2
Molluginaceae	2
Rubiaceae	2
Verbenaceae	2

Table 18 : Families of monospecies occurrence

Family	No. of plant species
Papaveraceae	1
Brassicaceae	1
Portulacaceae	1
Tamaricaceae	1
Zygophyllaceae	1
Rhamnaceae	1
Mimosae	1
Vahliaceae	1
Lythraceae	1
Onagraceae	1
Apiaceae	1
Salvadoraceae	1
Boraginaceae	1
Acanthaceae	1
Lamiaceae	1
Polygonaceae	1
Typhaceae	1

Table 19 : Families in order of dominance in distribution of genera therein.

Family	No. of genera represented
Compositae	10
Graminae	10
Fabaceae	4
Scrophulariaceae	4
Euphorbiaceae	4
Cyperaceae	4
Rest of the families	Less than 4 genera

II. Phenological Analysis :

Phenological observations and analysis was carried out during the period of study. The record of phenophasic transformation of each of the species was made during the field visits. This phenological analysis was mainly carried out with a view to prepating the phenological calender for Chokari ecosystem complex. The importance of phenological calender needs hardly any emphasis. The knowledge of phenophasic transformation is essential for various practical purposes such as planning the grazing interaction operations,

harvesting the phytomass for fuel purposes and also for plant identification and its consequent uses in various other ways by the ecosystem human component.

The Three Phenophases :

The phenological calender prepared in this study covers the three useful phenophases.

1. Vegetative growth,
2. Flowering,
3. Seed-setting.

The vegetative growth is essential for the vegetational development. It is essential to know the vegetative growth period of the each of component species in the ecosystem.

The flowering and seed setting are vital phenophases. The knowledges time of flowering is not only essential for academic pursuits like taxonomic surveys and plant identification but is of paramount importance in operational processes of grazing interactions. Hence this useful information has been analyzed and presented in Calender (Table 20). The phenological calender presents monthly picture of the phenological stage of all the 104 component species of vegetational system at Chokari Ecosystem.

Table 20 : Phenological Analysis : Phenophasic Calender

Symbols used in the Phenological Calender :

Phenophase	Symbol
(1) Vegetative growth	+
(2) Flowering	o
(3) Seed setting	x

	J	F	M	A	M	J	Jy	A	S	O	N	D
PAPAVERACEAE												
Argemone maxicana Linn.	+	o	o	o	o	o	x	x	+	+	+	+
BRASSICACEAE												
Lepidium sativum Linn.	o	o	o	x	x	+	+	+	+	o	o	o
CLEOMACEAE												
Cleome viscosa Linn.	+	+	+	+	+	o	o	o	o	o	x	x
C. gynandra Linn.	x	o	o	o	o	o	o	+	+	x	x	x
PORTULACACEAE												
Portulaca oleracea Linn.	o	o	o	x	x	+	+	+	o	o	o	o
TAMARICACEAE												
Tamarix sp.	-	-	-	-	-	-	-	-	-	-	-	-
ELATINEAE												
Bergia ammannioides Roxb. ex Roth	o	o	o	x	x	+	+	+	o	o	o	o
B. odorata Edgew.	o	o	x	x	+	+	+	o	o	o	o	o
MALVACEAE												
Abutilon indicum (Linn.) Sweet.	o+	o+	o+	o+	o+	o+	o+	o+	o	o	o	o
Hibiscus cannabinus Linn.	x	x	+	+	+	+	+	+	o	o	o	o
ZYGOPHYLLACEAE												
Tribulus terrestris Linn.	o	x	+	x	+	+	+	o	o	o	o	o
RHAMNACEAE												
Zizyphus mauritiana Lamk.	o	o	x	+	+	+	+	o	o	o	o	o
FABACEAE												
Alhagi pseudalhagi (M.Bieb.)Desv.	+	+	o	o	o	x	x	+	+	+	+	+
Crotalaria retusa L.	x	x	x	x	+	+	+	+	o	o	o	o
C. juncea L.	o	x	x	+	+	+	+	o	o	o	o	o
C. medicaginea Lam.	x	+	+	+	+	+	+	o	o	o	o	o
Cyamopsis tetragonoloba (Linn.) Taub.	x	x	+	+	+	+	+	o	o	o	o	o
Dolichos lablab Linn.	o	o	o	x	x	+	+	+	+	+	o	o
Teramnus labialis (Linn. f.) Spr.	o	x	x	+	+	+	+	+	o	o	o	o
MIMOSAE												
Prosopis cineraria (Linn.) Druce	o	o	o	o	x	x	+	+	o	o	o	o
VAHLIACEAE												
Vahlia digyna (Retz.) O. Kuntze	o	o	x	x	+	+	+	+	+	+	+	o
LYTHRACEAE												
Ammannia baccifera Linn.	o	o	o	x	x	+	+	+	o	o	o	o
ONAGRACEAE												
Ludwigia perennisi Linn.	x	x	x	+	+	+	+	o	o	o	o	o
AIZOACEAE												
Sesuvium portulacastrum Linn.	x	x	x	+	+	+	+	+	+	o	o	o
Trianthema pentandra Linn.	x	+	+	+	+	+	+	+	+	o	o	x
T. portulacastrum Linn.	+	+	+	+	+	+	o	o	o	o	x	x
MOLLUGINACEAE												

Table 20 contd.

	J	F	M	A	M	J	Jy	A	S	O	N	D
MOLLUGINACEAE												
Glinus lotoides Linn.	o	o	o	o	o	o	x	+	+	o	o	o
G. oppositifolius (Linn.) DC.	o	o	x	x	+	+	o	o	o	o	o	o
APIACEAE												
Anethum graveoleus Linn.	+	+	+	+	+	+	+	o	o	o	x	x
RUBIACEAE												
Dentella repens (Linn.) Forsk.	o	o	x	x	+	+	+	o	o	o	o	o
Oldenlandia corymbosa Linn.	o	x	x	+	+	+	o	o	o	o	o	o
COMPOSITAE												
Ageratum conyzoides Linn.	o	o	o	x	+	+	+	o	o	o	o	o
Blumea mollis (D.Don) Merr.	x	x	+	+	+	+	+	+	+	o	o	o
B. oblique (Linn.) Druce	o	o	x	-	+	+	+	o	o	o	o	o
Cyathocline purpurea (Ham. ex D.Don) Kuntze	x	x	x	x	+	+	+	+	+	o	o	o
Eclipta prostrata (Linn.) Linn.	o+	o+	o+	o+	o+	o+	o+	o+	o+	o+	o+	o+
Gnaphalium indicum Linn.	o	o	o	x	x	+	+	+	+	o	o	o
Grangea maderaspatana (Linn.) Poir	o	o	o	o	x	x	+	+	+	+	o	o
Oligochaeta ramosa (Roxb.) Wagen.	o	o	o	x	x	+	+	+	+	o	o	o
Sphaeranthus indicus Linn.	o	o	o	x	x	+	+	+	+	+	o	o
Vernonia cinerea (Linn.) Less.	o	o	o	x	+	+	o	o	o	o	o	o
Xanthium strumarium Linn.	o	o	o	o	x	+	+	+	o	o	o	o
SALVADORACEAE												
Salvadora persica Linn.	o	o	o	o	x	+	+	+	o	o	o	o
BORAGINACEAE												
Heliotropium supinum Linn.	o	o	o	o	o	x	x	+	+	+	+	o
CONVOLVULACEAE												
Cressa cretica Linn.	o	o	o	x	x	+	+	+	o	o	o	o
Convolvulus microphyllus Sieb. ex Spreng.	o	o	o	x	x	+	+	o	o	o	o	o
Ipomoea aquatica Forsk.	o	o	x	x	x	+	o	o	o	o	o	o
SOLANACEAE												
Datura metel Linn.	x	x	+	+	+	+	o	o	o	o	o	o
Nicotiana tabacum Linn.	o	o	o	x	x	+	+	+	+	o	o	o
Solanum nigrum Linn.	o	o	o	x	x	+	+	+	+	o	o	o
S. surattense Burm. f.	o	o	o	x	x	+	+	o	o	o	o	o
SCROPHULARIACEAE												
Bacopa monnieri (Linn.) Pennell.	o	o	x	x	+	+	+	o	o	o	o	o
Lindenbergia muraria (Roxb.)P. Bruehl.	o	o	o	x	+	+	+	o	o	o	o	o
Lindernia parviflora (Roxb.) Haine.	+	+	+	+	+	+	+	o	o	o	x	x
Stemodia viscosa Roxb.	o	o	x	x	+	+	+	+	+	o	o	o
Verbascum chinense (Linn. Santapau	o	o	o	x	x	+	+	+	+	+	o	o
OROBANCHACEAE												
Orobanchae cernua Loef.	o	o	o	x	x	+	+	+	+	+	+	o
ACANTHACEAE												
Peristrophae bicalyculata Nees.	x	x	+	+	+	+	+	+	o	o	o	o
VERBENACEAE												
Avicennia alba Blume	o	o	o	o	x	+	+	+	o	o	o	o
Phyla nodiflora (Linn.) Greene.	o+	o+	o+	o+	o+	o+	o+	o+	o+	o+	o+	o+

Table 20 contd.

	J	F	M	A	M	J	Jy	A	S	O	N	D
LAMIACEAE												
Leucas capitata Desf.	o	o	o	o	o	x	x	x	+	+	+	o
AMARANTHACEAE												
Achyranthes aspera Linn.	x	x	+	+	+	o	o	o	o	o	o	o
Alternanthera sessilis (Linn.) DC.	x	+	+	+	+	o	o	o	o	o	o	x
Amaranthus gangeticus Linn. var. tristis Prain.	o	o	x	x	x	+	+	+	+	o	o	o
Amaranthus hybridus Linn. ssp. cruentus Thell. var. paniculatus Thell.	x	x	+	+	+	+	o	o	o	o	o	o
Amaranthus spinosus Linn.	+	+	+	+	+	+	o	o	o	o	x	x
Amaranthus viridis Linn.	o	o	o	x	x	+	+	+	+	o	o	o
Digera muricata (Linn.) Mart.	x	+	+	+	+	o	o	o	o	o	o	x
Nothosaerua brachiata (Linn.) Wight Icon.	x	x	+	+	+	+	+	o	o	o	o	o
CHENOPODIACEAE												
Chenopodium album Linn.	o	o	o	x	x	+	+	+	+	+	o	o
Suaeda fruticosa Forsk.	o	o	x	x	+	+	+	+	+	+	o	o
S. maritima Dumort.	o	o	x	x	x	+	+	+	+	+	o	o
S. nudiflora Moq.	o	o	x	x	+	+	+	o	o	o	o	o
POLYGONACEAE												
Polygonum plebeium R. Br. Prodr.	o	o	o	x	x	+	+	+	+	+	o	o
EUPHORBIACEAE												
Chrozophora prostrata Dalz.	o	o	o	o	o	x	x	+	+	+	+	o
C. rottleri (Geis.) Juss. ex Spreng	o	o	x	x	+	+	+	+	+	+	o	o
Phyllanthus asperulatus Hutch.	x	x	+	+	+	+	o	o	o	o	o	x
Euphorbia hirta Linn.	x	x	+	+	o	o	o	o	o	o	o	o
E. hypericifolia Linn.	x	+	+	+	o	o	o	o	o	o	o	x
E. microphylla Heyne	+	+	+	+	+	o	o	o	o	x	x	x
Ricinus cammunis Linn.	o	o	x	x	+	+	+	+	+	o	o	o
TYPHACEAE												
Typha angustata Bory & Chaub.	x	x	+	+	+	+	+	o	o	o	o	o
CYPERACEAE												
Cyperus difformis Linn.	o	x	x	+	+	+	+	+	o	o	o	o
C. laevigatus Linn.	+	+	+	+	+	+	+	o	o	o	x	x
C. michelianus (Linn.) Link. ssp. pygmaeus (Rottb.) Aschers.	x	x	+	+	+	+	o	o	o	o	o	x
C. rotundus Linn.	x	+	+	+	+	+	+	+	o	o	o	x
C. tuberosus Rottb.	o	x	x	+	+	+	+	o	o	o	o	o
Eleocharis atropurpurea (Retz.) Kunth. Enum.	o	x	x	+	+	+	o	o	o	o	o	o
Fimbristylis dichotoma (Linn.) Vahl, Enum.	x	+	+	+	+	o	o	o	o	o	o	x
F. diphylla Vahl Enum.	+	+	+	+	+	+	+	+	o	o	x	x
F. miliacea Vahl Enum.	x	x	+	+	+	+	+	o	o	o	o	o
Scirpus maritimus Linn.	o	o	o	x	x	+	+	+	+	+	o	o
GRAMINAE												
Acluropus lagopoides (Linn.) Trin. ex Thw.	x	x	+	+	+	+	+	+	+	+	o	o

Table 20 contd.

	J	F	M	A	M	J	Jy	A	S	O	N	D
Cenchrus ciliaris Linn. Mant.	o	o	x	x	+	+	+	o	o	o	o	o
Chloris virgata Sw.	o	o	x	x	+	+	+	o	o	o	o	o
Cynodon dactylon (Linn.) Pers.	x	x	+	+	+	+	+	o	o	o	o	o
Dinebra retroflexa (Vahl) Panz.	x	x	+	+	+	+	+	o	o	o	o	o
Echinochloa colonum (L.) Link.	x	x	+	+	+	+	+	o	o	o	o	o
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	x	+	+	+	+	+	+	o	o	o	o	x
E. japonica (Thunb.) Trin.	x	x	+	+	+	+	+	+	o	o	o	o
E. viscosa (Retz.) Trin.	o	o	x	x	+	+	+	+	+	+	o	o
Pennisetum typhoides (Burm.) Stapf. & Hubbard.	+	+	+	+	+	+	o	o	o	o	x	x
Trikicus aestivum Linn.	o	o	o	x	x	+	+	+	+	+	+	+
Zea mays Linn.	o	o	o	x	x	x	+	+	+	+	+	+

III. Growth form and growth period analysis :

The growth form analysis of all the component species of the Chokari vegetational system indicated that the vegetation does not have many tree species. The herbs dominate and the distribution of shrubs is scattered (Table 21) (PLATE 26 B).

Table 21 : Growth form of component plant species

Form	Total Plant Species
Herbs	88
Shrubs	15
* Tree	1

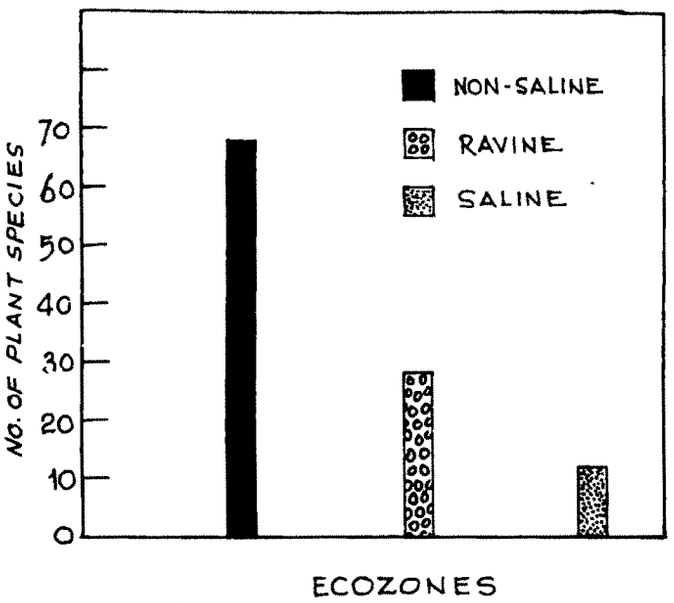
* (Stray trees in the fields and habitation area are not included).

The growth period analysis also yielded interesting results. It was found that the major portion of the components of vegetational system belong to the category of annuals. The biennials are least in dominance. The perennials out number biennials. The annuals however are dominant in all the three ecozones (Table 22).

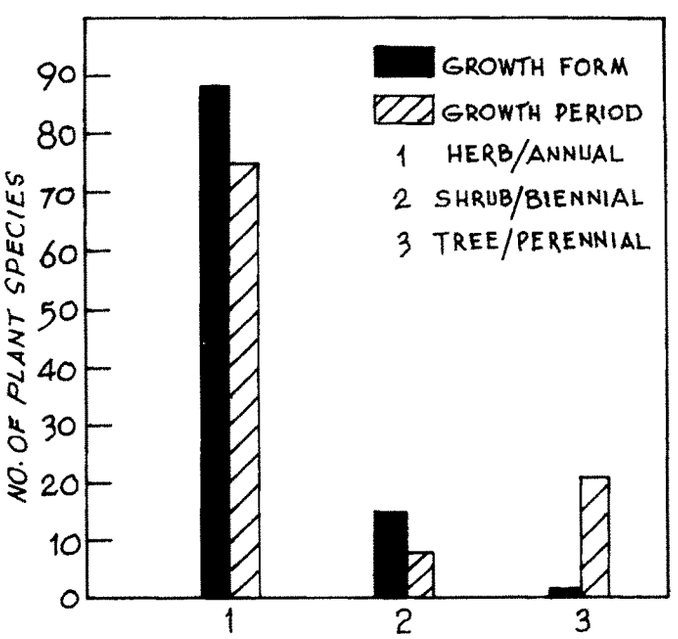
Plate - 26 A - Distribution of species in the three ecozones.

The comparison indicates the effect of salinity on the development of the vegetation.

Plate - 26 B - The Growth form and the Growth period analysis of the component species of vegetation is indicative ofthe typical agricultural environment with herbs and annuals in dominance.



DISTRIBUTION OF SPECIES IN ECOZONES - A



GROWTH FORM OF COMPONENT OF VEGETATION - B

PLATE - 26 (A & B)

Table 22 : Growth period of component plant species

Growth period	Total No. of plant species
Annuals	75
Biennials	8
Perennials	21

IV. Ecozonal Categorization of Vegetational System :

IV. 1. Climatic-Edaphic-Vegetational Interactions:

The physical environment of the Chokari region is semi-arid. There are annual species which survive this aridity of the physical climate. The edaphic environment in the Chokari ecosystem area also varies to a considerable extent. The interactions of the influences of the climatic and edaphic environments on vegetational systems are clearly visible. The ecozones of the Chokari ecosystem complex have already been described earlier.

The vegetational system of the entire ecosystem area also can be categorized into similar ecozonal patterns. The ecozonal patterns are distinct and comply with the concept put forth by Mooney (1974) that the physical and edaphic environments determine the structure of vegetation.

IV. 2. The ecozonal distribution and categorization :

(a) Non-Saline ecozone :

This supports typical semi-arid vegetation. The patches of vegetation are scattered. This zone supports the growth of 68 plant species. Some semi-arid elements such as Cenchrus ciliaris, Eragrostis tenella, Eragrostis viscosa, Eragrostis japonica are distinct. The plant species such as Alhagi pseudoalhagi, Argemone mexicana and some members of Compositae are indicative of dry spell of the region. At places where the water has accumulated as a result of canal blockage the amphibious plant species belonging to the genera like Cyperus and Scripus and Fimbristylis crop up. Some hardy species such as Xanthium strumarium are found in all the three ecozones except their absence is conspicuous in the saline zone near the coastal region. Salvadora persica is prominent in the entire landscape being the only tree species.

(b) Ravinous zone :

This is a peculiar zone in this ecosystem. The zone is geomorphologically so distinct that it separates the other two zones entirely. This zone is in fact is barren to the major extent but supports some green patches here and there. The

green patches in this zone include typical semi-arid grasses and hardy species belonging to the Compositae, Fabaceae and Euphorbiaceae.

(c) Saline ecozone :

This is typical zone which is marked by the dominance of members of the chenopodiaceae and graminae. The zone supports luxuriant growth of Suaeda fruticosa, S. maritima, S. nudiflora, Chenopodium album, Sesuvium portulacastrum, Ammannia baccifera, Aleluropus lagopoides. The presence of Avicennia alba is noted on the extreme regions of the coast and is considered to be a migrated species from shore zones by the vegetation scientists of this region. The saline ecozone shows presence of an association of Aeluropus lagopoides, Suaeda maritima, S. nudiflora and S. fruticosa in the patches where salt concentration is very high. These are the plant species which indicate salinity gradient in ecozones. Pure stands of Aeluropus lagopoides as well as Suaeda maritima were noted in extreme saline patches indicating the fact that salt tolerance of these as saline species is higher compared to the other halophytes of the area (Chapman, 1966; Ungar, 1966).

A word must be said about the halophytic potential of some hardy species based on their presence in saline zone at certain

places. The species which possess some considerable halophytic potential for growth in this region include Xanthium strumarium, Eclipta prostrata, Trianthema portulacastrum (PLATE 26 A).

Table 23 : Plant species distribution in the three ecozones

Ecozone	Total No. of plant species
Non-saline	68
Ravine	24
Saline	12

IV. 3. Typical Indicators of Saline ecozone at Chokari Ecosystem :A detailed Study of some halophytes :

Aeluropus lagopoides (Linn.) Trin. ex Thw. Enum. (Graminae)

Perennial, rigid, tufted, stems crowded on a woody root-stock with stout root-fibres, as thick as a crow-juill, simple or branched, smooth and polished, branches sometimes elongate, divaricate, 6-10 in. long, resembling stolones, giving off branchlets at the nodes but not rooting, nodes glabrous, internodes short or long. Leaves narrowly lanceolate, acuminate, flat or convolute and subulate, erect or spreading, glabrous or

sparsely ciliate, sheaths short, terete, or inflated, glabrous or ciliate, ligule a shortly hairy ridge. Heads of spikelets shortly pedunculate, subglobose or oblong. Spikelets reaching, 4-8 flowered, crowded, sessile, villous with soft hairs, pale green or white. Lower invol. glume, ovate-oblong, subacute, hairy and with ciliate margins, upper invol. glume 1/8 in. long, similar, floral glumes ovate, subobtuse, apiculate, many-nerved, hairy and ciliate, the lower 2-4 sometimes neuter, palea broad, 3-lobed. Anthers oblong. Grain obovoid-oblong, dorsally compressed.

Avicennia alba Blume, Bijdr. (Verbenaceae)

A shrub, branches pale. Leaves 2-3, lanceolate, very acute, glabrous above, whitish-tomentose beneath, base acute, petiole long. Flowers sessile, in heads at the apex of stout angular peduncles usually 3-4 from the last pair of leaves, less often solitary from each of a lower pair of leaves. Calyx 5-partite, almost to the base, sepals broadly ovate or suborbicular, obtuse, concave, ciliate. Corolla small, in diam. lobes 4, ovate, acute, subequal.Stamens included. Ovary villous, style villous, shorter than the ovary, 2-cleft. Capsules long, ovoid, compressed, apiculate, bright yellow and smooth when ripe (Gammie). Seed often germinating on the tree.

Sesuvium portulacastrum Linn. (Aizoaceae)

Herbaceous, stems prostrate, creeping and rooting at the nodes, often buried in the sand, stout, succulent, much branched, red, glabrous. Leaves opposite, linear or spathulate-oblong, sometimes subcylindric, fleshy, obtuse, glabrous, tapering much towards the base, petioles short, much dilated, and amplexicaul at the base, with broad scarious margins. Flowers axillary, solitary, pedicels about equalling the calyx, filiform, glabrous, calyx deeply 5-lobed, purplish outside, rosy within, long, lobes lanceolate, oblong, obtuse, with a mucro just below the apex behind. Stamens numerous, free or nearly so, filaments red. Ovary usually 3-celled, styles usually 3-capsules 3-celled, enclosed within the persistent calyx, pointed, circumscissile, black, smooth and polished.

Suaeda fruticosa Forsk (Chenopodiaceae)

Shrubby, usually erect, much-branched, stem pale, glabrous; leaves fleshy, subsessile, terete, variable, linear-oblong or ellipsoid or somewhat obovate, obtuse, narrowed at the base, the floral leaves short. Flowers hermaphrodite, axillary, solitary or 2-3-nate, bracteoles membranous, ovate, acute, entire or with slightly denticulate margins. Perianth in fruit subglobose, segments thick, oblong, cencave, obtuse, in curved. Utricle obovoid, thickened at the top, stigmas 3,

short, spreading. Seed long, obliquely ovoid, somewhat beaked, slightly compressed, smooth and shining, black when ripe.

Suaeda nudiflora Moq. (Chenopodiaceae)

A diffusely branched woody perennial undershrub, stems prostrate, much-branched, smooth, yellowish. Leaves numerous, soon falling, elliptic-oblong or linear-obovate, very obtuse, rigid, glabrous, at first flattish, afterwards half terete, glaucous green (Trimen), base narrowed. Flowers hormaphrodite, axillary, in dense globose many-flowered clusters, forming dense spikes, leafless in the upper part, bracteoles ovate, acute, membranous, with pectinate margins. Perianth long, obovoid, segments oblong, obtuse. Utricle ovoid. Stigmas 3. Seed erect, about small in diam. lenticular, smooth, shining, black.

Suaeda maritima Dumort. (Chenopodiaceae)

An annual, stems woody at the base, erect, quite high, with numerous very slender erect branches. Leaves numerous, narrowly linear (sometimes filiform), fleshy, subacute, the floral leaves very small. Flowers in small, few flowered globose clusters forming very slender elangate, lax spikes, bracteoles ovate, membranous, entire. Perianth scarcely long, segments rounded, covering the utricle. Stigmas 2, long, slender. Seed obliquely ovoid or sub orbicular, long, smooth, shining, black.

V. Eco-stresses on Vegetational System :

A qualitative analysis showed that the vegetational system at Chokari is not free from ecological stresses. There is constant and continuous interaction between the vegetational system and the physical environment as well as between the vegetational system and the biotic components. The excessive unidirectional interaction results in the stresses on the vegetational system. The eco-stresses at Chokari vegetation can be classified as follows :

(i) environmental stresses
(ii) grazing interaction stresses
(iii) harvest stresses.

(i) The environmental stresses :

These stresses can be that of physical environment or edaphic environment. The major environmental stress is the non-availability of adequate supply of water which results in the arid conditions. The accumulation and concentration of salts in the edaphic complexes also results in characteristic stress. The vegetational distribution in various ecozonal areas is indicative of such stresses.

(ii) The grazing interaction stresses :

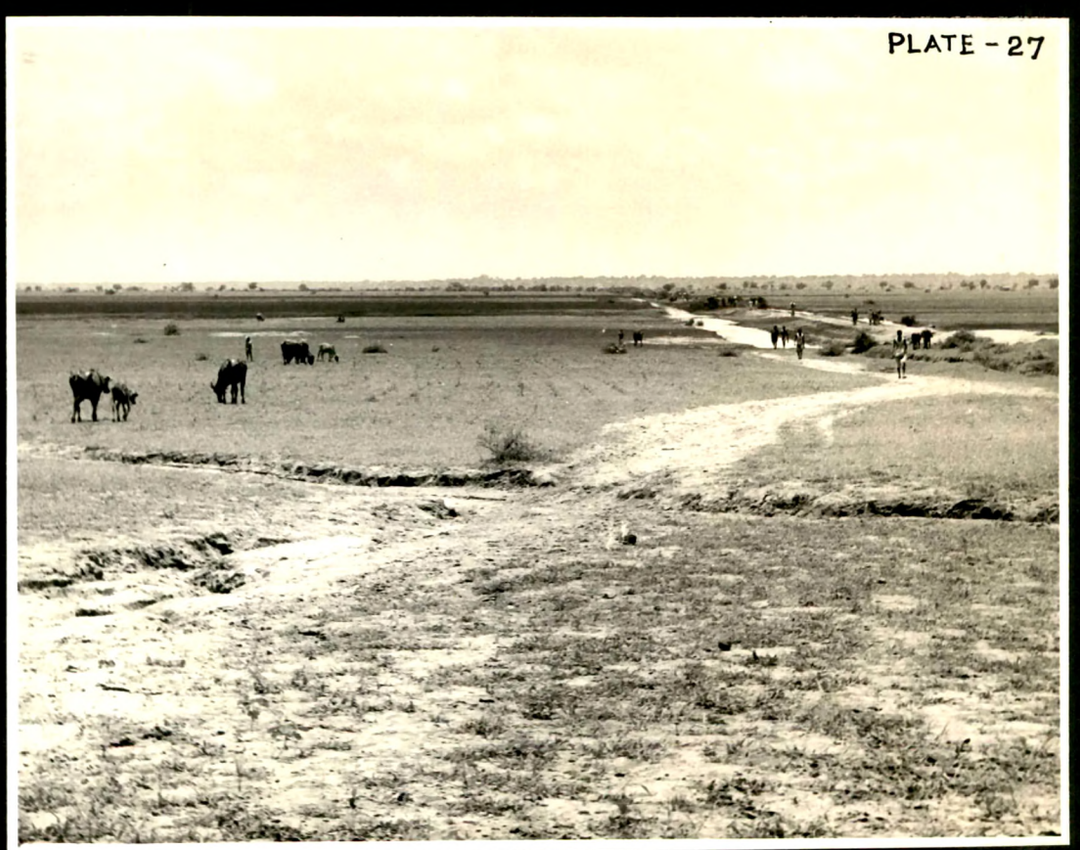
Chokari ecosystem has grazing population which exceeds considerably than its capacity to support. This results in excessive grazing pressure on the vegetational system and inhibits the growth and maturity of components of the vegetational system (PLATE 27).

(iii) The harvest stresses :

The human component at Chokari ecosystem depends upon the vegetational system for fuel as well as house thachting and supporting structures. Hence they harvest the live or dry phytomass for various purposes thus cause eco-stress for the vegetational system.

Plate - 27 : Stresses of Grazing on the vegetation patches (devoid of shrub or tree components) in saline ecozone.

PLATE - 27



Thesis Component III
Biotic Compartment

Unit - I

Autotrophic (Primary Producer) Component

Sub-Unit B

Crop Systems

Basic Conceptual Comprehension :

The tremendous growth of human population makes it absolutely essential to analyse the existing cropping systems and patterns and the actual land utilization pattern. In any ecosystem, where the population tends to increase with respect to its existing carrying capacity the optimal utilization of land and other resources is essential. On the other hand, climate and soil conditions cannot be segregated for the optimization of agricultural output. Manfred Domros (1976) has invited attention to the two basic issues of the problem :

1. Are the plants cultivated and used by man grown in those regions that have most favourable climatic and soil conditions for the plant in question?

2. Where would it be possible to effect a re-structuring or diversification of land use or cultivation of certain plants to make the best use of the natural conditions for plant growth? According to Domros (1976) these questions can be considered only after the critical evaluation of the actual land use patterns and cropping pattern in the given area. Domros (1976) further suggests that a careful evaluation of actual and potential land use from the view point of climate and soil is essential. The science of agroclimatology has made it possible to contribute to answering both the basic issues by the examination of the many inter-relationships affecting agricultural landuse and physical edaphic environment.

In the present unit an attempt has been made to analyse landuse patterns of Chokari rural complex.

The unit also presents a detailed analysis of the cropping pattern, yield data and the diagnosis of problems of agriculture in the ecosystem area.

I. Land utilization analysis : a realistic approach :

The land utilization analysis of Chokari rural ecosystem was done with the assistance of the village panchayat officials. The land use balance sheet emerging out of the analytical study is presented here (Tables 24 and 25).

Table 24 : Land utilization analysis

	Land use type	Area (hectares)
(a)	Total land area	1380.11
(b)	Cultivated land area	479.95
(c)	Barren and uncultivable waste land including the grazing land area	859.02
(d)	Habitation land area	29.81
(e)	Forest cover land area	Nil
(f)	Land area for Roads and Public use	11.33

The percentile land utilization pattern is presented below :

Table 25 : Percentile distribution of land utilization pattern.

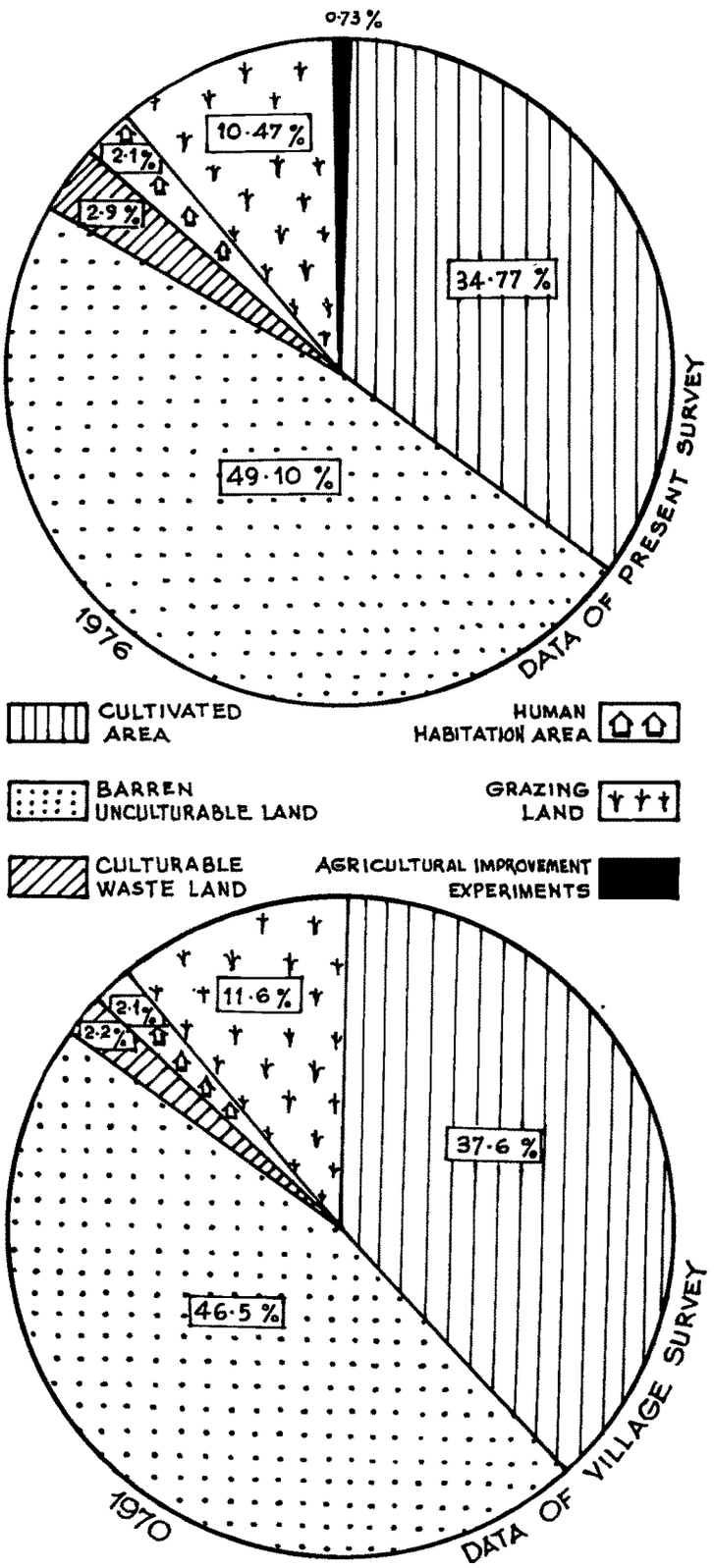
	Land use type	1970-1971 (village Records)	1975-1976 (present survey)
1.	Cultivated area	37.6%	34.77%
2.	Barren uncultivable land	46.5%	49.10%
3.	Cultivable waste land	2.2%	2.9%
4.	Human Habitation area	2.1%	2.1%
5.	Grazing land	11.6%	10.4%
6.	Agricultural Improvement Experiments	Nil	0.73%

The total land use pattern clearly indicates that 2.9% of the area is cultivable waste land while 49.10% is barren and uncultivable waste land.The cultivated area forms only 34.77% of the total area (PLATE 28).

I. 1. Uncultivable Land Use Pattern :

Recognizing the fact that the 49.10% uncultivable land it was further analyzed for its utilization pattern. This land

Plate - 28 : The Circular Graph of Land Use Pattern at Chokari. The 'minor' changes in the pattern are evident on comparison of the circular graph of 1970 and 1976. Agricultural improvement experiments include only the preliminary trials of 'coconut' introduction in saline ecozone.



LAND USE PATTERN AT CHOKARI

PLATE-28

includes grazing land area which is a constituent of the uncultivable land area (PLATE 29 A) (Table 26).

Table 26 : Percentile distribution of uncultivable land use pattern : Total area : 859.02 hectares.

Land use type	% Contribution
(a) Grazing land	75.24
(b) Road and approaches	5.42
(c) Village Pond	2.74
(d) Cemetry and burial place	1.30
(e) Village well	0.80
(f) Waste land	14.50

This analytical survey indicates that Chokari occupies only 2.57% of total taluka land. The Chokari agro-ecosystems are spread over 479.95 hectares which forms only 1.114% of the total taluka cultivation area (PLATE 30).

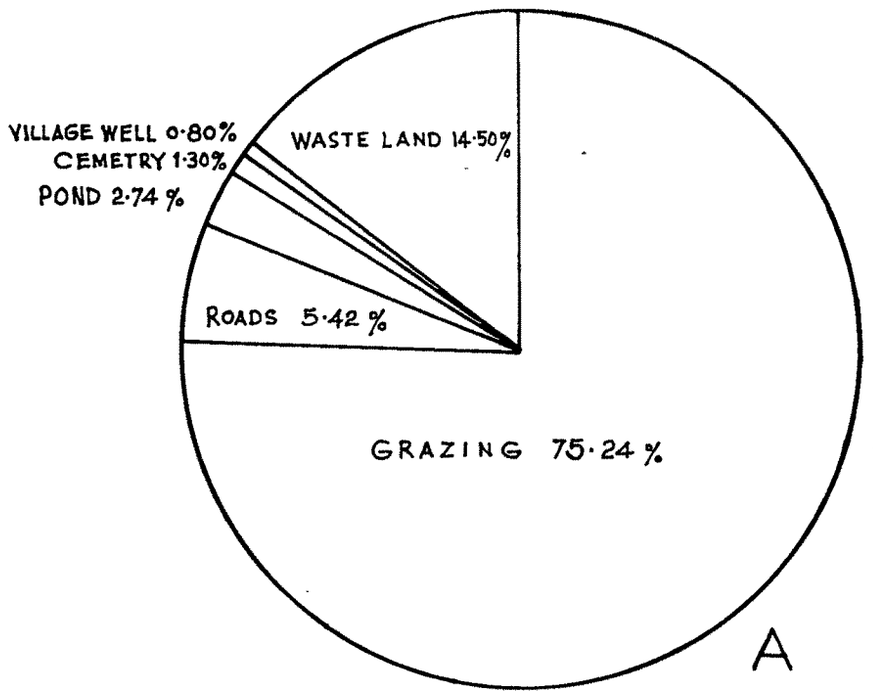
I. 2. Some indices of ecostatus of development of Chokari :

1) Land : Man Ratio :

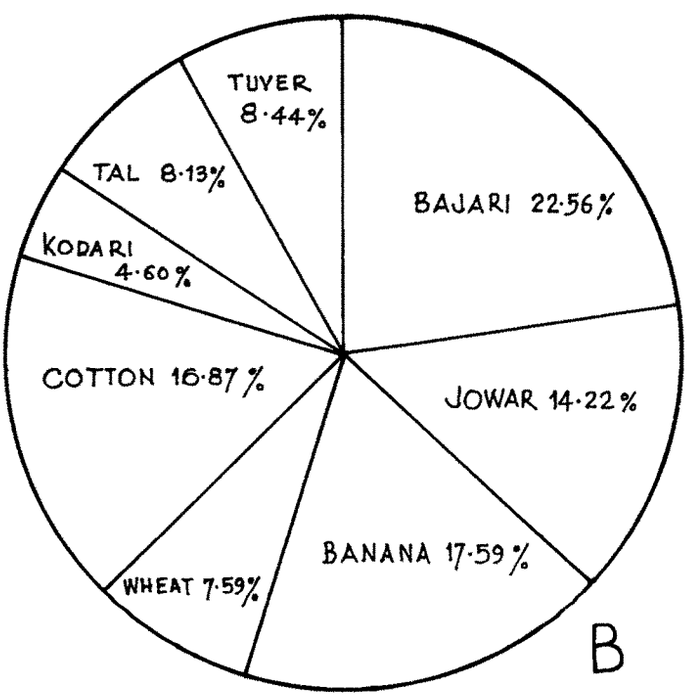
It is significant to know that land to man ratio gives an

Plate - 29 A : The Land use pattern o for the uncultivable land in the ecosystem area at Chokari.

Plate - 29 B : Cropping pattern in non-saline ecozone indicating percentage (of the total) area of each of the crop system.



UNCULTIVABLE LAND USE PATTERN
CHOKARI

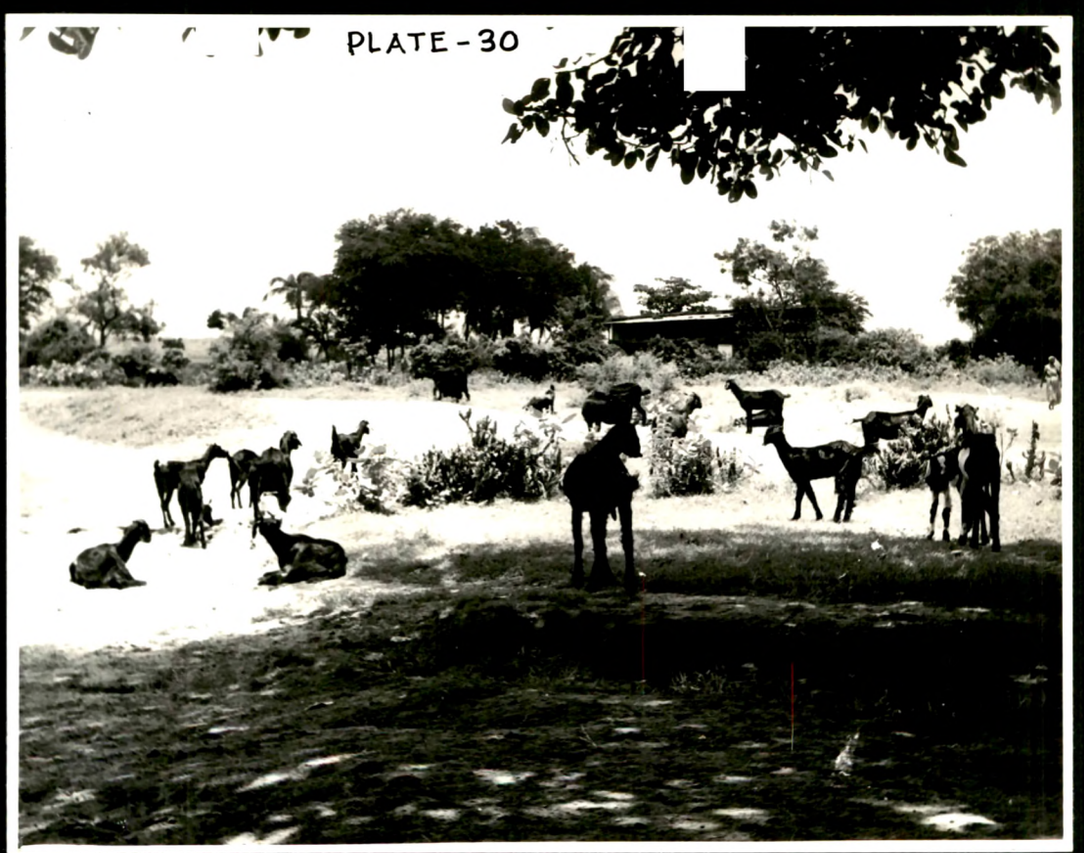


CROPPING PATTERN IN NON-SALINE ECOZONE

PLATE- 29 (A & B)

Plate - 30 : Uncultivable waste land used for the grazing purposes and now a small portion under trial experiments for the improvement (see coconut and other tree clusters).

PLATE - 30



index of the developmental stage of the given area. The land to man ratio is actually a measure of population pressure on the given area and serves as a useful index in determination of developmental ecostatus of the rural ecosystem. It is found that the Padra taluka land to man ratio is 0.25 hectares/person while for Chokari ecosystem the ratio is not much different. The value o for Chokari area is 0.21 hectare/person. The figure for India (1971) is 1.09 hectare/person (Sud, 1977). The ratio of Chokari rural ecosystem is comparatively low.

2) Cultivated Land : Man Ratio :

The land to man ratio of Chokari ecosystem or taluka complex does not vary much when compared to the other ecosystem areas of the region (Taluka Report, 1971). It was found that the ratio of the cultivated land to man also needs consideration. This index is one of the determinants of the ecostatus of the area and indicates the economic environment coupled with the socio-economic status of the population. The cultivated land to man ratio calculation here shows a low value of 0.077 hectare/person for Chokari rural ecosystem. The ratio gives an indication of the underdeveloped nature of the area. The ratio value for Gujarat region is 0.52 hectare/person and for India is 0.36 hectare/person as reported by the Economic Monitoring Service (1975). While comparing these ratios to

that of North American figure of 1.7 hectare of cultivated land/person (Vink, 1975) gives a clearcut picture of the underdeveloped condition of the Chokari ecosystem complex as well as of India in general.

3) Habitation Land : Man Ratio :

The habitation area is generally over crowded and there is no standard laid for the dwelling structure designs in an underdeveloped area like Chokari. This clustering and over crowding not only creates the problems of environment and health but also leaves no apparent scope for the development of the habitation area. Hence, habitation land : man ratio was calculated and it was found to be 0.004 hectare of habitation land/person. This figure indicative of the poor dwelling conditions at Chokari.

4) Grazing Land to Animal Owner Ratio :

The 'grazing wealth' is possessed by the Chokari human component. The average possession of milk yielding animals varies from family to family but is sufficient to meet the family needs. Hence there is pressure on grazing land in terms of owners of the 'grazing wealth'. This ratio is found to be 0.023 hectare/person.

From the above ratio-studies it is clear that the re-structuring of the land use is essential in non-saline ecozone. The village human habitation is divided in twelve units and this results in the waste of usable and cultivable land in this ecozone. The land use classification has revealed the existing patterns of land utilization. There is need to work out the potential land use by undertaking the ecological studies (Table 27).

Table 27 : Land to man ratio values : Chokari.

	Ratio Type	Ratio Value
a)	Total (geographical) land : Man	0.21 hectare/person
b)	Cultivated land : Man	0.07 hectare/person
c)	Habitation land : Man	0.004 hectare/person
d)	Grazing land : Animal Owner	0.023 hectare/person

II. An agroclimatological land classification and Crop System at Chokari Ecosystem :

Agroclimatological Land Classification : An improvised Concept :

Domros (1976) defines agroclimatology as a new scientific discipline which straddles the field of climatology and

meteorology on the one hand and the agricultural sciences on the other. In general terms, agroclimatology is concerned with the interactions of the fields of agricultural systems and climatological processes.

The classification of agricultural land envisaging the effects of the physical as well as edaphic environments also comes under the purview of this branch.

The Chokari cropping pattern has been dealt with from the agroclimatological points of view. The land used for cultivation has already been subdivided into the non-saline and saline ecozones. These ecozonal areas show considerable variation in the farming system of the area. These systems are discussed under separate headings in the second part of this Unit.

Table 28 : Agroclimatological landuse pattern in non-saline ecozone : (PLATE 29 B).

Total land area under cultivation = 479.95 hectares.

Crop System	% Area
Bajari	22.56
Jowar	14.22
Banana	17.59
Wheat	7.59
Cotton	16.87
Kodari	4.60
Sesamum	8.13
Tuver	8.44

Saline ecozone shows 'mixed' cropping patterns. The practice of 'mono' cropping is not very popular in this zone.

Basic Conceptual Comprehension :

On global scale the annual influx of photosynthetically active radiation (PAR) at earth's surface is of the order of 100×10^{22} joules. Total amount of biomass produced by autotrophic plants is estimated to be about 100×10^{9} tonnes of carbon which is equal to 170×10^{19} joules of energy. The total utilization of PAR is only 2%.

Cooper (1976) tabulates efficiencies between 3% and 4% during most active growing period of individual C_3 - C_4 crops.

Photosynthesis may reach 20-30% of absorbed light i.e. 1 mol of CO_2 assimilated for 8-10 quanta of light. There is 1-2% utilization of PAR in agriculture. Chokari rural ecosystem is solely dependent upon the efficiency of its agro-ecosystems.

III. Farming system of non-saline ecozone :

The farming system of non-saline ecozone is classified under the 'natural' or 'organic' farming systems.The input of 'organic' or 'the green manure' is highest. There is a very negligible input of the fertilizers and pesticides in the farming operations. There is a periodic weed-removal operation.

Irrigation to non-saline farm areas is available as there is a tube well in this ecozone (PLATE 31).

The irrigation is done only for the area of 117.5 hectares of the land. Farming is largely monsoon oriented. The harvest is termed as the 'natural' harvest as there is very negligible energy input into the entire zone of cultivation (PLATE 32).

Fragmentation of the land is another major reason which hampers the yield in this zone. The 'marginal' farming pattern dominates the entire zone.The average farmer is in hold of hardly 0.405 hectare of land. This is one of the causes of poor agricultural output of the area as reported by the taluka authorities. The farmer is devoid of any resources to use mechanized methods. There is intensive input of man power (Sud, 1977). In terms of energetics, the farming systems at Chokari are the means of harvesting the solar radiation energy for the human as well as animal population.

IV. Saline zone farming system :

Saline zone forms the part of the long saline belt of soils which touches several rural ecosystems complexes. These parts of this zone are also used for the cultivation purposes.

Plate - 31 : The Chokari crop field after the 'harvest' operation.

PLATE - 31

Plate - 32 : The tube well in non-saline ecozone for the irrigation of 117.5 hectares. This is the only tube well in the ecosystem area. The funds for this well came from 'Marginal Farmers Improvement Project' of the District.

PLATE - 32

IV. 1. Estuarine fluctuations :

The zone is distinct because of the typical estuarine fluctuations. There is periodic ingress of saline water into the tidal mouth of the river which makes the edaphic complexes saline. Salinity gradient varies and seasonal changes occur in the content of total soluble salts. Thus there is no psssibility of intensive agricultural operations. However, the Government has given this land to the marginal farmers who cultivate it on cooperative basis (PLATE 36A and 36B).

IV. 2. The Cooperative farming in Saline zone :

The marginal farmers have cooperative societies (about five) and these society members jointly cultivate the land on the patterns of 'mixed natural cropping'.

IV.3. The mixed natural cropping patterns :

The mixed cropping of several crops is done at a time. There is diversity of crop species. It is not a monoculture of one crop (PLATES 37A and 37B). This is due to the fact that in event of the failure of one crop species due to the fluctuating salinity gradient in the zone the other crop remains to give some yield. There is no input of fertilizers or pesticides except that of biotic energy in form of organic manure and human labour.

The society members work as the agricultural labour and their input is recorded. They perform only two agricultural operations, viz. the sowing and the harvesting operation. The sowing of seeds is done at the suitable time and the crop is allowed to mature. After crop matures the 'harvest' is done. There is no other operation in saline ecozone. The soil has sufficient moisture due to the proximity of river and due to the accumulation of rainwater. The crops are harvested and are shared by the members of the cooperative society. Labour input of members is considered while disbursing the 'share' of the 'natural' harvest.

V. Cropping Calendar and Harvest Calendar (Phenology of Crop Systems)

Field visits during the study period were made to analyze the phenology of agroecosystems. The observations were used to prepare the cropping and harvest calender for Chokari ecosystem.

It is needless to emphasize that such a calender shows the seasonal changes in the phenology of entire agro-ecosystem area in the Chokari ecosystem complex.

V. 1. Agricultural yields of Chokari Crop System :

The crop systems at Chokari give meagre yields compared

to the other rural ecosystem as reported by the panchayat authorities. The reasons have been already discussed in the concerned units and subunits. The crop yields are however, not enough to maintain the load of population and subsidies in terms grain imports from other rural ecosystems are commonly brought in to maintain the human component even at the subsistence level. (PLATE 34A).

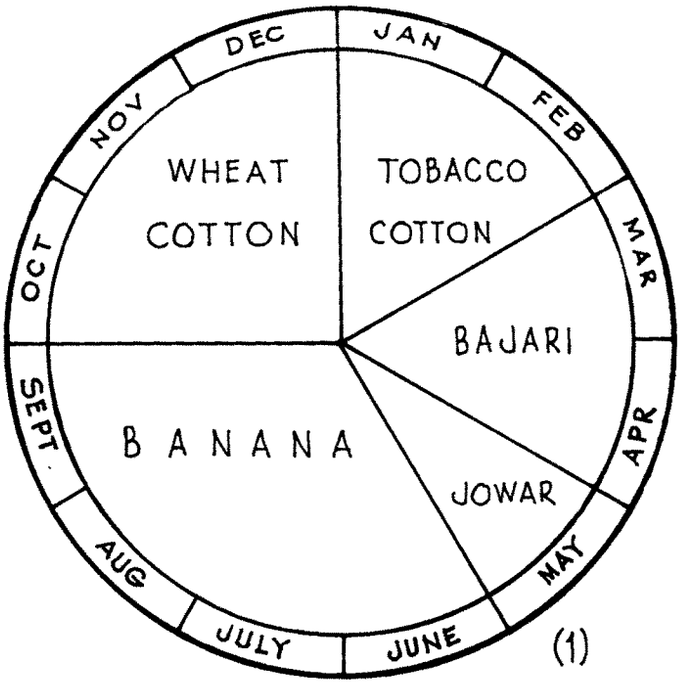
Table 29 : Crop yield output. (PLATE 35).

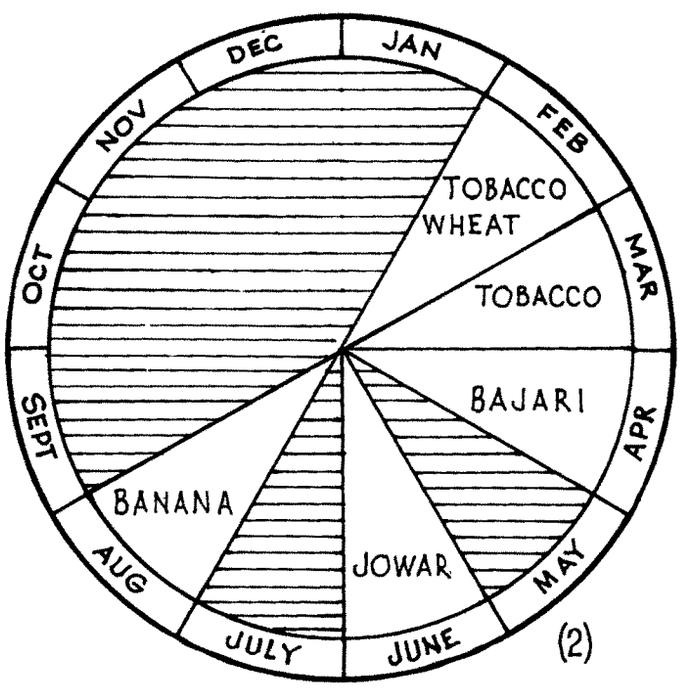
Crop system	Yield
Bajari	4446 kg/hectare
Banana	51870 kg/hectare
Paddy (occasional)	890 kg/hectare
Kodari	1976 kg/hectare
Sesamum	490 kg/hectare
Tuver	430 kg/hectare
Wheat	2021 kg/hectare
Cotton	24.7 bales/hectare

VI. Energy Inputs to Agro-ecosystem at Chokari:

It has been already mentioned that there is large input of organic manure. Chokari ecosystem does pose any problem of

Plate - 33 : Cropping and harvest calender of the Crop systems of the Chokari showing the monthly phenological status of the agro-ecosystems of the area.

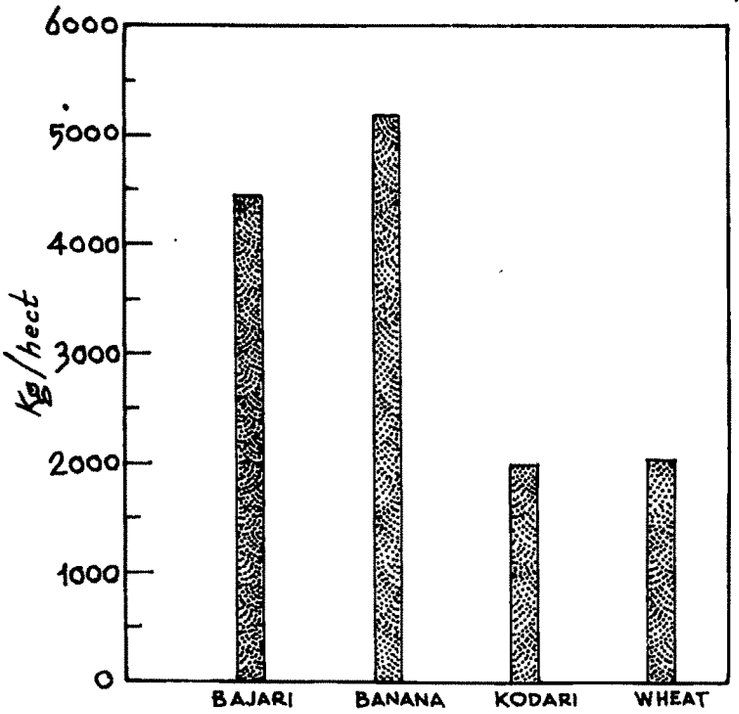




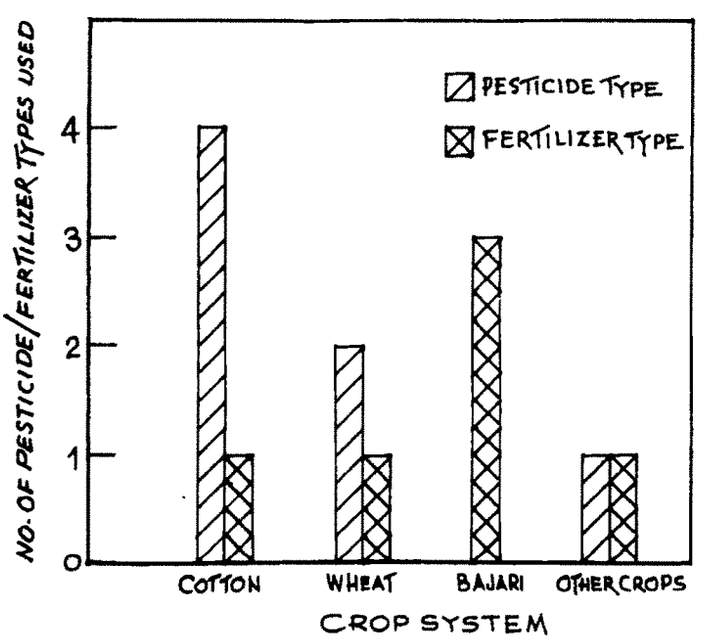
CROPPING (1) & HARVEST (2) CALENDER OF CHOKARI CROP SUBSYSTEM. PLATE - 33

Plate - 34 A : Agricultural output of the four major crops of the ecosystem area. (Kodari is Paspalum scrobiculatum Linn.).

Plate - 34 B : The 'input' of synthetic fertilizers and pesticides in the agro-ecosystem. The 'input' being low has no reported environmental impact.



AGRICULTURAL OUTPUT OF SOME MAJOR CROP SYSTEMS - A



PESTICIDE/FERTILIZER INPUT IN CHOKARI ECOSYSTEM - B

PLATE - 34 (A&B)

Plate - 35 : The Chokari Banana cropping in non-saline ecozone. The two views - one of the young plants and the other of the mature stands indicate the Chokari cropping pattern.

PLATE-35

Plate - 36 A :
36 B :

Comparison of the wheat cultivation in the non-saline ecozone and the saline cultivable ecozone.The marked difference in the crop density is evident. The saline patches are visible in Plate 36 B.

PLATE-36A

PLATE-36 B

Plate 37 - A : The 'mixed' crooping in saline ecozone is
37 - B : seen in the plate A. The crop field of saline ecozone after the other crops have been harvested and only the one remains to be harvested is seen in plate B.

PLATE - 37 A

PLATE - 37 B

excessive utilization of energy sources. On the contrary the ecosystem poses problem of input subsidies of energy. A graphic but self explanatory chart of input is presented here (Table 30) (PLATE 34B).

Table 30 : Input Patterns

Crop system	Fertilizer type	Quantity
Wheat	Urea Ammonium sulphate	16 kg/hectare
Bajari	" "	8-10 kg/hectare
Other crops	Organic manure	8880 kg/hectare

The marginal farmers totally depend upon the organic manure while one or two 'big' farmers may use synthetic fertilizers.

Pesticide input :

Pesticidal input is very low in entire ecosystem area. The pesticides used are Andrin, Seven, DDT, BHC and 2,4-D. An inventory revealed that input was 300-400 mg/hectare in case of liquid pesticides while 8-10 kg/hectare in case of powder pesticides. There is no record of extensive use of pesticides in ecosystem area.

In the end the output of crops systems can be correlated to the socio-economic status of the human component and vice-versa.

The agricultural output optimization at Chokari ecosystem has to be taken up by the authorities as an urgent measure to improve the economic environment of the ecosystem.

Thesis Component III

Biotic Compartment

Unit - II

Consumer Component

Sub-Unit A.

Animal Populations

(Grazing Component and Interactions)

" All animals are equal but some animals are more equal than others ".

- George Orwell (1946).

Basic Conceptual comprehension :

"All animals are equal but some animals are more equal than others". - Orwell (1946).

George Orwell's (1946) comment is ecologically oriented from the point of view of the interactional analysis of the ecosystem. The animal population of the ecosystem is the secondary producer component and constitutes an important link in the food chain. The domesticated animal populations interact with the human component of the ecosystem, thus being 'more equal' compared to the others.

In this unit an assessment of the grazing domesticated animal populations of the Chokari ecosystem is presented. A. qualitative analysis of the interaction is also discussed to comprehend the important role played by the animal population in the Chokari ecosystem complex.

I. Animal Population of Chokari rural ecosystem area : Over-all assessment

The animal population of Chokari rural ecosystem area belongs to the category of the grazing animal population. There is no wild life in the ecological sense of the term. The ecosystem has no area under forest cover and no natural or artificial plantation of forest tree species is maintained. Chokari ecosystem has typical agricultural environment and does not support any wild life species. Although an analysis of the ecohistory of the area reveals the fact that a part of this ecosystem area was under the 'shikar' department of the erstwhile Baroda State. Dabka rural complex (a nearby village) was the main 'shikar' centre of the erstwhile Baroda rulers. However, the entire area is dominated by agricultural systems for the subsistence of the population. The animal population at Chokari forms an important ecosystem component from the following points of view : (a) it is the source of biotic energy which is an essential input to agro-ecosystems, (b) it is also a source of secondary production - especially the milk production which brings animal population in the trophic chain, (c) it constitutes an interacting system for grazing which makes this population a focal point when considering the vegetational systems and the pressures of grazing, (d) it is

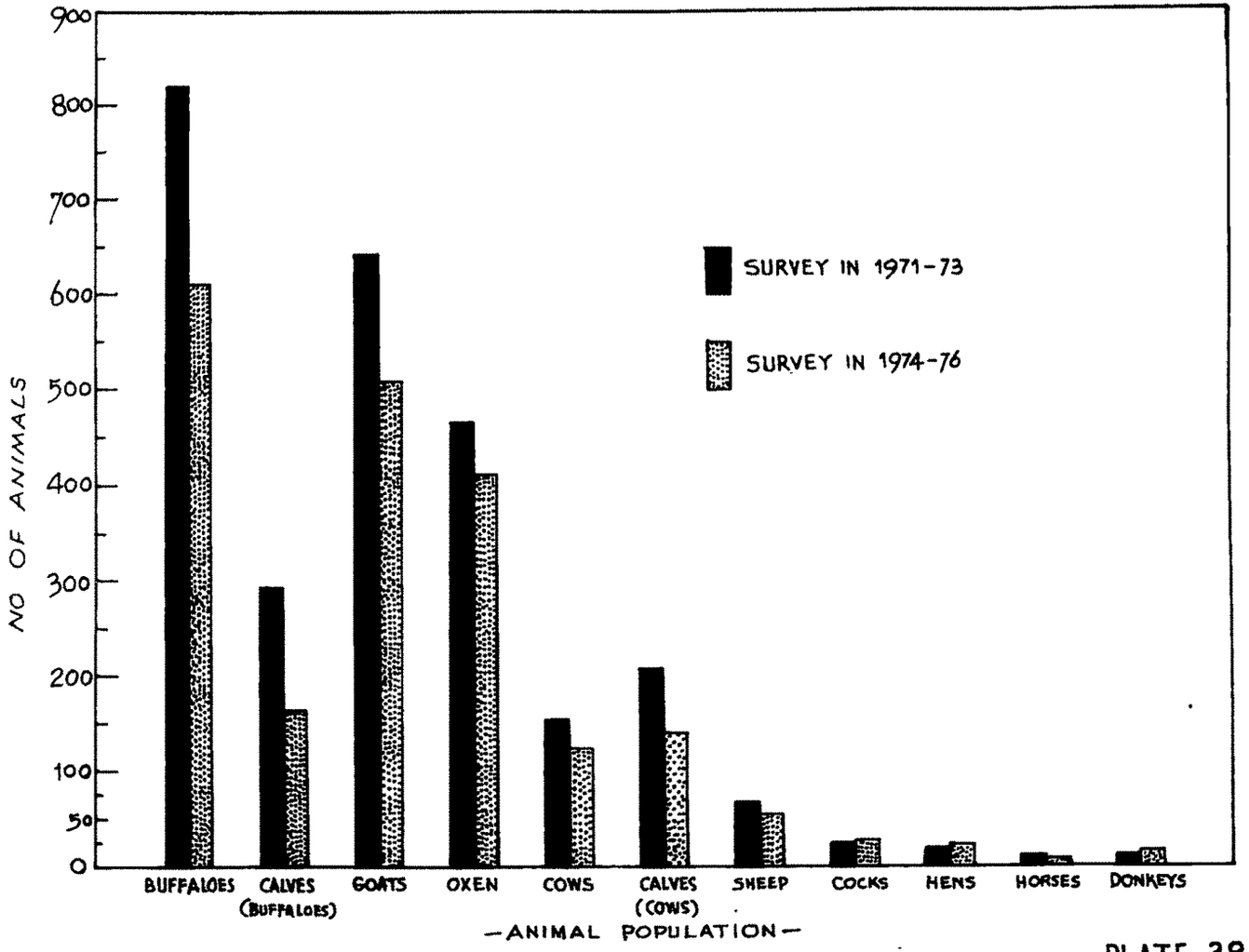
important as the producer of the part of 'organic' or 'natural' manure to be used in the ecosystem complex and in that process replenishing the edaphic component of the ecosystem with biogenic salts. Animal population consists of the following constituent animal types (PLATE 38) (Table 31).

Table 31 : Changes in Bovine Structure.

Animal type	1971-1973 village survey	1974-1976 present survey
Buffaloes	819	610
Calves (Buffaloes)	268	168
Goats	641	508
Oxen	465	410
Cows	151	121
Calves (cows)	206	163
Sheep	65	52
Cock	24	28
Hen	16	19
Horses	6	4
Donkeys	8	13

The assessment of the Bird populations of the ecosystem area was not included in this doctoral project due to the difficulties of the bird survey and project resources. It is

Plate - 38 : Changes in the Bovine structure are clearly observable when the survey values are compared. The overall trend is towards the decrease in grazing population.Taluka authorities report that 1974 'dry spell' had the adverse effect on the Bovine Structure of the ecosystem area.



BOVINE STRUCTURE AT CHOKARI ECOSYSTEM

PLATE-38

known by the author very well that study and assessment of the bird population and their ecological interactions is interesting and informative in ecosystem analysis. In qualitative as well as the quantitative modelling such a study gives a more meaningful picture of the ecosystem.

In the present analysis of the ecosystem attention has been focussed only on the grazing animal population and their interactions.

II. Interaction of the animal populations at Chokari rural ecosystem Complex :

(a) Grazing interactions :

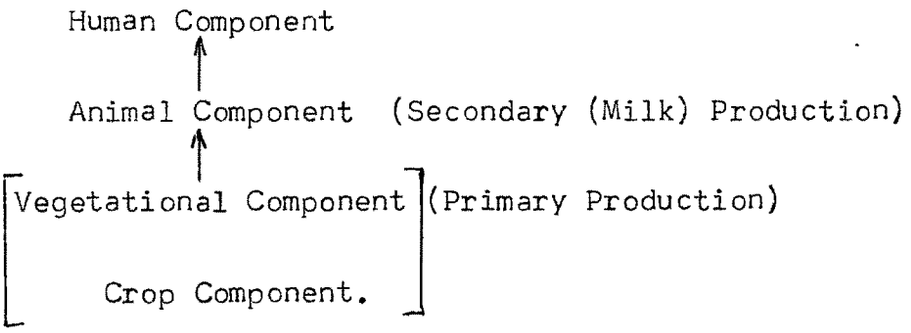
The animal grazing takes place on an area of 144.59 hectares which is actually included in the uncultivable and waste land.

The so called grazing land forms 10.47% of the total land area of the Chokari ecosystem complex and on 8.4% of the taluka complex.The grazing land supports a number of grass species. Noteworthy among these species are Cenchrus ciliaris, Linn. Mont., Chloris virgata Sw., Cynodon dactylon (Linn.) Pers., Dinebra retroflexa (Vahl) Punz., Eragrostis viscosa (Retz.) Trin., Eragrostis tenella (L.) P. Beauv. ex Roem. &

Schult., Eragrostis japonica (Thunb.) Trin. The area of grazing land in 1970 was 11.6% of the total land area which has decreased in 1976 to 10.47% and the land area classified as barren has been on the increase. The ratio comes to 0.023 hectare of grazing land per person.

(b) Milk Production (Secondary production) and trophic Interaction :

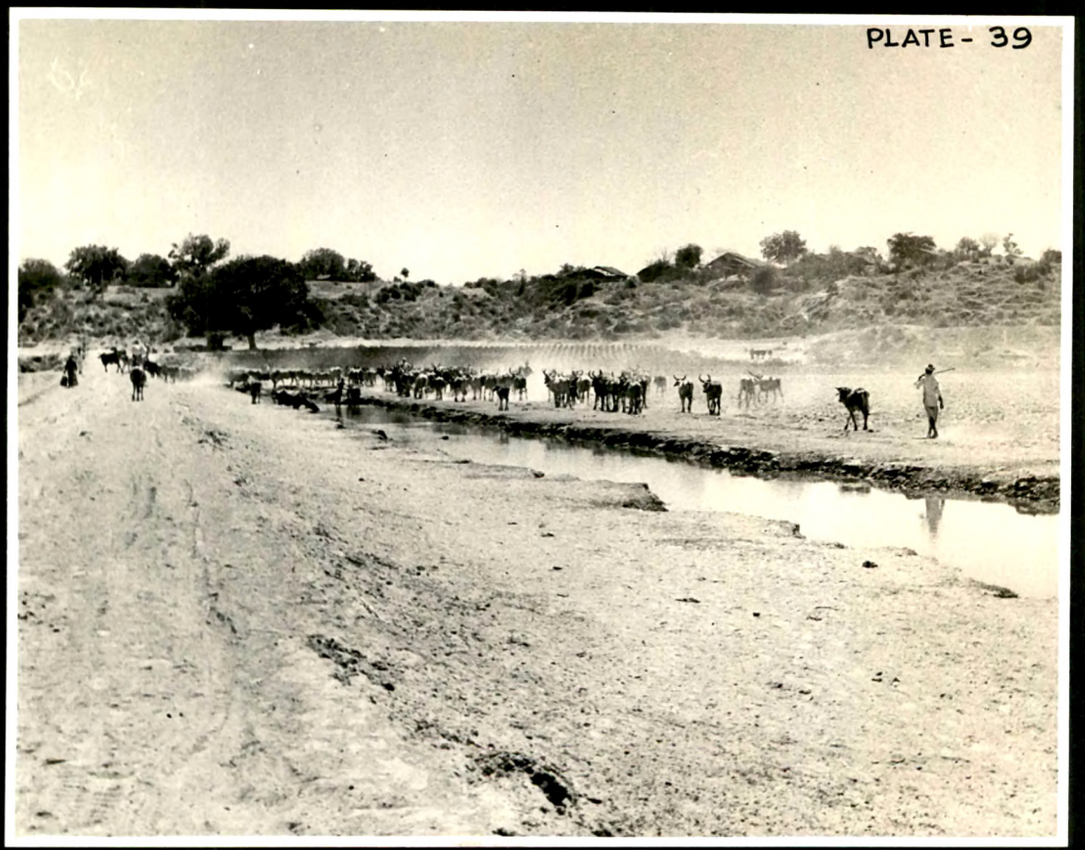
The animal population at Chokari forms an important link in the trophic structure of the ecosystem (PLATE 39). The milk and milk products are utilized to a some extent in the food. A simple Chokari food chain is given below.



The milk production of the animal component is only 2-3% of total taluka production.(Table 32). This milk production is slightly more than the average consumption of the human population - and this excess is supplied to the cooperative milk society of the taluka. However, the milk production

Plate - 39 : The 'secondary' producers (grazing animals) are ready to interact with the primary producer (components of vegetation) in the food chain of the ecosystem.

PLATE - 39



fluctuates and the income obtained as a result of the milk output has no substantial effect on the economy of the village as reported by the panchayat officials (PLATE 40A).

Table 32 : Milk Yielding Population.

Animal type	1971-1973 village survey	1974-1976 present survey
Buffaloes	462	316
Goats (female)	205	196
Cows	101	157

The farmers have not been alive to the better management of animal health and do not get better breed for their use. This can be correlated to their socio-economic status in general (Sud, 1977).

(c) Energy interactions :

The analysis reveals that 12.4% of the total human population uses the dung and other animal faecal material as a source of energy in their dwellings. It is used mainly as a fuel for cooking purposes in the traditional style of cooking. This faecal matter is collected periodically and dried and used as energy source.

It is also revealed by the data that a huge quantity of 'organic manure' or 'natural manure' or 'biological manure' is used as a resource input in agro-ecosystems. The inventory revealed a utilization figure of 7000 to 8000 kg/hectare of 'natural manure' in the ecosystem area. This is a major input compared to the energy produced fertilizers.

The live biomass of the n animal population depends upon the primary input of the crop-hay production. It is found that hay utilization is quite high due to the poverty of grazing land vegetation (PLATE 40B), (Table 33).

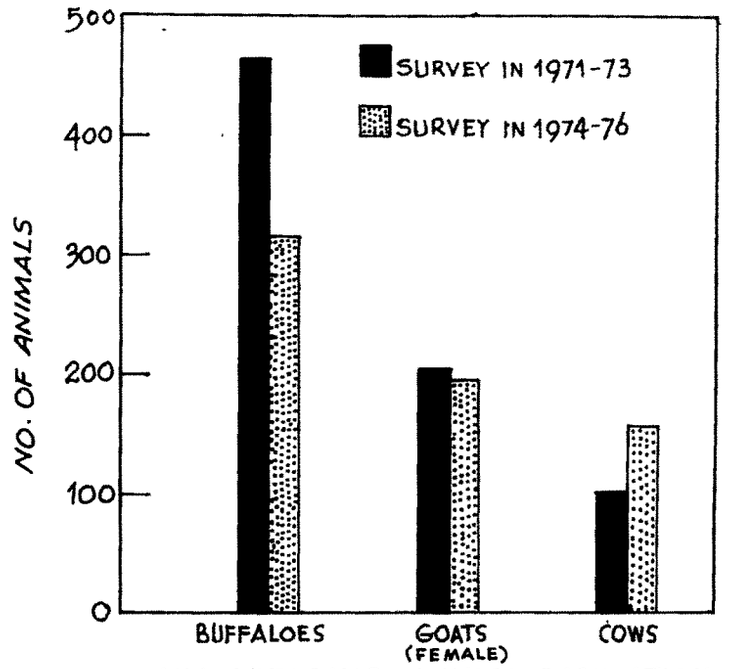
Table 33 : 'Hay' output of Chokari ecosystem area.

Wheat hay	988 kg/hectare
Bajara hay	1482 kg/hectare
Jowar green phytomass and hay	882 kg/hectare

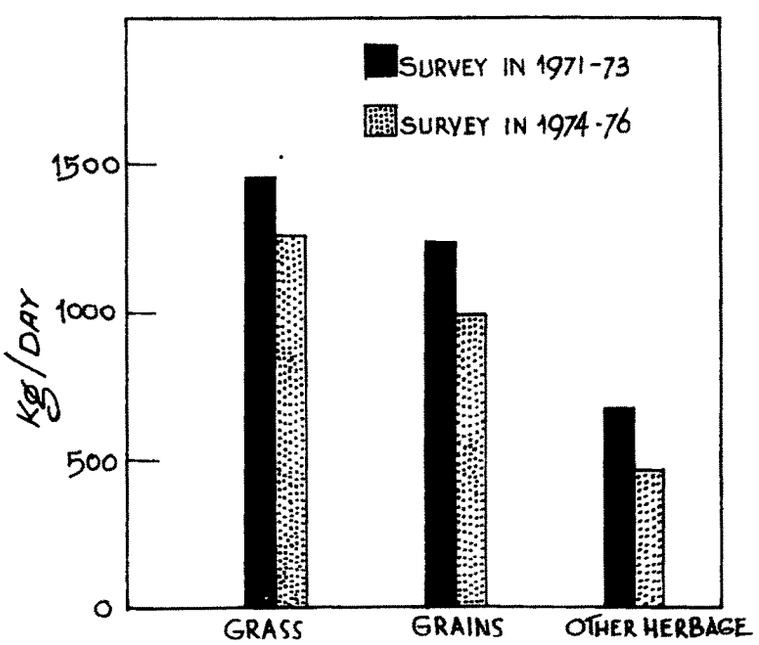
It is clear that the entire animal and human population is dependent upon the efficiency of the agro-ecosystem of the area to a considerable extent.

Plate - 40 :A : The number of 'secondary producers' in the ecosystem in the two surveys.

B : The pattern of 'consumption' of the secondary producers in the ecosystem area.



MILK YIELDING ANIMAL POPULATION – A



ANIMAL FEED CONSUMPTION PATTERN – B

FOR CHOKARI ECOSYSTEM

PLATE – 40 (A & B)

Thesis Component III

Biotic Compartment

Unit - II

Consumer Component

Sub-Unit B

Human Component (Population)

Basic Conceptual Comprehension :

According to the Man and Biosphere (MAB) Report 17 published by UNESCO in 1974, man is simultaneously the part of the environment - with his awareness and capacity for deliberate action - responsible for its stewardship. Thus, man is not merely an 'actor' on an environmental 'stage' but has created his own setting and his own environment. This dual relationship of man with his environment lies at the focal point of study of rural ecology. Man's behaviour towards environment has been parasitic in most of the cases (Odum, 1971). This parasitic behaviour has caused changes in the biotic and abiotic environment. Hence the study of human component is of prime importance in any ecosystem analysis.

The present unit deals with the analysis of human component of Chokari rural ecosystem complex.

I. Human Component at Chokari rural ecosystem: a factual assessment :

Human population of Chokari constitutes the part of backward population of Padra taluka occupying 2.19% of the total land area of the ecosystem. The population is categorized as socially and economically backward. The population comprises of the Baria community which is backward community according to the taluka authorities. The settlements of this population are scattered in the entire non-saline ecozone in the twelve aggregations of the populated pockets. These twelve aggregations are according to the status of the group of inhabitants (PLATE 42).

I. 1. The demographic structure :

The village ecosystem complex supports a population of about 6000 people in the physical land area of 29 hectares (Table 34). The population density is confined only to the non-saline ecozone. The non-saline ecozone is 6 meters high in altitude and hence constitutes the 'secure' zone for habitation purposes. The ravine zone has no settlements while saline zone has settlements of purely temporary nature. These settlements are that of migrated people who occupy the area for grazing their animals during some seasons of the year.

The other type of settlements which are encountered in the saline zone are 'harvest settlements'. These settlements do not add to the load of local population as the owners of such settlements come to stay in these dwelling structures only during the harvest period of the crop (PLATE 41).

Table 34 : Demographic structure of Chokari ecosystem complex during study period (1973-1976).

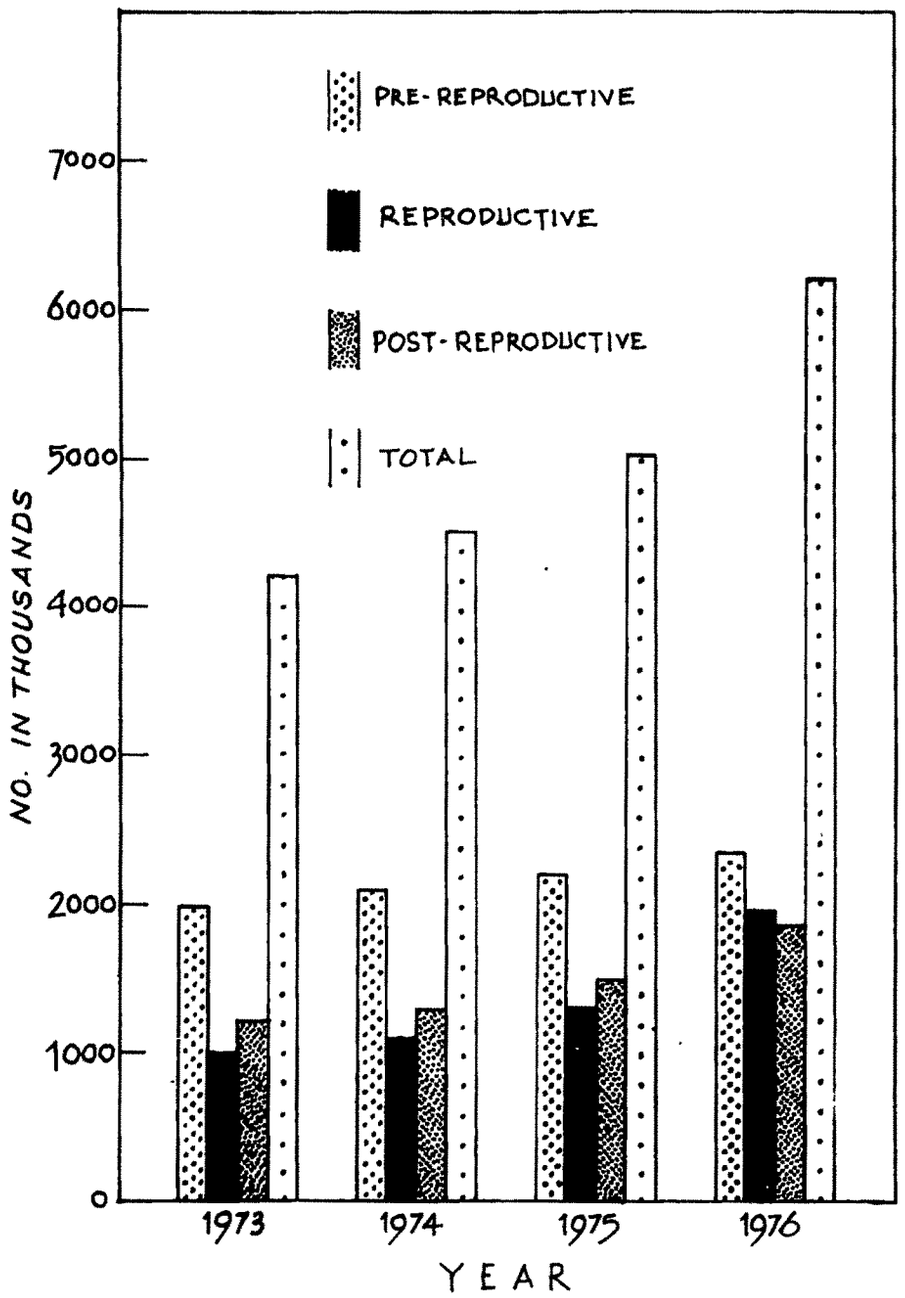
Year	Pre-Reproductive	Reproductive	Post-Reproductive	Total
1973	2001	1009	1216	4226
1974	2101	1107	1307	4515
1975	2210	1308	1506	5024
1976	2360	1987	1863	*6210

* (Including emigrated population).

The increasing load of migratory population :

The year 1976 shows abrupt or sudden increase in the total population of the ecosystem area. There is a load of migratory population to this village ecosystems. This load though temporary in duration causes stresses on essential resources of the ecosystem. An inventory revealed that the migration is from Kutch and Saurashtra arid zones and is special feature

Plate - 41 : The human population (component) in the ecosystem area through the years 1973-1976.



STRATIFIED DISTRIBUTION PATTERN OF HUMAN COMPONENT

PLATE - 41

whenever there is a dry spell in these arid zones. This migratory population is in possession of 'grazing wealth' which in turn results in increasing grazing pressure on ecosystem area.

Table 34 A : Comparative Population Density.

Hierarchical status	persons/sq. km.
Gujarat State	136
Baroda District	254
Padra Taluka	321
Chokari rural ecosystem	395

II. Human environment Analysis :

The human environment has been analyzed in terms of following sub-components :

(1) The Educational Environment :

The analysis of educational environment yielded the following factual data :

1. No. of schools	ONE (Primary school).
2. Standards	One to six only.
3. Enrolment patterns	Poor (15% of village children enroll).

4. Completion of studies (upto sixth standard)	30-40% of total enrolled children.
5. School building	3 rooms (with temporary partitions).
6. Teachers	5 - Temporary.

7. School is occasionally closed down due to poor community (students) response.

The educational environment is not at all congenial for the developmental processes. The poor response to studies has economic root causes. The children are encouraged to work as labour 'input' to supplement the family resources.

Chokari Literacy pattern :

Terms defined : Literate : a person who has completed the studies upto sixth standard.

Illiterate : a person who has not completed studies or has not even visited the school.

Literate - Male - 25% of population.
Female - Nil.

Illiterate - Male - 75% of population.
Female -100% of population.

It is observed that 1976 survey by the author showed improvement over the pattern. Some 2% of the children have completed the studies in the village school and have joined the seventh standard in Majatan - a village situated at the distance of 4-5 km from Chokari.

It is evident from this analysis that the response to education is poor due to the socio-economic status of the village population. This degraded educational environment is one of the causal factors of the underdeveloped condition of the rural ecosystem of Chokari.

(2) Ethnic grouping :

The human component can be classified into three major categories from the point of view of ethnic and religio-cultural aspects as follows : (PLATE 42).

I.	Baria Hindu units	90% of total families
II.	Lower Baria Hindu units	10% of total families
III.	Muslim unit	only 5 families recently settled.

The population has orthodox ethno-religious beliefs and is adhered to all the customary ways of life. There is a little impact of urban patterns of life style. There is not

Plate - 42 : The human environment : A typical 'Baria' marginal farmer's family and assests.

This is one of the 'main' habitation area.

PLATE - 42

much communication between taluka and village complexes. The population has orthodox celebrations and festivities. There are only two hindu temples and the Baria community worships some rural gods in the purely orthodox manners. The study and description of such practices is beyond the scope of the present analysis. There is no community interaction process in operation. There is no recreational facility in the village. There are hardly any organized interactional programmes.

III. Human Settlement Analysis :

Human settlement analysis was carried out with a view to obtaining a factual data of the living conditions of the human population and thereby determining the quality of the life. Human settlement analysis is carried out under three different headings - 1. Feeding habit analysis, 2. Dwelling structure analysis, 3. Energy utilization analysis.

III. 1. Feeding habit analysis :

The feeding habit analysis was carried out to assess the nutritional condition and the crop utilization pattern of the human component. It was observed that 97% of the families are vegetarian - living only on the energy sources of the plant origin. The nutritional status data revealed that majority of the population was not consuming the diet of standard

recommendations made by taluka medical officers (PLATE 43) (Table, 35).*

Table 35 : Nutrition analysis.

Nutrition status	% Population
Standard diet	Nil
Sub-standard diet (under nutrition)	3 - 8 %
Below Standard diet (malnutrition)	90 -98%

* (Taluka Hospital Data).

The agricultural output is not sufficient for the marginal farmer to feed his large family properly. The average family size is that of 6-8 members which feeds on the diet of 2.5 - 3 kg grains/day/meal. The chief grains consumed are that of Bajari, Jowar, Paddy and rarely Wheat (PLATE 44).

III. 2. Dwelling structure Analysis :

The Chokari ecosystem has 1150 dwelling structures in the human habitation area. These structures can be correlated to the socio-economic environment of the ecosystem and can as one of the indices of determination of the development status

Plate - 43 : A study of the condition of the Chokari children especially to indicate the adverse effect ofthe below standard diet.


PLATE-43

Plate - 44 : The 'sex' member unit of a marginal Chokari farmer near their dwelling.

PLATE-44

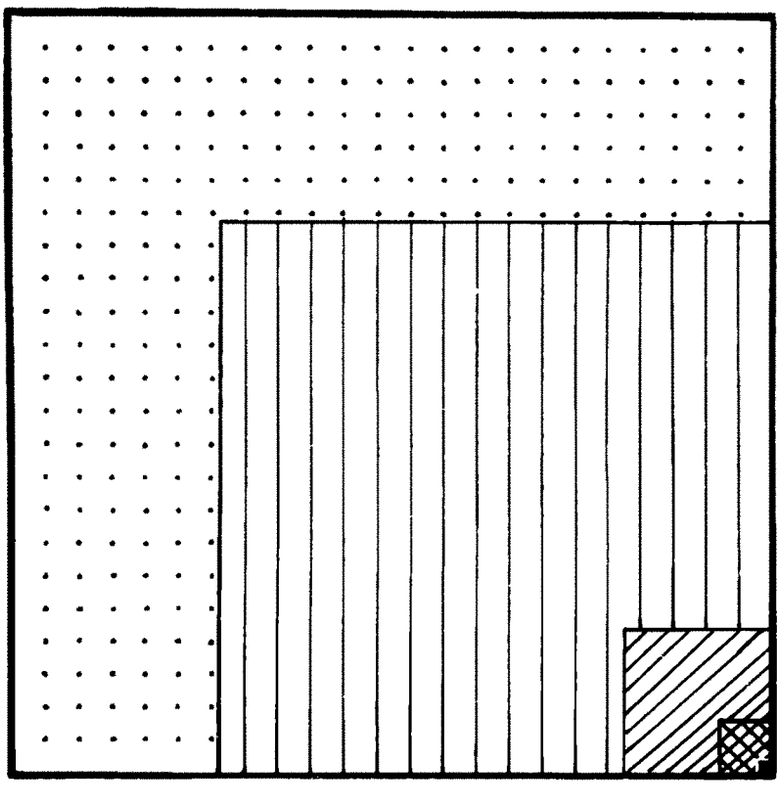
of the rural ecosystem. The analysis revealed following details (PLATES 45 and 46) (Table 36).

Table 36 : Dwelling Structure :

Type of Dwelling	Number	% of Total
Pucca Houses 1 Storey	838	72.88
Pucca Houses 2 Storey	12	1.04
Small Kutcha Hutments (1 room of mud walls)	220	19.13
Large Kutcha Hutments (2-3 rooms of mud walls)	80	6.95

This reveals the fact that the major portion population has built one storey pucca houses to guard against the environmental hazards due to the proximity of the Mahi river ecosystem. However, the living space is not sufficient and the houses appear over crowded, improperly planned and meagre. The ratio of habitation land/person is 0.004 hectare which is quite low in view of the fact that this land includes not only the real living space but also covers the storage area and animal protection area. Each settlement leaves a small land portion where dry phytomass for fuel stored and part of the land is used for the habitation of grazing animal. This causes problems of hygiene which are common to any Indian rural ecosystem.

Plate - 45 : A graphic view of dwelling structural types at Chokari.



PUCCA HOUSES 1 STOREY...838 No. (72·88%)

PUCCA HOUSES 2 STORYES...12 No. (1·04%)

LARGER KACHA HUTMENT... 80 No. (6·95%)
(1 ROOM OF MUD WALLS)

SMALLER KACHA HUTMENT..220 No. (19·13%)
(2-3 ROOMS OF MUD WALLS)

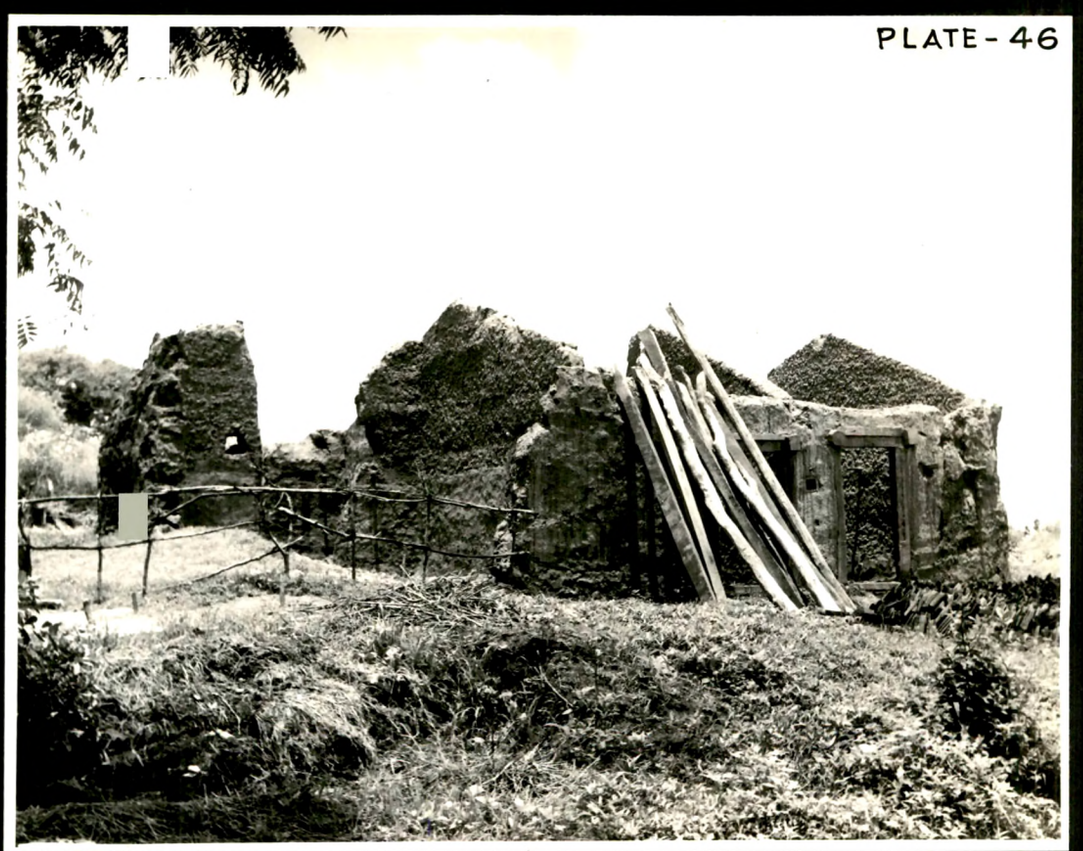
TOTAL DWELLING.....1150 No. (100%)

DWELLING STRUCTURE OF HUMAN COMPONENT- CHOKARI

PLATE- 45

Plate - 46 : A typical 'marginal' farmers' 'mud' walled abode being erected with wooden supporting structures (stress on vegetation).

PLATE - 46



Energy Utilization Analysis :

Efforts have been made in the present analysis to convey the idea that the utilization of energy in any human settlement can be correlated with the economic and social environment of the human component and this utilization value may be used as an indicator of the level of development of the ecosystem. With the above thinking in view, the Chokari human settlement complex was analyzed for use of energy for both the purposes viz. the cooking and the illumination. It was found that the energy utilization is quite low and sources of energy quite primitive (PLATE 47) (Table 37 A and B).

Table 37 A : % Distribution of population utilizing various energy sources. Cooking purposes.

Source	% Population
Kerosene	4
Wood	79
Dry biomass of herbs/shrubs	4.6
Dung and animal faecal material	12.4

Plate - 47 : The Chokari sources of energy :

- biotic energy of animal as an 'input' into the agro-ecosystem.
- the 'organic' manure as local energy input into the agro-ecosystem
- the dry phytomass and wood for domestic use
- the electricity (no longer used to illuminate the village).

PLATE - 47

Table 37 B : Illumination purposes

Source	% Population
Electricity	4.34
Kerosene	80.64
Wood/other dry biomass of plants (occasional)	15.02

The computation of data on the basis of the energy utilization per dwelling structure it was found that the village complex uses 8,36,360 kg of wood material and 230 litres of kerosene for energy purposes (PLATE 48) (Table 38).

Table 38 : Energy utilization computation :
Size of family = 6-8 members.

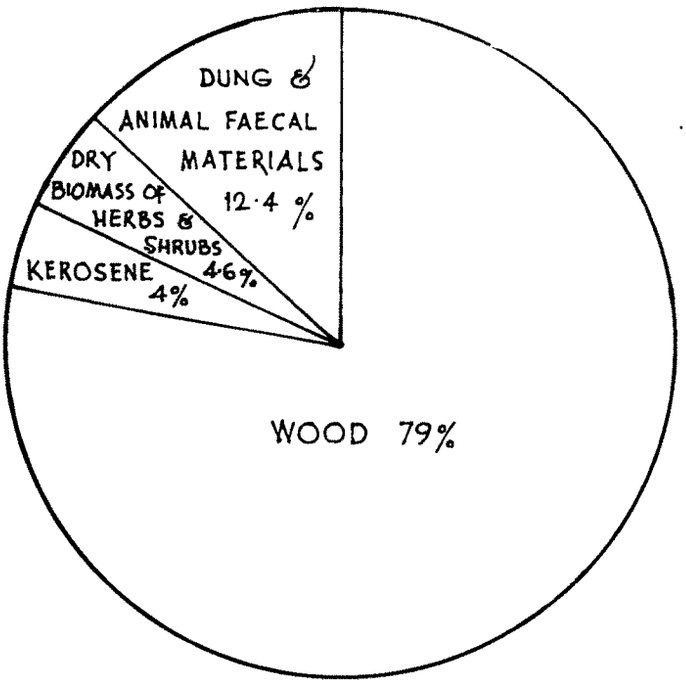
* Wood - 727.27 kg/dwelling - multiplied by 1150 dwellings
= 8,36,360 kg

* Kerosene 0.2 lit/dwelling - multiplied by 1150 dwellings
= 230 litres.

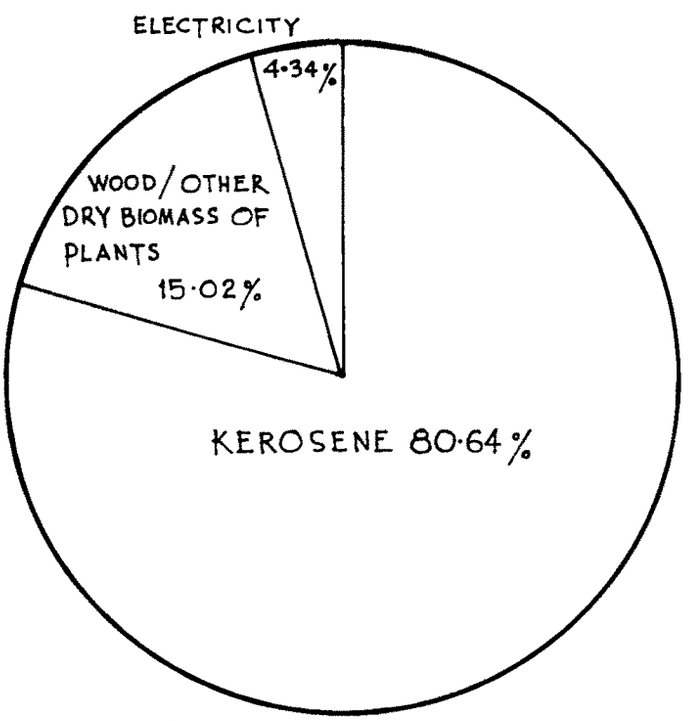
Note : (Only 35-45 dwellings have electricity and that is used only for illumination purposes).

* (Values are average for one family).

Plate - 48 : The circular graph of energy utilization structure - indicating the ecostatus of the rural ecosystem.



COOKING PURPOSE



ILLUMINATION PURPOSE

ENERGY UTILIZATION STRUCTURE OF HUMAN COMPONENT–CHOKARI

PLATE - 48

It is of interest to note that the Chokari village Panchayat electrified the village streets in the year 1970. It is found that the village population could not pay the electricity charges as street electric tax and hence there is no electricity in the village complex streets. Paradoxically the installed lamp posts are still intact. Energy utilization analysis confirms the backward and underdeveloped condition of Chokari rural ecosystem. The energy subsidies have to be brought in even for bare existence of the human population of the ecosystem.

IV. Human interactional analysis :

The human component of Chokari ecosystem is to a certain extent isolated and neglected. There are no infra-structural rural facilities for inter and intra communication purposes. An inventory of the transportation availability which so essential for the communication purpose revealed the details presented below (Table 39).

Table 39 : Interactional analysis.

1. Village possession of cycles	20-25 cycles in population of 6210 people.
2. Seasonal State Transport Bus frequency	(a) 2 buses/day in winter - summer. (b) 1 bus/day in early monsoon. (c) No bus during monsoon season.

These evident shortcomings of rural infra-structural facilities do not encourage the village population to interact with the other ecosystem complexes and contribute significantly to the isolation which results in under-developed conditions.

Thesis Component III

Biotic Compartment

Unit - III

The Decomposer Component*

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* (This component is not investigated in detail, however a graphic assessment has been presented in the following paragraphs).

I. 1. Decomposer Component :
The Replenishing unit

Odum (1971) classified the decomposer component of the ecosystem as microconsumer component. In the classification of microconsumers, he, further separates the group into saprotrophs and osmotrophs. The heterotrophic organisms chiefly the bacteria and fungi, which break down the complex compounds of dead organic matter, absorb some of the decomposition products and release inorganic nutrients that are usable again by the primary producers together with other organic sources. Thus, decomposers are of vital importance in any ecosystem. The entire 'replenshing responsibility' of the ecosystem is entrusted to the decomposer component. It is this component of the ecosystem that has a controlling key to the economy of nature as the microbes are circulation managers of the ecosystem. This component includes variety of microbial species which vary in their composition, density, and function in each ecosystem. The study of this component itself forms a huge and ardous task compared to the entire ecosystem studies. The decomposers, due to their structural, functional and behavioural complexities have received for less attention in the studies made by the Indian ecologists (Misra, 1968).

I.2. Limitations of the Present Analytical Study :

The present analytical study for the doctoral thesis was essentially the author's single handed undertaking. Due to the immensity and complexity of the microbial species in any ecosystem it was thought desirable to keep this component beyond the scope of the present doctoral project. The facilities and training required for this analysis were also insufficient. The study of decomposer component itself will form a huge project with expertise in bacteoriology microbiology, mycology, culture technology and warrants specialized research facilities and training. The investigator, therefore, decided not to include the detailed analysis of this component in the present thesis.

Needless to point out here that the investigator is fully aware of the importance and significance of the functional interactions of this particular component of the ecosystem at Chokari. A separate project dealing with decomposer component is being planned to be taken up by Prof. C. H. Pathak, the research supervisor of this doctoral project in which the author is also associated. However, an attempt has been made in the following paragraphs to present a graphic view of the decomposer component at Chokari ecosystem complex.

II. A Graphic assessment :

The fungi and actinomycetes in general were assessed with assistance of soil microbiologist of the Soil Laboratory of the Engineering Research Institute, Baroda.

II. 1. Actinomycetes :

The number of actinomycetes per cm^2 area of soil was determined by microscopic examination. It was found that the number is found to vary from layer to layer of the soil. However, the maximum number was obtained in the upper layer and middle layer of the soil. The soil samples from saline ecozone have not been included in this study.

II. 2. Fungi : (in general)

This is an assessment of fungi colonies as opposed to the slimy moulds, it was found that the upper layer showed more amount of fungi colonial growth. In this section also the samples from saline ecozone have not been included.