Identifying the Desertification Problems In the Hyper Arid Lands of India

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ABSTRACT

This paper is an attempt to trace the problems of survival and sustainability in the hyper arid lands of India. These hyper arid lands are confined to the extreme western parts of Rajasthan along the International Border. The paper identifies micro and sub micro spatial variations against a general understanding that, hyper arid areas carry environmental and ecosystem homogeneity and that these areas wear a monotonous and desolate look. Desertification is one of the greatest environmental challenges. The problem of desertification is becoming squarely acute in the wake of global warming. The survival and sustenance of flora, fauna and humans is highly vulnerable to annual meteorological uncertainties.

Arid and semi-arid lands encompass 41 per cent of the earth's land area. These highly fragile ecosystems barely sustain nearly 2 billion people and even greater livestock population. The magnitude and variability of desertification hinges upon aridity and the pressure of livestock population. This is because overgrazing has been identified as the single most important cause of desertification. The blame of overgrazing and the resultant desertification lies on the distant shepherd. Little do we acknowledge the immediate and inevitable role of rich man's market forces in terms of growing mutton demand in the major, metro and megacities for overgrazing caused by the poor shepherd. Desertification has rendered the hyper arid areas to a meager carrying capacity. Hence, the population density is generally very low. The landuse implications of desertification vulnerability have also been enquired.

Keywords: Desertification, Overgrazing, Hyper Arid, Fragile Environments and Social Sustainability.

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Introduction

Desertification is one of the major environmental problems of hydrographic, edaphic and biotic degradation in the arid and semi-arid lands. Overgrazing, traditional dryland practices and mining spoils are the major causes of desertification. Desertification is potentially the most threatening ecosystem change with an adverse impact upon the livelihoods of the poor today. Persistent reduction of ecosystem sustenance as a result of desertification and land degradation is a loss to human well-being. Arid and semi-arid lands encompass 41 per cent of the earth's land area. These fragile to highly fragile ecosystems have to support nearly 2 billion people and even greater number of livestock population. Desertification is characteristic to all the continents except Europe. Therefore, desertification ranks among the greatest environmental challenges today and is a major impediment to meeting the basic human needs in the drylands (Millennium Ecosystem Assessment Report, 2005).

Desertification assessment has shifted from appraisals of inter-annual movement of desert boundaries to complex multi-variate field surveys with the methodologies based on indicators of ecosystem functioning. Thus, the future challenges for assessment of desertification include the lack of reference situations due to varying methodologies for assessment of desertification. The issue of desertification assessment has been approached from a site-specific perspective (Prince et. al, 1998; Runnstrom, 2000; Collado et.al, 2002). Some studies provide catastrophic perspectives on both the rate of advance of desert lines and the area affected by desertification (Lamprey, 1975; UNEP, 1984). New research (Huenneke et. al, 2002; Veron et. al, 2005) has called into question these studies, due to methodological problems which makes desertification assessment controversial. The failure to achieve an accurate inventory of desertification is evident from the following statement of United Nations Convention to Combat Desertification: "To date, although great deal of data on land resources is available, it has not been possible to get a clear picture of the status of land degradation at regional or national level." (UNCCD, 2000)

The phenomenon of desertification is a highly dynamic process that involves both biophysical and socio-economic factors (Reynolds and Smith, 2002). However, land can hardly be said to be desertified until the symptoms appear in the biophysical system (Prince, 2002). Thus, long term monitoring is needed to distinguish between the role of anthropogenic actions and climate variability in the accentuation of desertification.

Definition and Concept of Desertification

Lavauden (1927) was the first to coin the term 'desertification' as a process to describe severely overgrazed lands in Tunisia. Later on, Aubreville (1949) used the term to refer to the excessive soil erosion due to deforestation in French West Africa. Since then, the term desertification has undergone several etymological changes. The United Nations first Conference on Desertification in response to the prolonged Sahelian droughts, defined desertification as, "an aspect of widespread deterioration of ecosystems under the combined pressure of adverse and fluctuating climate and excessive exploitation, implicitly restricted to dry areas." (UNCOD, 1977). Harold Dregne (1986) referred the desertification as, "the impoverishment of terrestrial ecosystems under the impact of man." Similarly, UNEP (1977) defined desertification as the intensification of desert conditions. UNEP (1992) defined desertification as, "a condition of impoverishment of arid, semi-arid and sub-humid ecosystems by the combined effect of man's activities and droughts."

Desertification is generally understood as merely an expansion of desert like conditions towards the fringe or non-desertic areas. This is because an instantly visible and obvious expression of desertification is the encroachment of aeolian sand on the non- sandy areas. But, desertification in fact, is the weakening of the natural support system or ecosystem of the land. Desertification is a long term decline in the land's biological productivity. Thus, when processes of restoration and amelioration of ecosystem are outpaced by the deterioration and overuse, the inevitable result is desertification.

Desertization and Desertification

The term desertization is referred to the visible expansion of desert like conditions on the fringe areas of the deserts. Desertization is the creep of desert like conditions into areas where they should not climatologically exist. Wind erosion is identified as a dominant factor which carries away sand particles to long distances. Another factor of desertization is salinization and alkalinization due to poor water management practices.

On the contrary, desertification is an invisible process of degradation of the soil, flora and fauna. The environments where potential evapotranspiration greatly exceeds precipitation are vulnerable to desertification. Thus, desertification involves an imperceptible impoverishment of the ecosystems through climatic changes as well as human impact. While desertification may be triggered by physico-chemical exigencies, its processes are always accelerated by the socio- economic impulses. It would be too late to acknowledge desertification in the visible stage of expansion.

Desertification and Drought

Prolonged droughts were initially considered as the harbinger of desertification. Even the first United Nations Conference on Desertification in 1977 was organized in response to the prolonged Sahelian droughts. Droughts and desertification are environmental hazards. Droughts are short term and reversible meteorological phenomenon but desertification is long term damage to the totality of the environment. The most common perception of drought is a period of prolonged dry weather during the rainy season. But drought has different definitions in view of the varying thermal and rainfall regimes.

India Meteorological Department identified a drought as situation when the annual rainfall is less than 75 per cent of the normal. A moderate drought is when the rainfall deficit is between 25-50 per cent of the normal. A severe drought is when the rainfall deficit is above 50 per cent of the normal. (Singh, 1978) Similarly, the British Rainfall Organization (1936) defined absolute drought as, "a period of atleast 15 consecutive days to none of which is credited a rainfall of 0.1 inch or more." (Encyclopedia Britannica) Among the definitions used in the USA following is the most common: "A year having less than 85 per cent of the normal precipitation i.e. a period of atleast 21 days when the precipitation is less than 30 per cent of the normal." (Hofman et. al, 1968) A factor common to all the definitions involves a departure from the normal rainfall.

Many authors view drought as a short-lived phenomenon responsible for recurrent but not permanent stress to the environment. (Le Houerou, 1977) A common misconception is that droughts are solely responsible for desertification. However, droughts do increase the likelihood of land degradation if the inherent carrying capacity of an ecosystem exceeds.

Desertification and Aridity

The intensity or severity of desertification is proportionate to the aridity index. The theoretical concept of aridity centers on the inadequate rainfall and absence of adequate vegetation cover. It is not of practical utility to define aridity in terms of rainfall inadequacy alone. Aridity is the cumulative climatological characteristic of continued moisture deficiency when rainfall is unable to meet the evaporative demands of a region.

Thornthwaite (1948) quantified aridity as a ratio between the precipitation and potential evapotranspiration. The atmospheric water need is the potential evapotranspiration

and the water availability is the amount of rainfall. The water deficit is the difference between the potential evapotranspiration and the precipitation in Thornthwaite's (1954) modified formula.

Thornthwaite's aridity index is expressed as percentage :

$$IA = \frac{PEt - P \times 100}{PEt}$$

Aridity is not determined by the amount of rainfall alone. It is controlled by factors such as high temperature, low atmospheric humidity, strong wind velocity and atmospheric pressure. Any definition of aridity is incomplete and inconclusive unless all of these factors are taken into account.

Nature of Hyper Arid Areas

Initially, hyper arid areas were excluded from the ambit of desertification assessment as they were perceived to be irreversibly desertified (UNCOD, 1977). As a matter of fact, hyper arid lands account for 8 per cent of the global land area and are also substantially populated. Moreover, even hyper arid lands have measurable levels of ecosystem support provisions. Desertification has been observed in hyper arid lands, where mechanisms of degradation are more intense than those in other drylands (Millennium Ecosystem Assessment Report, 2005).

The problem of intensification of desertification in the hyper arid lands of the Indian Desert is crucial, since they are more vulnerable to accentuation of the desertification conditions because of relatively greater population and livestock pressures. The hyper arid lands are extremely marginal with meager environmental sustainability. The hyper arid lands of Indian Desert are more vulnerable to degradation of its inherent biological production potential due to:

(i) Largest number of rural settlements.

(ii) Highest population density than anywhere else.

(iii) Comparatively higher livestock pressure than any other hyper arid zone in the world.

Geographical Profile of the Study Area

The hyper arid lands of India lie in the extreme western most part of the Indian Desert. They attest along the impregnable International Border with Pakistan. The hyper arid areas of Indian Desert lie west of the Indira Gandhi Canal Command Area. It is a sandy waste of shrinking interdunal plains. The geographical area encompasses 16, 368.67 sq.km with a population of 99,837 persons coupled with a livestock population of 4,64,188 heads. (Fig. 1)The man-livestock ratio is 1:4.7 which clearly reveals the dominance of nomadic herding and animal husbandry activity. The entire geographical area stretches along the parts of two tehsils of Jaisalmer and Pokaran with Kolayat in Bikaner District. (Fig. 2) There are a total number of 175 villages, out of which 10 are uninhabited. Out of the total hyper arid zone area and population:

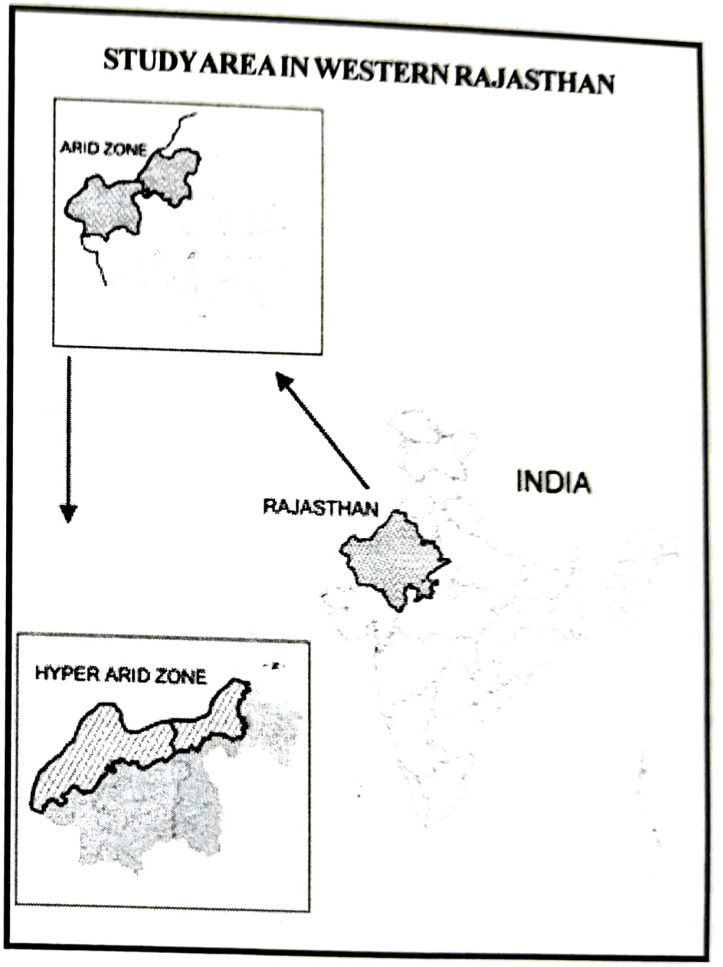

Fig. 1

(i) Jaisalmer tehsil has 11,822 sq. km with a population of 52,397 in 102 villages.

(ii) Pokaran tehsil has 2,511 sq. km with a population of 19, 148 in 43 villages.

(iii) Kolayat tehsil has 2,034 sq. km with a population of 28,292 in 20 villages.

The average population density of the hyper arid zone is 6.1 persons per sq. km. It varies from 4.432 in Jaisalmer tehsil with 7.624 in Pokaran tehsil and 13.905 in Kolayat tehsil.

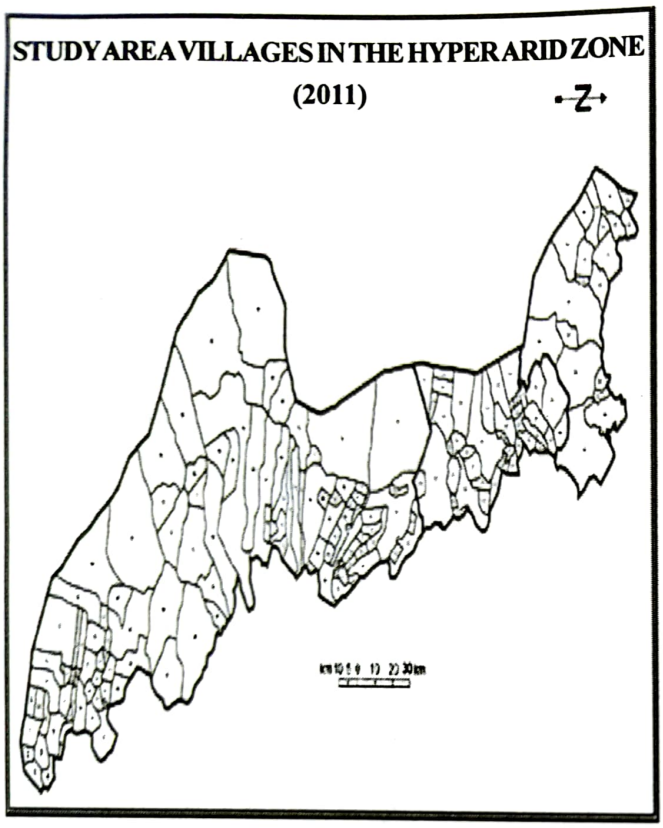

Fig. 2

Scientific Demarcation of Hyper Arid Lands

The hyper arid zone has been demarcated on the basis of Thornthwaite's Modified Classification Model of 1954. The area has been mathematically delimited on the following annual aridity index:

$$IA = \frac{\text{Water Deficiency}}{\text{Atmospheric Water Need}} \times 100$$

(i) The mean annual precipitation is 115 mm and less

(ii) The mean annual potential evapotranspiration is 2350 mm.

(iii) Hence, the average annual aridity index is 95 per cent.

(iv) Hyper arid areas of India have an aridity index of 95 per cent and above.

Data Base and Research Methodology

Field work was conducted in the sampled villages and primary data was generated along with environmental observations. Statistical data was obtained from the Directorate, Census Operations, and Offices of the District Collectors from respective tehsils. Meteorological data was obtained from IMD, Pune. Secondary data was obtained from the District Gazetteers and published records. The socio-economic data has been screened through simple statistical techniques and the spatial variation analysis has been made.

Results and Interpretation

Size-Location of Hyper Arid Villages

The geographical area of the villages has been analyzed in their locational perspective. (Fig. 3) The different size of villages have been examined in relation to the amount of rainfall and the degree of aridity. It has been noted that the large size villages mostly correspond to the more desolate locations. The increasing aridity has also played a crucial role in determining the village size. Further, several villages have recently been sub-divided into the new ones.

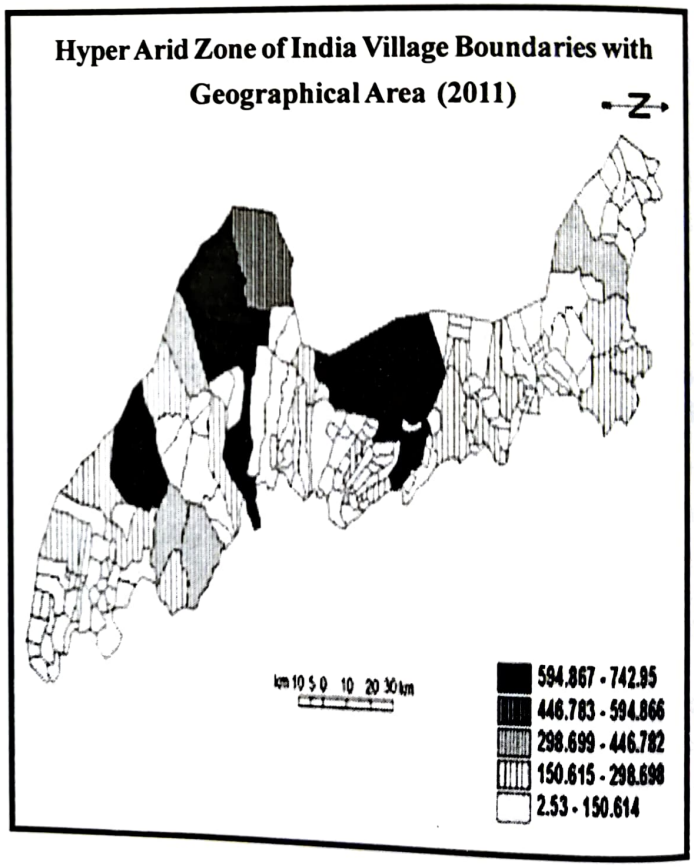

Fig. 3

Source: Based on Census of India, 2011.

Population Gravity of Villages

It is surprising to note that even in this desolate hyper arid zone of India, several villages have been found in a large size category of over 2000 persons to 5000 persons and even up to more than 9000 persons. (Fig. 4)

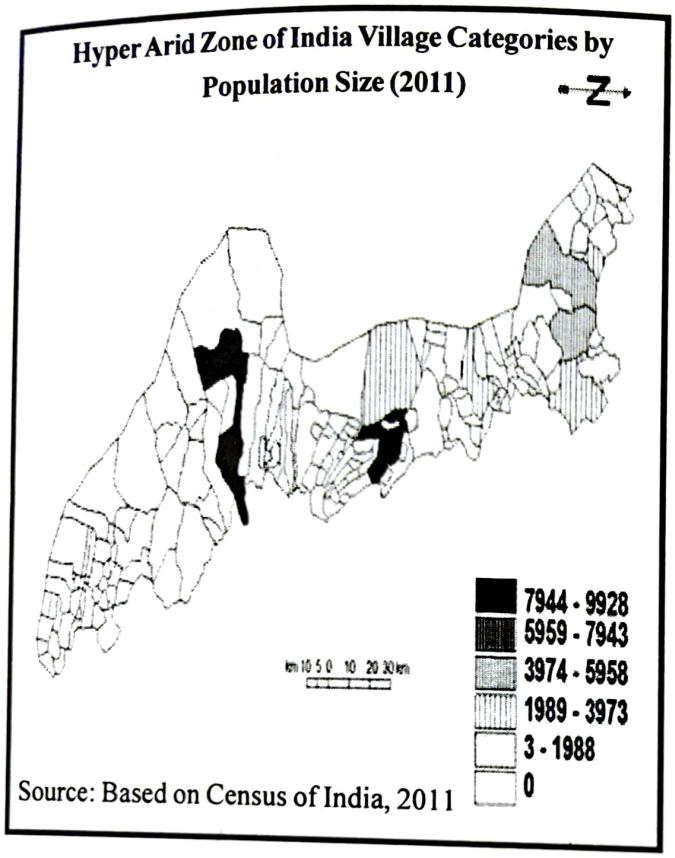

Fig. 4

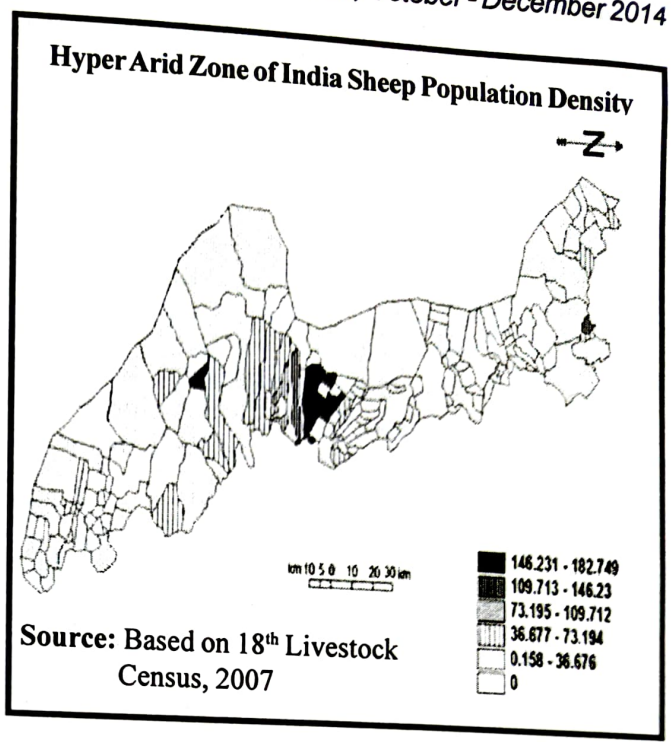

Fig. 5

Some of the large population villages were found in the considerably favorable locations of good water availability. Most of the large size villages are not located along the highly inflammable International Border with Pakistan. Out of the total 175 villages under enquiry 10 villages were uninhabited in these areas. The uninhabited villages are from small size to medium size in their geographical extent. Only two uninhabited villages were found on the International Border with Pakistan. However, all the uninhabited villages were in Jaisalmer tehsil. Pokaran and Kolayat tehsils do not have any uninhabited village. Further, the status of uninhabited villages keeps on changing. Sometimes the villagers abandon their very small villages with population size of less than 50 persons. At other times of emergency, the Border Security Forces temporarily evacuate even the villages of larger size.

Livestock Overgrazing

The hyper arid areas of extremely vulnerable ecology have considerable pressure of livestock population and overgrazing. The major livestock are sheep, goats, bovines and camels. Sheep is the most dominant livestock. (Fig. 5)

The largest number of 2,21,598 heads of sheep is an extreme pressure on the highly precarious rangelands. Moreover, sheep is a close grazer in comparison to the goats. Another rangeland grazer is goat with 1,81,296 population. The percentage of sheep population to the total livestock population is 47.7 per cent. Goat being the second largest comprises 39.05 per cent. Sheep and goats together comprise bulk of the livestock population with 86.8 per cent concentration. Environmentally, the most hardy and sustainable animal camel has witnessed a decreasing population trend. On the other hand, the population of environmentally less sustainable cow is on the increase largely due to social and sentimental priorities.

Conclusion

The hyper arid lands of the Indian Desert are highly vulnerable to desertification. It was a matter of surprise to find an average population pressure of 6.1 persons per sq. km. Further, the livestock pressure on these highly fragile rangelands is also considerably high with an average livestock density of 28.35 per sq. km. No other hyper arid lands anywhere in the world, either in the Atacama desert, or Ruba-ul-Khali in the Arabian desert or the Southern Negev desert in Israel or the Gobi desert in China have such a high man-land ratio or land-livestock ratio. This uniquely high man-land ratio and the land-livestock ratio in the hyper arid lands of the Indian desert render it distinctly vulnerable to desertification.

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J.M.Keynes on Capitalism

It was evident from these lectures that already in the mid-1920s Keynes was thinking about the problems of reforming private capitalism. In the Minutes of one of his lectures, there is the note that, "Prof.Keynes states that he is not a defender of the capitalist system in its present form and believes that a number of measures can be taken to improve it; the existing social system must be reconstituted on more acceptable principles" (Central State Economies Archives of the USSR, Fun No. 3429, file 109),

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