EPILOGUE

I. Analytical Qualitative Model
of Estuarine Rural Ecosystem at Chokari

II. Recommendatory Observations.

To manage and to optimize, we must control
To control, we must measure and analyze
To analyze we must define
both qualitatively* and quantitatively.

- An old industrial engineer's adage.

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* The present work

Otto Somoerwotto (1974) has rightly pointed out that it is the time for research workers of developing countries to study the ecology of rural ecosystems in relation to development. He presented the qualitative model of his findings of a Java rural ecosystem at the First International Congress of Ecology in 1974 at The Hague. The present ecosystem analysis data has helped the author also to obtain a qualitative model for the estuarine rural ecosystem at Chokari (Baroda - India).

I. The Analytical Qualitative Model (AQM) of rural ecosystem at Chokari :

The rural ecosystem at Chokari was analyzed qualitatively so that further quantification can be achieved later.

(a) The overall Interactions

The rural ecosystem at Chokari consists of two basic compartments from the point of view of the interactions. The primary Producer Compartment consists of the agricultural system and the vegetational system with the 'inputs' of the minerals from the soil, water and solar energy. The Consumer Compartment consists of the animal and human components. The animal component with both the agricultural as well as the vegetational system with their grazing interactions acts as the secondary

producers and the human component remains at the top level of consumption in this ecosystem. The human population not only interacts with the agricultural system but also with the vegetational system. The agricultural systems are used by the Chokari man to obtain essential food material and the vegetational system is exploited for the fuel energy and for the structural raw material for habitation purposes.

The decomposing system has interactions with all the components of the ecosystem and serves as a means of replenishing and cycling of the minerals (PLATE 67).

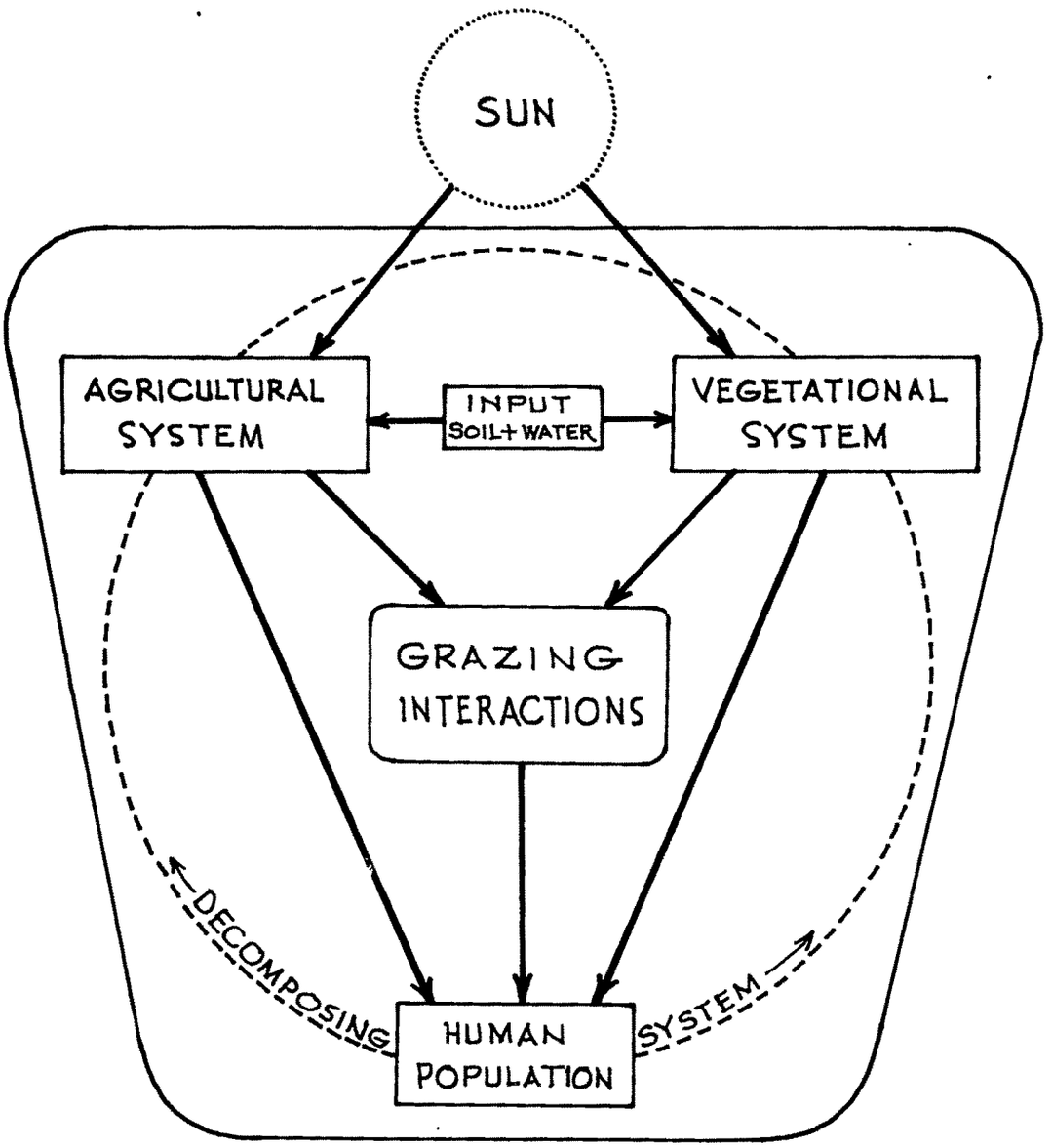
(b) Mutual Interactions of Sub-systems in Biotic Compartment :

As the qualitative analysis reveals, the Chokari ecosystem food chain is simple.

- Agricultural 'Grain' Output ⟶ Man
- Agricultural 'Hay' Output, Vegetational phytomass ⟶ Grazing Animals (milk production) ⟶ Man

From the point of view of the interaction, there is mutual interaction between the producer compartment and the consumer compartment. This can be further detailed into the sub-systems. The vegetational sub-system and the crop sub-system indicate interaction with the human and animal population (PLATE 68).

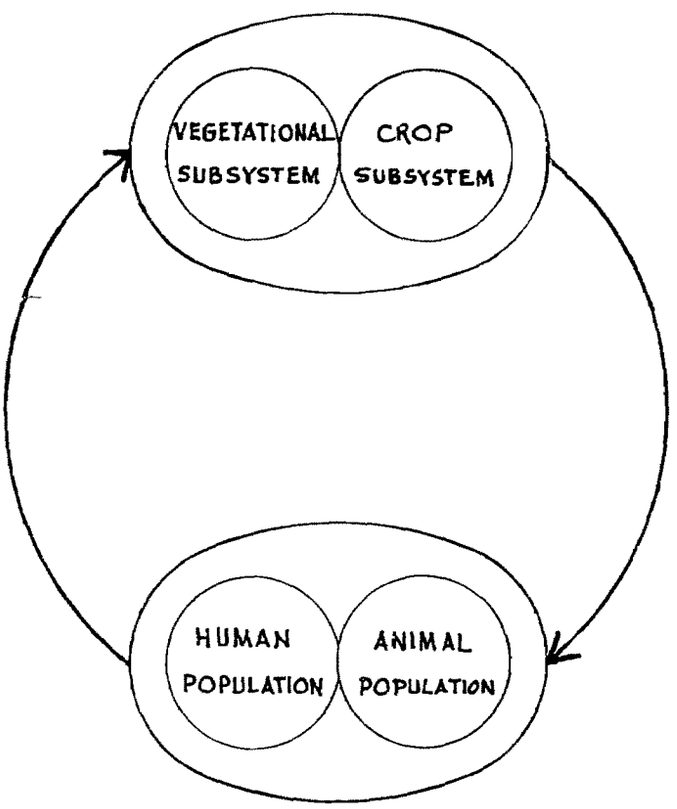
Plate - 67 : The Over-all qualitative interaction pattern (model) of the estuarine rural ecosystem - Chokari.



ESTUARINE RURAL ECOSYSTEM - CHOKARI - INDIA

(INTERACTION MODEL) PLATE - 67

Plate - 68 : Mutual interactions in the biotic compartment presented in the 'systems' context for quantification.



MODEL OF MUTUAL INTERACTIONS OF SUBSYSTEMS IN BIOTIC COMPARTMENT AT CHOKARI RURAL ECOSYSTEM COMPLEX.

PLATE-68

Quantifying the mutual interaction :

This kind of mutual interaction obtained as a result of the qualitative ecosystem analysis, the quantification can be now done to understand the dynamic nature of the interaction. According to Milsum (1968) the quantification can be achieved by the following cybernetic equation :

$$\frac{Xn}{Xo} = (K_L)^n = \frac{Yn + 1}{K_{(v)}\ Xo}$$

where

n, n + 1 = time interval

K_L = Constant (specific for ecosystem) (loop gain)

$K_{(v)}$ = variables in the system.

Xo = initial interaction in the sub-system one.

Yn +1= initial interaction in the Sub-system two.

(c) 'Energy Transfer' Interactions :

The rural ecosystem in this case is entirely dependent upon the 'input' of solar energy. The 'input' of climatic and edaphic environment is associated with theinput of energy. These inputs are accumulated as the net primary production of crop and and vegetational system. The transfer of the potential energy (obtained as a result of net primary production) to the Human

and animal populations occurs through the consumable active plant part. The Human component thus directly harvests the solar energy fixed by the crop-plants. The indirect harvest of the same is achieved through the secondary production of the grazing animals who consume 'hay' output of crop systems and 'active plant part' of the vegetational system.

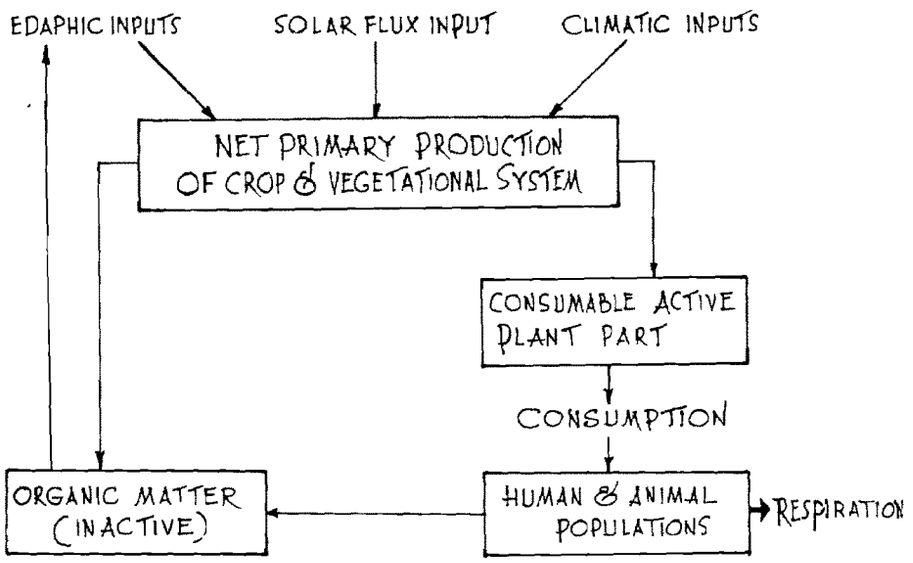
The other kind of consumption is for the purposes of fuel energy. The primary source of fuel energy is wood obtained from the vegetational system or imported from other ecosystem areas.

The human and animal energy is also the source of 'biotic' energy 'input' in the crop systems. The inputs of synthetic fertilizer and pesticide are very low. Due to the high population density the carrying capacity ofthe environment is low (Otto Somoerwotto, 1974) (PLATE 69).

(d) The cycling process

The man in the ecosystem utilizes the 'organic' manure to a greater extent in the agricultural operations. The labour intensive process of composting solid waste is performed. There is no practice of collecting the human wastes which are scattered in some edaphic patches of the ecosystem area. The process of natural cycling operates in

Plate - 69 : The qualitative model of the estuarine rural ecosystem at Chokari showing the energy transfer process and the cycling process in the ecosystem area.



QUALITATIVE MODEL OF RURAL ECOSYSTEM AT CHOKARI

(▭ STATE VARIABLES ⟶ ENERGY TRANSFER)

PLATE - 69

this case. The inorganic remains of the primary fuel energy sources are also a part of 'input' along with inactive organic matter to the edaphic environment (PLATE 69).

(e) Optimization of ecosystem at Chokari.

The details of ecosystem optimization have been discussed in the relevant units. The consideration of network concept is essential and the qualitative aspects of this concept lead to the application of set theory to the basic ecosystem components at Chokari - i.e. the environment and the biota. The application of the properties of set intersection results into the Venn diagrams of resources habitat and cultural variables which can form the basic informative units of network of the ecosystem components to develop the optimization machinery at the grass root level (PLATE 70).

II. Recommendatory Observations :

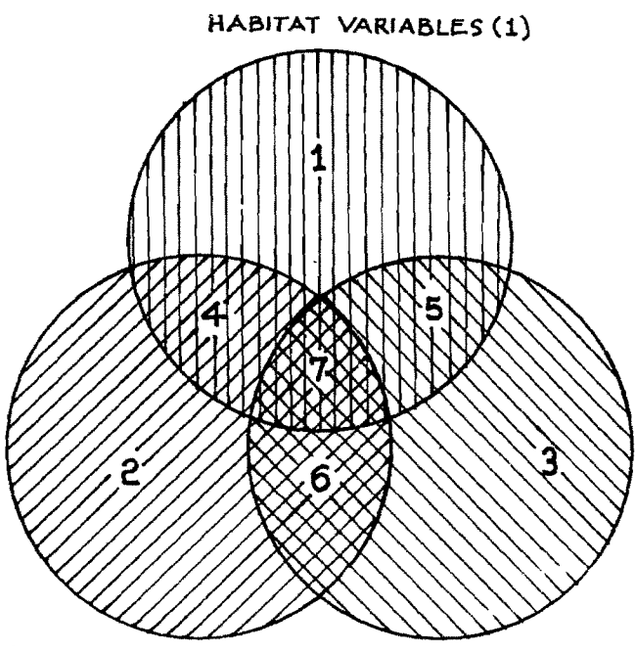
The present analytical investigations of the rural ecosystem can be labelled as the 'Need analysis' in the language of Systems approach. The ecosystem optimization investigations come under the 'Optimality analysis' in the systems approach. The micro-level data generated during the present investigation when viewed from the 'cause and effect' point of view, leads to some recommendatory observations. These observations for the rural ecosystem at Chokari are

Plate - 70 : The Venn diagrams of Resource, Habitat and Cultural variable for developing the ecosystem optimization machinery at the grass-root level.

Set descriptions of the seven partitions are as follows :

($\cup$ and $\cap$ are set unions and intersections respectively).

1. $H \cap (R \cup O)$
2. $R \cap (H \cup O)$
3. $O \cap (R \cup H)$
4. $H \cap (O \cap R)$
5. $R \cap (O \cap H)$
6. $R \cap (H \cup O)$
7. $H \cap R \cap O$



VENN DIAGRAMS OF RESOURCE, HABITAT & CULTURAL VARIABLES AT CHOKARI.

PLATE - 70

presented here. In presenting these observations the author has the following words of Dr. Mesarovic* (1977) in mind : 'Today's problems result partly from the fact that decision makers do not get specific inputs from scientists and professionals, their decisions are therefore dictated by political or ideological considerations'.

1. The carrying capacity of the environment is expected to be low on the basis of the analytical data, while the population density of Chokari is quite high with an average figure of 395 persons/km^2. To increase the carrying capacity the energy subsidies are required (Odum, 1971).

2. Higher levels of energy subsidies are necessary to improve the living conditions of the human component (Otto Somoerwotto, 1974) in this rural ecosystem.

3. The energy subsidy provided to the ecosystem area may not be allowed to compete with the local biotic human energy to avoid increase in the rural unemployment.

4. The energy subsidy provided to the ecosystem area must be evenly distributed as far as possible.

5. The energy subsidies in agricultural sector should not disturb the cycling process and subsidies must be of

'low' risk environmental impact as far as practicable (Otto Somoerwotto, 1974).

6. The ecosystem (Chokari) is not self-sufficient due to low carrying capacity hence import of energy sources is imperative. It seems clear that local energy subsidies sources such as composting of human waste need attention to have less dependence on the 'imported' sources. This can go a long way in achieving self-sufficiency in the ecosystem.

7. As the analysis reveals, there is a large volume of unutilized labour in this ecosystem area which could be put to productive use in the labour intensive economic rural projects such as cooperative double cropping which increases the rural employment (PAU** Report, 1973).

8. The interactional and infra-structural facilities for the mobility of the labour have to be provided for improving the socio-economic environment of the ecosystem.

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* Dr. Mesarovic (1977) in Seminar on Futurology - Vignan Bhavan, New Delhi.

** PAU (1973) - Pubjab Agricultural University Ludhiana Report.