A FRAMEWORK AND ECOCOMPUTATION OF CARRYING CAPACITY ON FOOD-RESOURCES OF THOUBAL DISTRICT, MANIPUR

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The carrying capacity of Thoubal, one of the highest food producing district of the valley area, Manipur have been explored based on the total food production capability of the individual crop/ food item. The accounted carrying capacity accords 655684 in 1991 and 517945 in 2001 for rice, 145266 in 1991 and 157698 in 2001 for vegetables, 290575 in 1991 and 1264347 in 2001 for fruits, 33972 in 1991 and 50703 in 2001 for milk, 94589 in 1991 and 132438 in 2001 for eggs, expedited the capabilities of individual food item to support the carrying capacity of the district with relation to food resources. The resulted sign of precautions highlighted the ultimate needs of immediate caution and proper planning with everincreasing population, man made extra essential components and thereof growth of development. Carrying capacity of various food resources signifies the requirement of compulsorily extra energy input in planning food resources, particularly those of deficit itsems. However, in certain food items, carrying capacity quantifies balancing to the potentialities and encompasses to justify the sustainable development. The finding elucidated the accountability of the resources on carrying capacity by planners is inseparable step forward tools for developmental works and execution. The finding victual the most sensational grist for basic needs of planning and development of the district with hopeful conservation of natural resources.

Keywords : Carrying Capacity; Conservation; Degradation; Footprint; Natural Resources; Population; Sustainable Development.

Introduction

Carrying capacity is a general concept based on the idea that every ecosystem has a limit for use that cannot be exceeded without damaging the system. Further, the carrying capacity of a particular region may be accorded as the maximum population of a given species that can be supported indefinitely, allowing for seasonal and random changes, without any degradation of the natural resources[1].

Fearnside also defined carrying capacity as the maximum number of persons that can be supported in perpetuity on an area, with a given technology and set of consumptive habits, without causing environmental degradation. In other words, the carrying capacity is the foundation for recent interest in sustainable development, an environmental approach which identified thresholds for economic growth and increase in human population. Carrying capacity of the environment based on the sustainable development, the standard of living desired, the overall quality of life, the quantity and type of artifacts created and the demand on energy and other resources.

It is the fact that, carrying capacity is a very controversial term when applied to ecology, it evolved from the limits to growth philosophy which is based on the facts that there are local shortages of water and food, there are atmospheric changes affecting people and many species are becoming endangered.

The present investigation attempts to find the maximum possible sources for planning the developmental programmes in the Thoubal district that will not saturate the resources, infrastructure and other system, that will not exceed pollution levels beyond accepted standards; and will not affect the fragile ecosystem. The objective is to study the carrying capacity based on the resources and current standard of living and regeneration of resources in the district.

Materials and Methods

Existing and potential agricultural productivity in calories were calculated following FAO[2] statistics, I.C.M.R.[3] and Dietary guidelines U.S.A.[4].

Carrying capacity of certain food resources (like rice, vegetables, fruits, milk and egg) are calculated following Subramanian[5].

(1) For rice resources

$$K_{rice} = RP_{max}/RRP$$

Where, K_{rice} = Carrying capacity of rice.
RP_{max} = Maximum rice production.
RRP = Rice requirement for a person.

(2) For vegetables

$$K_{veg} = VP_{max}/VRP$$

Where, K_{veg} = Carrying capacity of vegetable.
        VP_{max} = Maximum vegetable production.
        VRP = Vegetable requirement for a person.

(3) For fruits

        K_{fruit} = FP_{max}/FRP
Where, K_{fruit} = Carrying capacity of fruit.
        FP_{max} = Maximum fruit production.
        FRP = Fruit requirement for a person.

(4) For milk

        K_{milk} = MP_{max}/MRP
Where, K_{milk} = Carrying capacity of milk
        MP_{max} = Maximum milk production.
        MRP = Milk requirement for a person.

(5) For egg

        K_{egg} = EP_{max}/ERP
Where, K_{egg} = Carrying capacity of egg.
        EP_{max} = Maximum egg production.
        ERP = Egg requirement for a person.

The probable amount of food requirement for various food items was computed as

        PAFR = P x AAC
Where, PAFR = Probable amount of food requirement
        AAC = Average annual consumption.
        P = Population.

Results and Discussion

Food is an essential input for life. Consequently well management of food, not only for the instant but also for near future to some few years, glorified the significance of high and well maintained standards of a country upto a family.

The total production of rice, vegetables, fruits, milk and egg recorded 95.73 thousand tonnes, 11.930 thousand tonnes, 15.909 thousand tonnes, 9.30 thousand tonnes and 69.05 thousand tonnes respectively during 1991. The probable amount of food requirement for the population of 293958 persons of the district computed as 42.239 thousand tonnes of rice, 23.796 thousand tonnes of vegetables, 15.839 thousand tonnes of fruits, 79.199 thousand tonnes of milk and 211.119 thousand tonnes of eggs. The computed carrying capacity values of rice, vegetables, fruits, milk and egg scored 655684, 145266, 290575, 33972 and 94589 respectively for the Thoubal district (Table 1). The documented data were outlined in Fig.1.

During 2001, Thoubal district recorded the population of 366341 persons and the total production of rice, vegetables, fruits, milk and egg which accounts for 75.62 thousand tonnes, 12.951 thousand tonnes, 69.223 thousand tonnes, 13.88 thousand tonnes and 69.68 thousand tonnes respectively. The respective probable

amount of food requirement were 52.640 thousand tonnes, 29.655 thousand tonnes, 19.740 thousand tonnes, 98.701 thousand tonnes and 263.204 thousand tonnes for rice, vegetables, fruits, milk and eggs respectively. The computed carrying capacity values of rice, vegetables, fruits, milk and egg was observed 517945, 157698, 1264347, 50703 and 132438 respectively (Table 2). The illustrated data delineate in Fig. 2.

Table 1 revealed the total production of food resources of the Thoubal district for the year 1991. The population of the district remained 293958 persons. The total production of rice and probable amount of rice requirement accorded 95.73 and 42.239 thousand tonnes respectively. The computed carrying capacity of rice accorded 655684 for the year 1991. The finding indicates the total production of rice is greater than that of the probable amount of rice requirement i.e. there is an amount of surplus in food grains. The total vegetable production and probable amount of requirement of vegetable in the district accorded 11.930 and 42.239 thousand tonnes respectively. The computed carrying capacity of vegetables was 145266 for the same year. The requirement in the district is far ahead than that of its production. In other words, a serious deficit of the vegetable requirement was faced by the district. The total fruit production and probable amount of requirement of the district accounted 15.909 and 15.839 thousand tonnes respectively. The computed carrying capacity of fruit valued upto 290575. The probable amount of requirement is little exceed than that of production i.e. a deficit of the fruit requirement was commonly faced. The district accorded 9.30 and 79.199 thousand tonnes as the total production of milk and probable amount requirement. The computed carrying capacity value of milk accounted upto 33972. The requirement is far ahead than that of the total production. In other words, a deficit in the milk production is critically faced by the district. The total production and probable amount of requirement of egg in the district accorded 69.05 and 211.119 thousand tonnes respectively. The computed carrying capacity value of egg for the district hits upto 94589. The requirement is far ahead than that of the production i.e a serious deficit in the production of egg was recorded.

Table 2 revealed the total production of rice in the district for the year 2001 as 75.62 thousand tonnes and the population as 366341 persons. The computed carrying capacity value of rice attained 517945. The present finding clearly shows that the district have rice more than that of the computed carrying capacity in the year 2001. The excess value of carrying capacity clarify the significance status of food grains of rice in the district. Though the carrying capacity value falls from

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Table 1. Potential carrying capacity of food resources for Thoubal district during 1991.

Food items	RDA(1,2)			Total productivity land (1000 ha)	Total Production ('000 tonnes/nos.)	Average annual consumption (Kg/nos./capital	Population **	Carrying capacity	Deficit/ Surplus	Probable amount of food ('000 tones/ nos.)
	Size of seving*	No. of serving	Total serving (g/nos.)							
Rice	25	16	400	43.038	95.73	146.00	293958	655684	53.491	42.239
Vegetable	75	3	225	14.80	11.930	82.25		145266	-11.866	23.796
Fruit	75	2	150	2.70	15.909	54.750		290575	0.00007	15.839
Milk	150	5	750	6.76	9.30	273.750		33972	-69.899	79.199
Egg	1	2	2	58.00	69.05	730.00		94589	-142.069	211.119

Source: 1. ICMR, 1991, 2. FAO, 1981, 3. Dietary Guidelines USA, 2005, 4. Statistical Abstract of Manipur, 2001, **- Provisional Population, RDR = Recommended Daily Allowance, * – An amount of food or drink sufficient for one (1) person (Webster Dictionary), 1979.

Table 2. Potential carrying capacity of food resources for Thoubal district during 2001.

| Food items	RDA(1,2)			Total productivity land (1000 ha)	Total Production ('000 tonnes/nos.)	Average annual consumption (Kg/nos./capital	Population **	Carrying capacity	Deficit/ Surplus	Probable amount of food ('000 tones/ nos.)
	Size of seving*	No. of serving	Total serving (g/nos.)							
Rice	25	16	400	24.428	75.62	146.000	366341	517945	22.98	52.640
Vegetable	75	3	225	1.680	12.951	82.125		157698	-16.704	29.655
Fruit	75	2	150	24.647	69.223	54.750		1264347	+49.483	19.740
Milk	150	5	750	12.35	13.88	273.750		50703	-84.821	98.701
Egg	1	2	2	107.92	96.68	730		132438	-166.524	263.204

Source: 1. ICMR, 1991, 2. FAO, 1981, 3. Dietary Guidelines USA, 2005, 4. Statistical Abstract of Manipur, 2001, ** – Provisional Population, RDR = Recommended Daily Allowance, * – An amount of food or drink sufficient for one (1) person (Webster Dictionary), 1979.

655684 to 517945, the district serves well regarding rice food item. In this regard Subramanian[5] stated that "The carrying capacity of any region based on food producing capacity is the capacity of its food by that particular region".

The district accorded 12.951 and 29.655 thousand tonnes as total vegetable production and probable amount of vegetable requirement respectively during 2001. The computed carrying capacity of vegetable valued as 157698 which indicates that the requirement is far exceed than that of the production i.e. a serious deficit of the vegetable production is faced by the district. Eventhough the carrying capacity value increases from 145266 to 157698, the district still facing the deficit problem. It vividly showed the basic needs of either boosting production or lowering population. The present finding clearly illustrated the carrying capacity of vegetables among food resources highly signifies that it is indispensable for the management and planning of the

food resources for the district. Further it showed the ecological deficits are as a measure of the entropic load and resultant "disordering" being imposed on the ecosphere by so called advanced countries as the unaccounted cost of maintaining and further expanding their wealthy consumer economics. This massive entropic imbalance involves the first axiom of ecological foot print analysis. Thus inturn has serious implications for region, state, national and global development trends[6,7].

The total production and probable requirement amounted of fruits account 69.223 and 19.740 thousand tonnes respectively during 2001. The computed carrying capacity of fruits valued upto 1264347. The requirement is less than that of the total production i.e. an amount of surplus fruit is available in the district. Regarding comparison of decennial ecocomputed carrying capacity value which increases from 290575 to 1264347, with an exploration of high significance the increasing production
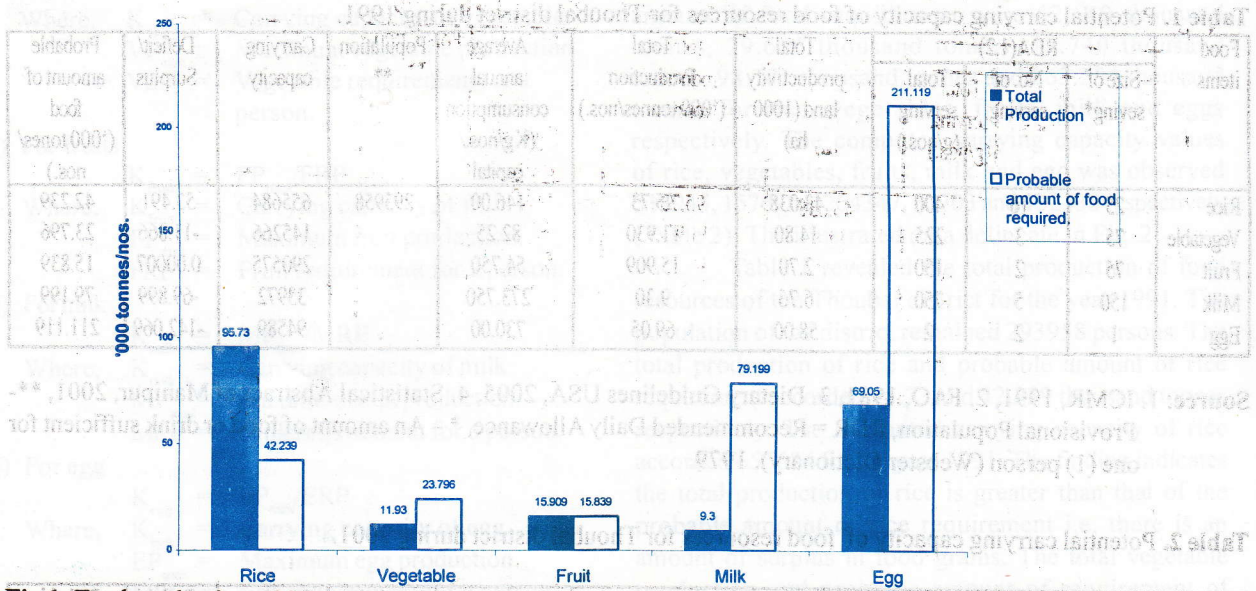
Fig.1. Total production of food resources (rice, veg., fruit, milk and eggs) and probable amount of food requirement in '000 tonnes/nos. for Thoubal district during 1991.
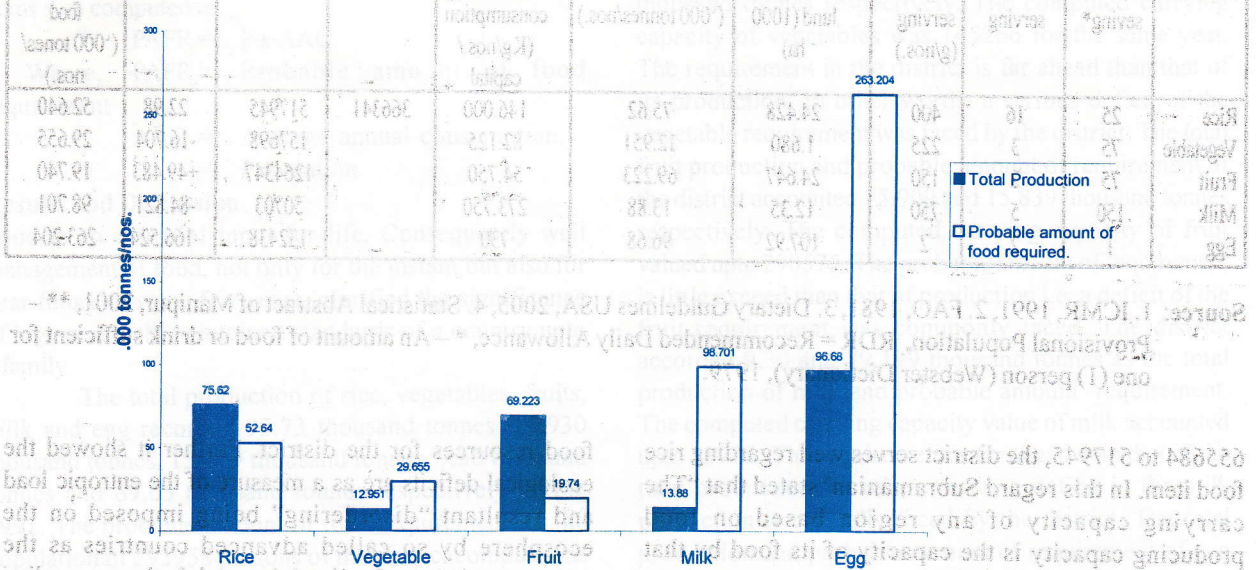
Fig.2. Total production of food resources (rice, veg., fruit, milk and eggs) and probable amount of food requirement in '000 tonnes/nos. for Thoubal district during 2001.

ahead than that of population growth. The finding vividly showed the carrying capacity of fruit among food resources have highly significance with an indication of the indispensable for the management and planning of the excessive production of fruits among food resources of the district so as to increase the productivity and right utilization of natural and other resources.

During 2001, the total production of milk and probable requirement amount of milk accorded with 13.88 thousand tonnes and 98.701 thousand tonnes respectively in the district having a population of 366341

persons. The determined carrying capacity of milk raised upto 50703. Though carrying capacity value in 2001 attained 50703 which is 16731 more than that of 1991, the requirement is still in deficit. The requirement in the district is far ahead than that of the total production. It indicates a serious deficit of the milk production in the district blazeflashed the indispensable for the management and planning.

Thoubal district accorded 96.68 thousand tonnes as total production of egg and 263.204 thousand tonnes as the probable requirement amount of egg

requirement during 2001. The carrying capacity value of egg computes 132438 whic indicates the requirement is far ahead than that of the production. In comparison with 1991, the value of carrying capacity of 2001 increased from 37849 (i.e.94589to132438). The finding supports the significance of carrying capacity value.

The carrying capacity of the district based on food production have great impact on the sustainable development of the district. Carrying capacity as being constrained by the current status of technology, physical, chemical, biological factors, and social, political, economic environment. A close look into the matter and prior planning for developmental work is must. Cotton[8] rightfully claimed "the world is being required to accommodate not just more people but effectively larger people ....". The present finding vividly clarify the carrying capacity as essential tool to determine the basic component of management of the resources available from the nature or any other sources.

Acknowledgement

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