RESEARCH ARTICLE

ANIMALS AS WEATHER-FORECASTING BIO-INDICATORS A CASE STUDY OF DIFFERENT COMMUNITIES OF BISHNUPUR DISTRICT, MANIPUR, NE INDIA."

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Manuscript Info	*Abstract*
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Introduction:-
Traditional knowledge is very important which is mainly based on innovations and practices of indigenous local communities following traditional lifestyles. Ethnic and local people, especially farmers, fishers, hunters and local medicine practitioners are very astute weather-watchers and are quick to recognize weather conditions and whether they are not favorable to their production systems. Traditional practices wisdom developed over many generations of holistic traditional utilization of the lands, natural resources and environment. This knowledge is generally passed down from generation to generations by experiential learning and word of mouth and is importantly most part, undocumented in written form.

Bishnupur district lies in the south–western corner of the Manipur Valley (also known as Imphal Valley). The district, covering a total area of 530 km and stretching from 93.43^0 E to 93.53^0 E longitude 24.18^0 N and 24.44^0 N latitudes, is located at the South Western Part of the valley region of Manipur State. It is situated at an altitude of 800m amsl.

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Historically and culturally, Bishnupur district is an important place in Manipur as the district with a number of traditional stories, historical events and monuments.

The ethnic people, especially farmers and fishers, are very incisive weather watchers and are quick to recognize weather conditions and whether or not they are favorable to their production systems (Posey D,1992; Mcfarland et.al.,1994 ; Lantz TC et.al.,2003; Ravi Shankar et.al., 2008). The production and application of local forecasts are deeply localized, derived from an intimate interaction with a micro environment whose rhythms are interwined with the cycles of seasonal changes. The vulnerability caused by vagaries of the weather creates a knowledge base among the ethnic people/farmers in the form of Indigenous Technical Knowledge (ITK) that helps people to overcome uncertainty and prepare for possible adverse or favorable events (Posey D, 1992; Altieri, M,1999 ; Roncoli C et.al.,2002).

Local indicators and local knowledge systems cannot be replaced with scientific knowledge, because they are holistic and specific to local situations, providing farmers and others with the ability to make decisions and prepare for the coming agricultural year (Posey D,1992;Bharara LP et.al., 1994;Altieri M, 1999 ; Ravi Shankar et.al., 2008; Sandeep Acharya,2011).

Scientific evidence of climate variability of events such as droughts and floods suggests that climatic oscillations have occurred in the past and may occur in future, potentially with larger impacts on human society and economy and on the ecosystems on which they depend (Bharara LP, 1986 ; Fisher, 1997; Aparna P et.al.,2011). There is an evidence to show that slow and gradual climatic changes over the earth's history have been interspersed with abrupt climatic changes such as rapid cooling, warming, wetting and drying due to the forcing of earth systems across the threshold (Bharara L.P, 1986; Aparna P et.al.,2011).

Despite the presence of modern technology to predict weather conditions over the next day or month in a specific location, folk weather lore has remained an important form of local weather forecasting, and can serve to supplement public meteorological information and weather prediction. People have been attempting to predict the weather for a very long time and have used a number of different methods, some of which have proven very effective and successful (Sandeep Acharya,2011; Angchok D et.al.,2006; Galacgac ES et.al., 2009). There is an urgent need to authenticate the various traditional methods of weather prediction, especially rainfall forecasting, and ways to predict other natural weather phenomena such as floods, cyclones, etc(Sandeep Acharya,2011; Angchok D et.al.,2006).

Indigenous knowledge is now much sought after in the present context of globalization. However, while the diverse knowledge systems of the third world are claimed as heritage that belongs to all humanity, the knowledge about how to apply this diversity is often exclusive to the domain of the people who have developed it (Hussain Z,1991; Balwanera P, 2001; Aparna P et.al.,2011).

Materials and methods:-
The aim of the present study is to document the traditional indigenous knowledge of some indicator species used for weather forecasting and assessing climate change, in order to assist cultural preservation and renewal among different communities of Bishnupur district of Manipur, especially the Meiteis, Kabuis, Koms and Chothes, etc. The study is mainly based on the data collected from the primary sources, interviews and group discussions with local elders and personal interactions with villagers of Bishnupur District, Manipur.

Respondents who had lived in the village for the past many years and preferably older than 30 years were mainly targeted. Interviews of the selected respondents were conducted in their homes using open ended questionnaires. This gave the respondents an opportunity to describe important features of their local weather forecast systems while detailing features that are important for them. Information on demographic characteristics and indigenous knowledge of forecasting the onset of the rainy seasons was collected.

Although investigation and data collection was a tedious one because the indigenous people are hesitant to transfer their traditional knowledge acquired from their ancestors since time immemorial, there was no literature and no well documented data in the study area before. The participant's observations were also used in data collection. Questionnaires made to different group of elders were a checklist that included issues on conventional climate

forecast knowledge, seasonal rainfall predictions, knowledge on traditional indicators and past climatic events documented through interviews.

Most of the people interviewed in this study valued traditional knowledge in relation to early warning and copying mechanisms for natural disasters. Only a few self-confident young people who were accustomed to the use of transport vehicles said that they rely mainly on radio weather forecasts rather than on local methods of anticipating weather events.
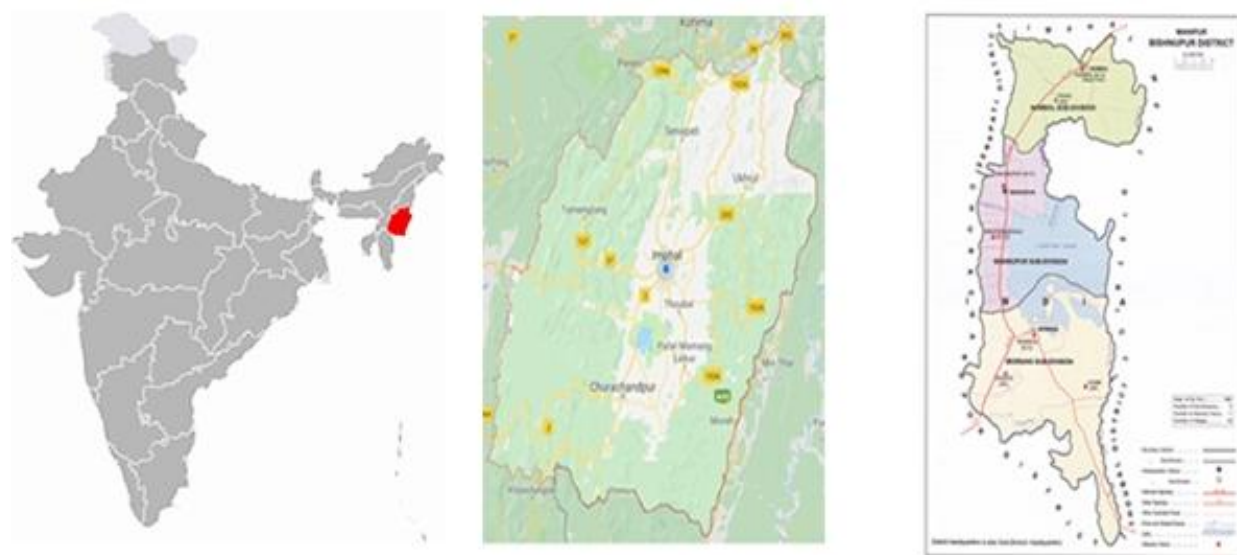

Fig 1:-Bishnupur District, Manipur.

Results:-

The present investigations reveals the use of 28 species of animals belonging to 27 genera and 25 families as Animal Indicator species for prediction of weather conditions by the different indigenous ethnic communities of Bishnupur District, Manipur, belonging to the Meiteis, Meitei Pangals (Muslims), certain tribes, viz. Chothe, Kabui and Kom tribes. These ethnic people mostly relied on similar bioindicators to predict rainfall and other weather conditions. The study revealed that indigenous knowledge systems have enabled the various ethnic communities in the area to live in harmony with their environments for generations, and that their traditional knowledge systems are important tools in environmental conservation and natural disaster management. Based on this traditional knowledge and people's long standing experiences concerning cloud formation, lightning wind directions, occurrence of rains in a particular period of the lunar calendar, the indigenous rain forecasters predict the reasonably exact nature of rainfall for the entire season, including good and undesired effects (e.g., flooding, droughts).

In traditional weather forecasting, the onset of the rainy season and upcoming rain is also indicated by the unusual behavior of certain birds and animal's aggressive and abnormal activities. The possibility and beginning of the rainy season in Bishnupur is signaled by the unusually chirping of the Apis dorsata Fabricius, Bos taurus Linnaeus, Bufo melanostictus Schneider, Centropus toulou bengalensis Gmelin, Cuculus canorus Linnaeus, Megalaima asiatica, Megalaima australis Cyanotis Melanochlora sultanea Hodgson, Odontotermes sp., Papilio Linnaeus, , Picus canus Gmelin, Pycnonotus jocosus Linnaeus and Treron cuvirostra nipalensis. In traditional weather forecasting, a typhoon or flood is imminent when insects start incessant chirping Pheretima posthuma (earthworm), coming out of the ground and scattered in the backyard of the houses, Rucervus eldii eldii (deer) become restless and also spiders spin shorter and thicker webs (Sivanarayana G,1993; Seetharaman RN, 2001; Angchok D et.al.,2006; Galacgac ES et.al.,2009; Sandeep Acharya,2011).

These findings on traditional bioindicators of weather uses of 28 (twenty eight) animals used by ethnic communities of Bishnupur district of Manipur, N.E. India are shown in Table 1 below:

Table1:-Indicator species of animals for prediction of weather conditions

Sl.no	Scientific name	Family	Common name/Local name	Animal biological behaviour	Weather predictions
1	*Acridotheres fuscus* Wagler 1827	Sturnidae	The Northern Jungle Myna/ Chonga amubi.	Call of Chonga amubi	Summer season.
2	*Apis dorsata* Fabricius, 1793	Apidae	Honey bee / Khoiren	Wasps hiding their honeycomb	Upcoming rain
3	*Apis mellifera* Linnaeus, 1758	Apidae	Honey bee	Appearance and movement of the insect.	Onset of dry season
4	*Araneus angulatus* Clerck, 1757	Araneidae	Spider/ Mirang	Spider spinning shorter and producing thicker web	Adverse weather condition (typhoon or flood).
5	*Bos Taurus* Linnaeus, 1758	Bovidae	Cow/San	Calves becoming uneasy	Upcoming rain
6	*Bubulcus ibis* coromandus Boddart, 1783	Ardeidae	The Cattle Egret/ Sandungil	Appearance of migratory the Cattle Egret	Onset of dry season
7	*Bufo melanostictus* Schneider 1799	Bufonidae	Frog / Hangoi	Croaking of toad/ frog	Possibility of rain.
8	*Centropus toulou* Gmelin 1788	Cuculidae	The Lesser Coucal /Nongoubi	Call of Nongoubi	Possibility of rain.
9	*Cicada sp.* Linnaeus, 1758	Cicadidae	Cicada/Hari nongnang	Chirping of insect (Cicada)	End of a day (approaching dusk)
10	*Corvus macrorhynchos levaillantii* Lesson 1831	Corvidae	The Eastern Jungle Crow/ Kwak	Crows nesting at low height of trees.	Windy year.
11	*Cuculus canorus* Linnaeus, 1758	Cuculidae	Common cuckoo	Calling of cuckoo	Upcoming rain
12	*Formica sp.* Linnaeus, 1758	Formicidae	Ant/Kakcheng	Ants carrying their eggs	Occurrence of flood.
13	Gallus gallus (Linnaeus, 1758)	Phasianidae	Red jungle fowl / Lamyel	Unusual clucks and sand bathing	Occurrence of flood
14	*Gracula religiosa* Linnaeus, 1758	Sturnidae	Northern Hill Myna / Chong-nga amubi	Unusual chirping and aggressive behaviour	Occurrence of flood
15	*Halcyon symensis* Swainson, 1821	Alcedinidae	The Eastern White breasted Kingfisher/ Ngarakpi	Appearance of Ngarakpi	Winter season
16	*Lonchura striata* Linnaeus, 1766	Estrildidae	White-rumped munia / Ushuk	Chirping unusually with strident sound	Adverse weather condition
17	*Megalaima asiatica* Latham, 1790	Megalaimidae	The Blue Throated Barbel / Hungkrok laobi	Unusual chirping	Upcoming rain
18	*Megalaima australis* Cyanotis Blyth 1847	Megalaimidae	The Indian Blue-eared Barbet / Hangkrok laobi	Unusual chirping and flying low	Upcoming rain

| 19	*Melanochlora sultanea* Hodgson, 1837	Paridae	Sultan Tit	Unusual chirping	Upcoming rain
20	*Notonecta sp.* Linnaeus, 1758	Notonectidae	Backswimmer /*Longkhajing*	Nesting above the water level	Occurrence of flood.
21	*Odontotermes sp.* Holmgren, 1913	Termitidae	Termite /*Leisou* in immature form, *Mukthrubi* in winged form	Appearance of many termites indicates near rainfall onset.	Upcoming rain
22	*Papilio* Linnaeus, 1758	Papilionidae	Butterfly/*Kurak*	Appearance of many butterflies	Upcoming rain
23	*Pheretima posthuma* Kinberg, 1867	Megascolecidae	Earthworm/ *Tinthrok*	Earthworm coming out from the ground	Adverse weather condition (flood or typhoon).
24	*Picus canus* Gmelin, 1788	Picidae	Grey headed Woodpecker / *Ootubi*	Unusual activity with rotation around the tree	Upcoming rain
25	*Pycnonotus jocosus* Linnaeus, 1758	Pycnonotidae	Red- whiskered Bulbul/ *Khoining*	Unusual chirping	Upcoming rain
26	*Rucervus eldii eldii* M'Clelland, 1842	Cervidae	Deer /*Sangai*	Deer becoming restless	Adverse weather condition (flood or typhoon).
27	*Streptopelia chinensis* Scopoli, 1768	Columbidae	Spotted dove / *Leima khunu*	Chirping unusually and Moving in pairs and taking shelter in shadow of leaves and	Adverse weather condition (flood or typhoon).
28	*Treron cuvirostra nipalensis* Gmelin, 1789	Columbidae	Thickbilled Green Pigeon / *Khunu ashangba*	Chirping unusually	Upcoming rain
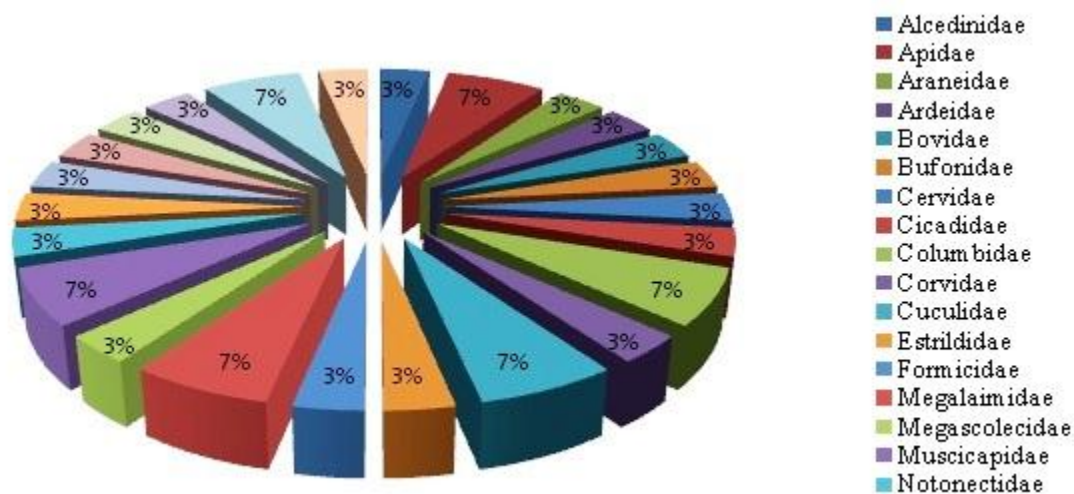
Fig 2:-Familywise distribution of indicator species of animals for prediction of weather conditions of Bishnupur district of Manipur

Discussion:-

The behaviour of animals and the appearance and movement of birds and insects are frequently used by elders to predict weather and climate in their communities (Chang'a LB et.al.,1991). Local indicators were used by local communities in seasonal rainfall prediction. There have been interesting proposals about the validity of some animal folklore and it is pointed out that science is based on observation and folklore is based on centuries of observation although the observations were not conducted in controlled circumstances. Also, differences exist across species and between individuals of the same species in their sensitivity to weather fluctuations. While some animals may be great weather predictors, others within that same species might not show the same sensitivity (Hussain Z, 1991). Indigenous people expresses that when average number of cows are lying down in a field, rain is on its way as the cows sense the moisture in the air and are making sure they have somewhere dry to lie down. If average numbers stand up in their fields or pastures weather will be fine on the other hand, if they lie down in average, they sense the moisture of approaching rain and make sure they have a dry patch to lie on[9]. In Germany as a weather forecaster the green frog called Laubfrosch (in German language) is very popular for accurate prediction of weather condition(Angchok D et.al.,2006).Since indigenous knowledge is mainly based on relative experience and local experience, lack of benchmark makes it difficult to be harmonized and integrated into conventional forecasting system. Systematic documentation, quantification and subsequent integration of indigenous knowledge into conventional weather forecasting system is therefore recommended as one of the strategy that could help to improve the accuracy and reliability of seasonal forecasting information under a changing climate(Aparna P et.al.,2011).

Conclusion:-

Traditional indigenous knowledge deals with the activity of species at those very moments when animals prepare to take necessary precautions against upcoming natural dangers. Cultural emphasis on the relationship between knowledge and responsibility also calls for scientists to be more aware of and accountable for the intended and unintended impacts of scientific products. This is proven by substantial evidence from bioindicators (Table1) from India with a possible explanation for abrupt changes in behavioral activities of animals respectively. A number of literatures sources also support this evidence (Selvanayagum M,1991; Sen S, 1992; Altieri M, 1999; Balwanera P, 2001; . Laishram Imoba et.al.,2003; Turner NJ, 2003; Vavrova M,2003; Briggs John,2005; Dessai S et.al., 2005; Dekens Julie,2007; Turner N J,2006 & 2009; Matari ER et.al.,2008; Joshua S et.al.,2013;). Now is the time to integrate data from modern techniques of weather forecasting from traditional indigenous knowledge, to support the extra demands for local weather prediction at specific times and in particular regions at this era of rapid climate change. If it is not done, countries like India, which are totally dependent on the seasonal rainfall for sustainable agricultural and allied activities, will suffer greatly in near future from deficiencies in short, medium and long range rain forecasting (State of Environment Report,Manipur(Turner N J et.al.,2006; State of Environment Report Manipur, 2009).

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