

Climatic variability and its role in crop yield in central Himalaya

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Abstract

For a country like Nepal, whose economy is predominantly agrarian and the agriculture sector contributes more than two thirds of the gross national product, it is extremely important to have the knowledge of seasonal variation moisture and the extent to which precipitation is not able to meet the water need. Thus the study of water balance is very significant to answer such agricultural questions. Meanwhile the surplus and deficiency of water define the moisture index of the region, which in turn affects the climatic pattern. Results of this study indicate that the annual moisture index in the basin ranges from 400 to -39.3, which shows the wide variety of climatic type; almost half the stations of the basin are humid type climates. The southern belt of the basin has suitable climate for the production of rice and wheat while the midlands favor maize production.

Introduction

Agriculture is highly dependent on weather therefore changes in global climate could have a major effect on crop yield and world food supply. Weather is dominant factor in determining the success or failure of agricultural enterprises. Weather manifests its influence in agricultural operation and farm production through its effect on soil, plant growth as well as every phase of animal growth and development. For a country like Nepal, whose economy is predominantly agrarian and the agriculture sector contributes more than two thirds of the gross national product, a study of water balance is important. Again due to the limited facility of irrigation most of agricultural activities depend on seasonal precipitation. So drought is a serious problem. In 1982 the onset of monsoon over Kathmandu was delayed by two weeks and as a result some parts of eastern Nepal experienced drought during June to September. Grain production reduces to 15 to 20 percent of yield of normal year. It is extremely important to have knowledge of seasonal variation of moisture and the extent to which precipitation is not able to meet the water need. Thus the study of water balance is very significant to answer such agricultural questions. Meanwhile the surplus and deficiency of water define the moisture index of the region, which in turn affects the climatic pattern.

Study Area

The study area is the Koshi basin located in the central Himalaya, in the mountain and hill areas of eastern Nepal between longitudes 85°29' - 88°15' E and latitude 26°30' -28°07'N. The basin includes Himalayan range to the plain of Terai, with the elevation varying from 8848metre at Mt. Everest to 71 meter at the Nepal India border. The Koshi basin in the study area extends 230 km from east to west and 120 km from south to north. Koshi river system is the largest river system in Nepal has the catchment area of 60,400 sq. km area lies in Tibet and 27753 sq.km in Nepal. Topography of the study area as that of Nepal in general may be divided into following parallel Geographic regions: The Mountain, Hill and Terai zones. The climate of the Koshi basin can be divided into four seasons as follows:

Hot weather seasons - March to May

Rainy season - June to September

Post-monsoon season-October to November

Cold weather seasons-December to February

Agriculture is the major source of income and employment in the central Himalaya. Subsistence farming is the prevalent system in agriculture as most of the farmers have smallholdings. Farms are scattered and tiny in size. Irrigation facilities are limited and most crops are raised on dry farms under rain fed conditions. Local manures are applied for the important summer crops. Winter cropping is raised mainly in neighboring farm plots where family supervision can be carried out. The food crops are rice and maize but potato and millet are the staple food crops for the highland communities. Wheat is the major winter crop and the potato for the lower altitudes.

Data & Methodology

The data used for this study is taken from the climatological records of Nepal. Potential evapotranspiration (PET) estimated using the Thornthwaite method to estimate water balance Parameter and Moisture index. The influence of climatic type for major crops is estimated by analyzing the agro-climatic data.

Results

PET calculated by Thornthwaite method shows that Terai belt observes 1200-1500 mm, Midland observes 700-900 mm and Mountain observes 500 mm. Penman Method shows southern belt has 1400mm and Northern 900mm.

The southern belt shows a larger amount of water deficiency. Maximum value is 406 mm in Himalayan and midland region due to the enormous rainfall and lower water need. Maximum value in Nepalthok. Minimum in Namchebazar, Syangboche and Taplethok. Water deficiency starts increasing from November and reaches peak in April and May.

Water surplus occurs during monsoon season. Maximum observed in Num is about 3469mm. Minimum observed in Nepalthok is about 2mm.

Annual moisture index in the climatic station

Index	Station	Moisture index	Climatic type	Index	Station	Moisture index	Climatic type
1022	Godavari	131.6	A	1301	Num	400.2	A
1036	panchkhal	1105	C2	1303	Chainpur	45.9	B2
1062	Sangachowk	50.9	B2	1304	Pakhribas	102.4	A
1103	Jiri	18.7	A	1307	Dhankuta	13	C2
1107	Sindhuligadhi	139.6	A	1314	Terathum	12	C2
1115	Nepalthok	-39.3	D	1318	paripatle	20.5	B1
1201	Namchebazar	105.6	A	1320	Tarahara	32.1	B1
1206	Okhaldhunga	117.6	A	1324	Bhojpur	62.7	B3
1212	Phattepur	-8.06	C1	1404	Taplethok	200.8	A
1213	Udayapurgadhi	56.1	B2	1405	Taplejung	156	A
1220	Chyalsa	198	A	1419	Phidim	30.2	B1
1225	Syanboche	204.2	A				

A-Per humid B1-B4-Humid C2-Moist sub humid

C1-Dry sub humid D-Semiarid

The planting and harvesting period are assumed as follows:

S.N.	Crops	Planting period	Harvesting period	Total duration
1	Early paddy	Mar 15	June 30	105 days
2	Main paddy	Jul 01	Nov 30	150 days
3	Main paddy1	Jul 15	Oct 31	105 days
4	Wheat	Nov 15	Mar 15	120 days
5	Wheat1	Dec 01	Mar 31	120 days
6	Maize	Mar 15	Jun 15	105 days
7	Potato	Nov 15	Mar 31	130 days
8	Potato1	Sep 01	Jan 15	130 days
9	Oil seed	Dec 15	Mar 15	90 days
10	Pulses	Mar 01	Jun 15	105 days

Source: WECS

Major crop yield in the Koshi basin of central Himalayas

Paddy: Climatic pattern of *midland and Terai* of Koshi basin is almost suitable. Mean yield of paddy is 1934.92 Kg. per ha. Maize: Hill climate of *midland* favors for maize production.

Mean yield of maize is 1578.24 Kg.per ha.

Wheat: Climate of *hill and Terai* is more or less suitable for wheat. Mean yield of Wheat is 1230.72 Kg.per ha.

Conclusion

No water deficiency is observed at higher altitudes. At the lower altitude the problem of water deficiency exists. This indicates that the southern belt requires a higher amount of irrigation than the midland and the northern mountain region.

Annual water surplus in the basin ranges from 2mm to 3469 mm. Water surplus occurs everywhere during monsoon season. So this season is suitable for the cultivation of a wide variety of crops. Surplus water can be conserved from monsoon season which in turn can be used in winter season for dry food crops.

Annual moisture index in the basin ranges from 400 to -39.3, which shows the wide variety of climatic type. Almost half of the stations of the basin have humid climates.

The southern belt of the Koshi basin has suitable climate for the production of rice and wheat while the midland of the basin has favorable climate for maize production but in the northern mountain region, due to the disrupting effect of the glaciations and cooler climate, major food production is unfavorable.

References

- F.A.O., 1977. Early agroclimatological crop yield assessment, F.A.O. plant production and protection paper 73.
- Griffiths, J.F., 1994. *Hand book of Agricultural meteorology*. Oxford University Press.
- Manandhar, D.N., Shakya, 1996. Climate and crops of Nepal. NARC (Nepal Agricultural Research Council) publication.
- Sir M. Macdonald & partner's Ltd, 1990. Hydrology and Agro meteorology manual, M3.
- WECS, 1999. Basin wise water resources and water utilization study of Koshi river basin.