Ecological Indicators 77 (2017) 105–113

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Original Articles

An assessment of social vulnerability to climate change among the districts of Arunachal Pradesh, India

Sanjit Maiti[b,*], Sujeet Kumar Jha[b], Sanchita Garai[b], Arindam Nag[c], A.K. Bera[a], Vijay Paul[a], R.C. Upadhaya[d], S.M. Deb[a]

[a] ICAR-National Research Centre on Yak, Dirang, 790101, Arunachal Pradesh, India
[b] Dairy Extension Division, ICAR-National Dairy Research Institute, Karnal, 132001, Haryana, India
[c] Department of Extension Education, Bihar Agricultural University, Sabour, 813210, Bihar, India
[d] Dairy Cattle Physiology Division, ICAR-National Dairy Research Institute, Karnal, 132001, Haryana, India

ARTICLE INFO

Article history:
Received 11 April 2015
Received in revised form 3 February 2017
Accepted 6 February 2017

Keywords:
Vulnerability to climate change
Adaptive capacity
Exposure
Sensitivity
Eastern Himalaya
Arunachal Pradesh

ABSTRACT

The present study highlighted the state of climate change induced social vulnerability of the districts of Arunachal Pradesh. For the purpose of assessment of one of the most fragile ecosystems of the eastern Himalaya, the 'Integrated Vulnerability Assessment Approach' and IPCC's definition of vulnerability were utilized. The assessment was based on various secondary data, like socio-economic and biophysical indicators, collected from several authenticated sources; and the respective weightage of these indicators was assigned by using 'Principal Component Analysis'. Vulnerability was calculated as the net effect of exposure and sensitivity on the adaptive capacity. Anjaw district of eastern Arunachal Pradesh was found to be the most vulnerable district, while Tawang district of western Arunachal Pradesh happened to be the least vulnerable. This net effect was found negative in 7 out of 12 districts viz. Anjaw, Upper Siang, West Siang, Lower Dibang Valley, East Siang, East Kameng and Kurung Kurmey. This net negative effect could be construed as an alarming situation.

1. Introduction

'Climate change' is a natural phenomenon; however, the rate at which the change takes place, as of now, is far more than the normal; this is due to anthropogenic activities (Bharali and Khan, 2011). The 'Fourth assessment report' of IPCC clearly depicted that the impact of climate change would be more severe in mountain and costal eco-system, especially in developing and least developed countries (IPCC, 2007). The north-eastern states of India are expected to be greatly affected by climate change because of their geo-ecological fragility, strategic location vis-à-vis the eastern Himalayan landscape and international border, their trans-boundary river basins and the inherent socio-economic instabilities. Climate change will affect all natural eco-systems, but the impacts will be more prominent on the already stressed eco-systems of the Eastern Himalayas (ICIMOD, 2010). Cavaliere (2009) and Xu et al. (2009) also explained that high-elevation eco-systems of the Himalayan region are the most vulnerable geographic regions of the world (outside of the polar region) to climate change.

The ecological systems in Arunachal Pradesh, due to its physiographic condition are more fragile, complex and vulnerable to global climatic change and are found to be easily disturbed. Climate change will not only impact the bio-diversity of Arunachal Pradesh, but also affect the livelihood of local communities, as they happened to be fully dependent on the natural resources and they perceived the changes in climate since last decade (Bharali and Khan, 2011; Maiti et al., 2014). Of late, Arunachal Pradesh experienced extreme climatic events, including two extremely dangerous cloudbursts of unprecedented intensity in the years 2008 and 2010, respectively, which produced devastating flash floods, causing many deaths and enormous loss to the forested and agricultural land. As a part of the Eastern Himalayas, Arunachal Pradesh is also rich in endangered, endemic and threatened floral and faunal species with restricted distribution and narrow habitat ranges (Wikramanayake et al., 2009), which are at particular risk due to climate change (ICIMOD, 2010). However, it is extremely difficult to assess the impact of climate change due to limited data availability, coupled with the uncertainties associated with the climate scenarios. A very little of the impacts of climate change in Arunachal Pradesh is known till now. Therefore, making the future scenario more visionary, an assessment of climate induced vulnerability was

* Corresponding author.
E-mail addresses: sanjit.ndri@gmail.com, sanjitndri@rediffmail.com (S. Maiti).

http://dx.doi.org/10.1016/j.ecolind.2017.02.006
1470-160X/

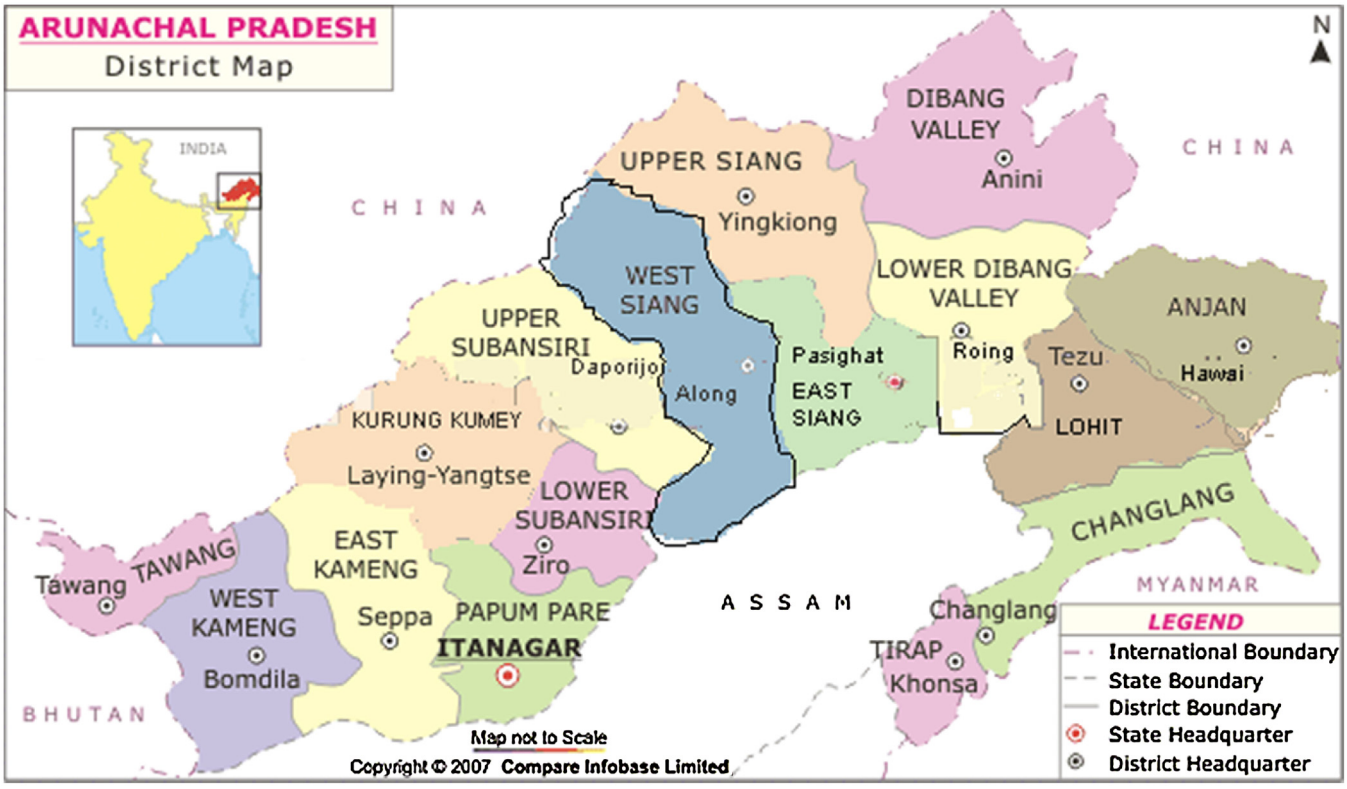

Fig. 1. Map of Arunachal Pradesh, India.

thought to be the need of the hour, which undertaking the present study.

2. Materials and methods

2.1. Study area

Arunachal Pradesh, the largest state in the north-eastern region of India, is located between 26°28′–29°30′N lat. and 91°30′–97°30′E long., and covers a geographical area of 83,743 sq. Km, with a population density of 17/sq. km (2011 Census). The state forms a major part of the Eastern Himalayas, and is predominantly hilly and mountainous (Bharali and Khan, 2011). The state is also recognized as one among the 200 globally important eco-regions (Olson and Dinerstein, 1998).

There are 16 districts in the state of Arunachal Pradesh (Fig. 1). Among these sixteen districts, 13 districts (except Tirap, Changlam, and Lohit) are in alpine and sub-temperate alpine agro-climatic region. Hence, these thirteen districts namely Tawang, West Kameng, East Kameng, Kurung Kurmey, Papumpare, Lower Subansiri, Upper Subansiri, East Siang, West Siang, Upper Siang, Dibang Valley, Lower Dibang Valley and Anjaw were covered to prepare district level vulnerability profile. Dibang valley district was dropped during data collection due to non-availability of climatic data at India Metrological Department, Pune, India. Therefore, 12 districts of Arunachal Pradesh were finally selected for the present study.

2.2. Data sources

The present study was based on the secondary data and district level data, which were obtained from the diverse sources. Data on the district-wise demographic features like population density, decadal growth rate, rural literacy rate, rural population to total population as well as household data like rural households availing banking service, households not having drinking water sources at their home premises, households having houses in dilapidated conditions were taken from the official website of *Census of India,* as per 2011 census. Climatic indicators were calculated from the high resolution daily gridded temperature and rainfall data for the Indian region during the period of 25 years (1975–1999), as developed by the India Metrological Department, Pune, India. District-wise agricultural productivity (Rs/ha of Net sown area) were taken from the 'Policy Paper no' 26 (entitled as 'Instability and regional variation in Indian Agriculture'), as published by the National Centre for Agricultural Economics and Policy Research, India in the year 2011. District-wise 'Human Development Index' value was obtained from the human development report of the Govt. of Arunachal Pradesh. Data on the district-wise land utilisation pattern; agriculture; animal husbandry; fisheries; infrastructure like rural electrification, medical institution; per capita income; and operational holding were collected from the latest published statistical handbook and official websites of Arunachal Pradesh and respective districts.

2.3. Development of social vulnerability index for the districts of Arunachal Pradesh, India

There are three major conceptual approaches for analysing vulnerability to climate change: the socio-economic, the bio-physical (impact assessment), and the integrated assessment approaches (Deressa et al., 2008).

The integrated assessment approach combines both socio-economic and bio-physical approaches to determine vulnerability. The vulnerability mapping approach (O'Brien et al., 2004; Kumar and Tholkappian, 2005) is a good example of this approach, in which both socio-economic and bio-physical factors are systematically combined to determine vulnerability. Thus, this method was fol-