
Changing Pattern of wetlands - A case study of Damak Municipality, Jhapa District, Nepal

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Abstract

The climate of Damak was unhealthy until 1965 A.D. The D. D.T. spray program started here only since 1963. Before 1963 Damak was a home of malaria. This area was dreadful due to the wide due to the wide-presence of poisonous creatures like cobras, Karent (*Bungarus lividus*), and scorpions. There were a lot of oxbow lake, marshes, quicksand, Holies and swamps inside the tick and dense forests of Damak. It used to be a very difficult situation to the local cowboys to rescue the new foot travelers from hill areas who plunged into the marshes. But Damak, these days, has lost its past physical landscape. The people who visited Damak in the 1960's and 1970's can hardly recognize present Damak. The actual identify of Damak still are the marshes and wetland areas. The name " Damak" itself is derived from the word "Daldal" which means "marshes" in English. In Dhimal language, " Damdam" means "Daldal" meaning " marshy". So from " Damdam" the name " Damak" was derived. This land is hard to plough as it is marshy. The paddy is planted only after digging the field with a spade. So the meaning of Damak reflects "shiny bright". As we step on one part at marshy land (Damdam place), the other part produces shiny fountains. With references to legends and proofs, Damak can be said to have been a marshy area before 1960.

Key words: Wetlands, dynamics, store house of resources, critically endangered

1. Introduction

Wetlands are amongst the most productive, valuable ecosystems on the Earth surface (Winter, 2000; Bates, Kundzewicz, Wu, & Palutikof, 2008; Ghermandi et al., 2008), and provide many important services to human society (ten Brink et al., 2012). Wetlands are unique, where terrestrial and aquatic habitats meet. However, they are also ecologically sensitive and adaptive systems (Turner et al., 2000). They are one of the most threatened habitats of all the biomes on the earth. Wetlands have played a major role in human history. They are an essential part of human civilization meeting many crucial needs for life on earth such as drinking water, source of protein production (fish, shellfish, snail and crab), fodder, aquatic flora and fauna, recreation, research-education, sinks and climate stabilizers). Wetlands are indispensable for the "ecosystem services" that they offer, including drinking water supply, cleaning up polluted water, and building materials, flood control, disaster risk reduction and climate change mitigation (TEEB, 2013; WWAP 2015). Bursting with biodiversity, wetlands are a vital means of storing carbon. Wetlands are also tremendously productive ecosystems that provide a myriad of services to society worldwide. Wetlands are also tremendously productive ecosystems that provide a myriad of services to society worldwide. The geographical, geological, geomorphologic, climatic,

hydrological and biotic diversity across the country of Nepal has supported and maintained to wetland biodiversity.

Wetlands environments are continuing to declining globally, both in area, water level depth, and aquatic biodiversity and in quality. As a result, the environment services which wetlands provide to society are diminishing. Global climate change is recognized as a threat to species survival and the health of natural systems. Scientists worldwide are looking at the ecological and hydrological impacts resulting from climate change (Erwin 2009) Wetland ecosystems, including rivers, lakes, marshes, provide many services that contribute to human well-being and poverty alleviation (Millennium Ecosystem Assessment 2005) According to Millennium Ecosystem Assessment Wetlands deliver a wide array of hydrological services—for instance, swamps, lakes, and marshes assist with flood mitigation, promote groundwater recharge, and regulate natural springs and river flows—but the nature and value of these services differs across wetland types. Wetlands are usually formed in the depressions (subjected to flooding), hollowness on a surface and groundwater seeps. Wetland ecosystems depend on constant, recurrent or shallow inundation at or near the surface of the substrate and characterize the presence of physical and biological features. The wetland ecosystem covers 6 percent of the total global land area (WCMC, 1998). Among the natural resources, wetlands management is regarded as major issues in instituting sustainable development of the earth. Most of wetlands are doomed to die in the long run. The natural and physical process of change strikes (takes) place so slowly over such great periods of time although it may seem that nothing much is happening.

Nepal has occupied 1, 78,112 hectares (8.52%) of the total area of the country (Bhandari, 2009). Nepal with its unique geographic spread, diverse climate and terrain have been harbouring diverse types of wetlands till 1950s. Since end of 1960s wetlands environment in Nepal are degrading slowly. Since 1980s wetlands of Tarai Region of Nepal have been facing various anthropogenic pressures (Pokhrel, 2017). Therefore, the rapidly growing human population, large- scale changes land use/land cover, burgeoning infrastructural development projects and unscientific use of watersheds area have the entire motive a substantial decline of wetland environment and resources of the country.

2. Study Area

Geography has given favorable position to Damak for ease of access from all parts of the country. Almost all districts headquarter of the country and major cities of India can be reached by road network. Rural migrants have been attracting in this area continuously. It is a fast growing urban centre of Eastern Tarai of Nepal. It is located between 98 meters - 232 meters above sea level. Numerous fresh water ponds, lakes, cut-off river meanders, swamps, marshes, and Holies were formed in the lap of Churia Range and low lying natural depressions between the Mawa and Ratuwa River (Khola) of Damak Municipality. Average rainfall is 2391mm recorded at Damak . Wetlands of Damak are repeatedly inundated during the deluge, downpour and rainfall in the monsoon season (June to September) every year. The municipality lies within subtropical climate and the mean temperature recorded at Damak between 1960 and 2010 is 24.5 degree Celsius (Pokhrel, 2017). Agriculture was the main economic activities of this area. Paddy and Jute were the famous summer wetland crops of Damak. There was no any peasant family, which was not involved in jute cultivation. Jute was the main cash crops during the 1980s. Now it has not trace and existence. At present most of the wetlands are modified in agricultural land

and deep wide fertile cultivated lands are changing in residential land. Virgin and fallow lands (*Ailani Jagga*), marginal land, marshes and Holies are rapidly filling by sand and gravel by land traders.

3. Methods and Materials:

The area selected for present study is Damak municipality where were a lot of wetlands before 55 years ago, which was one of the famous Village Panchayat of Jhapa district during the Panchayati regime.

Initially, Damak was a marshy place. It was popularly known as "Kala Pani" a deadly malaria ridden area of Jhapa District. Before 1960 there were majority of indigenous casts. The area was storehouses of wetland resources. But, during the time whenever began the processes of urbanization, land use pattern has been changing drastically. At present wetland is modifying as a agricultural and residential area. In the present study attempts has been made to trace out the threats to associated wetlands of study area. The present paper discusses disturbances and devastating effects of land use change on associated wetlands of Damak Municipality.

The study is based on primary and secondary data. The primary data were derived using household survey, Key informant interviews, Focus Group Discussion, observation. Information on changing pattern of wetlands was captured using different types of maps (aerial photo, cadastral maps, topographical maps 1959, and 1991, land cover map 1981 and goggle map 2017. was analyzed with the GIS system.

4. Changing wetlands Landscape: Results and Discussion

Spatial pattern of wetlands is refers to the landscape patches of different sizes and shapes in space arrangement, it is an important manifestation of landscape heterogeneity, and is the result of various ecological processes on different scales. The wetland landscape pattern connected with the geographical distribution of wetland resources and components, and the ability of anti-jamming, stability, resilience, biodiversity is closely related to wetland ecological system.

Among aquatic ecosystems, urban wetlands have undergone some of the most varied and severe human-caused alternations (Paul & Meyer 2001; Suren & Elliott 2004). One of the main factors contributing to the environmental deterioration of the wetlands comes from the pressure of the human settlements along its transitional zone. With the increase in population, the pressure on the urban wetland and its surrounding as potential settlement areas and reclaimed land, has increased. Each wetland thus is ecologically unique. The interaction of man with wetlands during last few decades has been a concern largely due to rapid population growth accompanied by intensified agricultural, commercial and residential development that further leads to wetlands pollution. Wetlands of Damak were transitional areas between aquatic and terrestrial environment where the water table was at or near the surface (below two meter). The most of land was covered by swamps, streams & rivers shallow marshes, ponds and small lakes were the dominant wetland types of the study area. But ironically, preservation of wetland ecosystem has received very little attention by Former Panchayat System and present federal democratic republican state, Local Level Structure of Nepal Government (Rural municipality and Municipality) till recently in the study area.

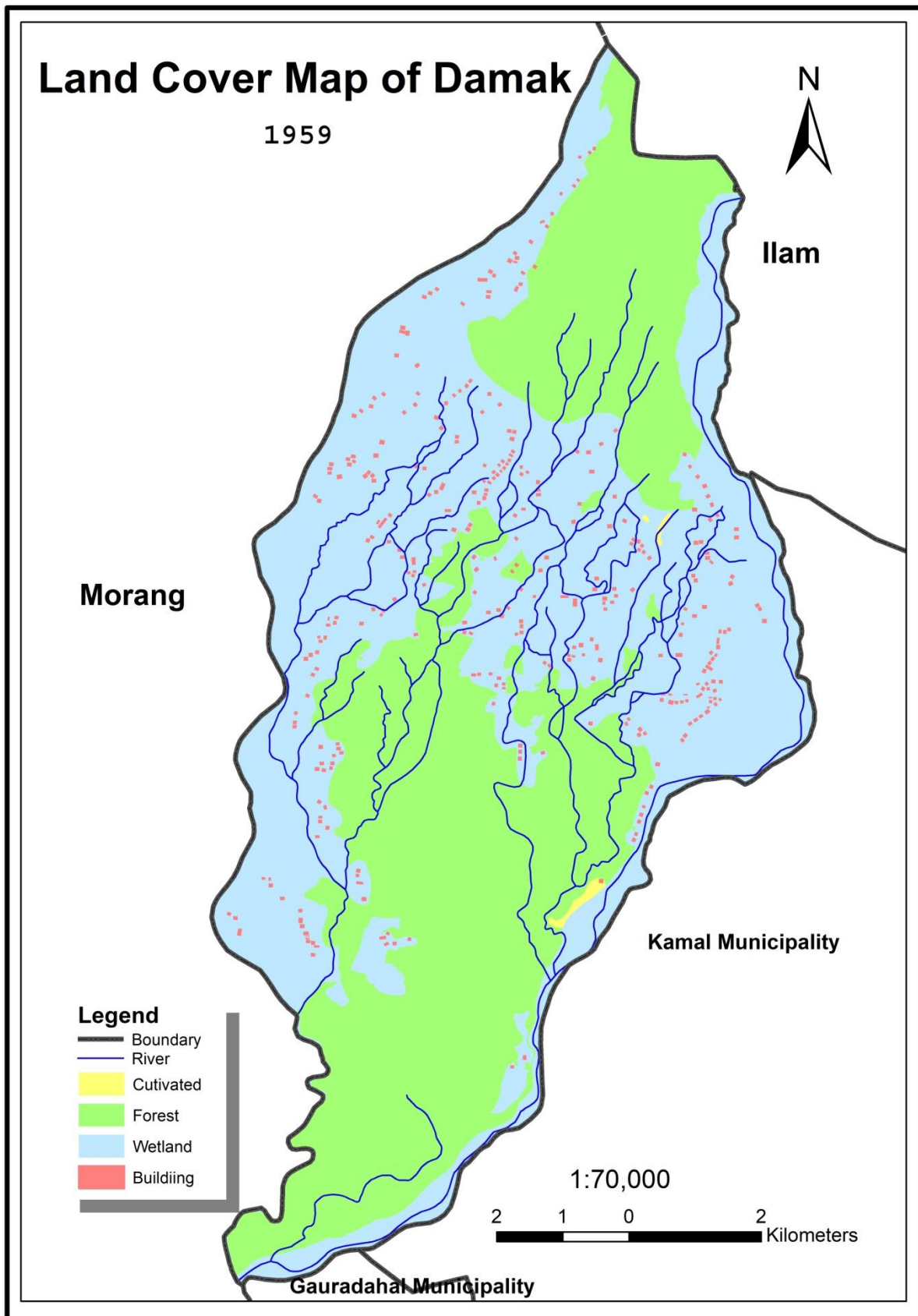
The climate of Damak was unhealthy until 1965 A.D. The D.D.T. spray program started here only since 1963. Before 1963 Damak was a home of malaria. This area was dreadful due to the wide due to the wide-presence of poisonous creatures like cobras, Karent (*Bungarus lividus*), and scorpions. There were a lot of oxbow lake, marshes, quicksand, Holies and swamps inside the tick and dense forests of Damak. It used to be a very difficult situation to the local cowboys to rescue the new foot travelers from hill areas who plunged into the marshes. But Damak, these days, has lost its past physical landscape. The people who visited Damak in the 1960's and 1970's can hardly recognize present Damak. The actual identify of Damak still are the marshes and wetland areas. The name " Damak" itself is derived from the word "Daldal" which means "marshes" in English. In Dhimal language, " Damdam" means "Daldal" meaning " marshy". So from " Damdam" the name " Damak" was derived. This land is hard to plough as it is marshy. The paddy is planted only after digging the field with a spade. So the meaning of Damak reflects "shiny bright". As we step on one part at marshy land (Damdam place), the other part produces shiny fountains. With references to legends and proofs, Damak can be said to have been a marshy area before 1960.

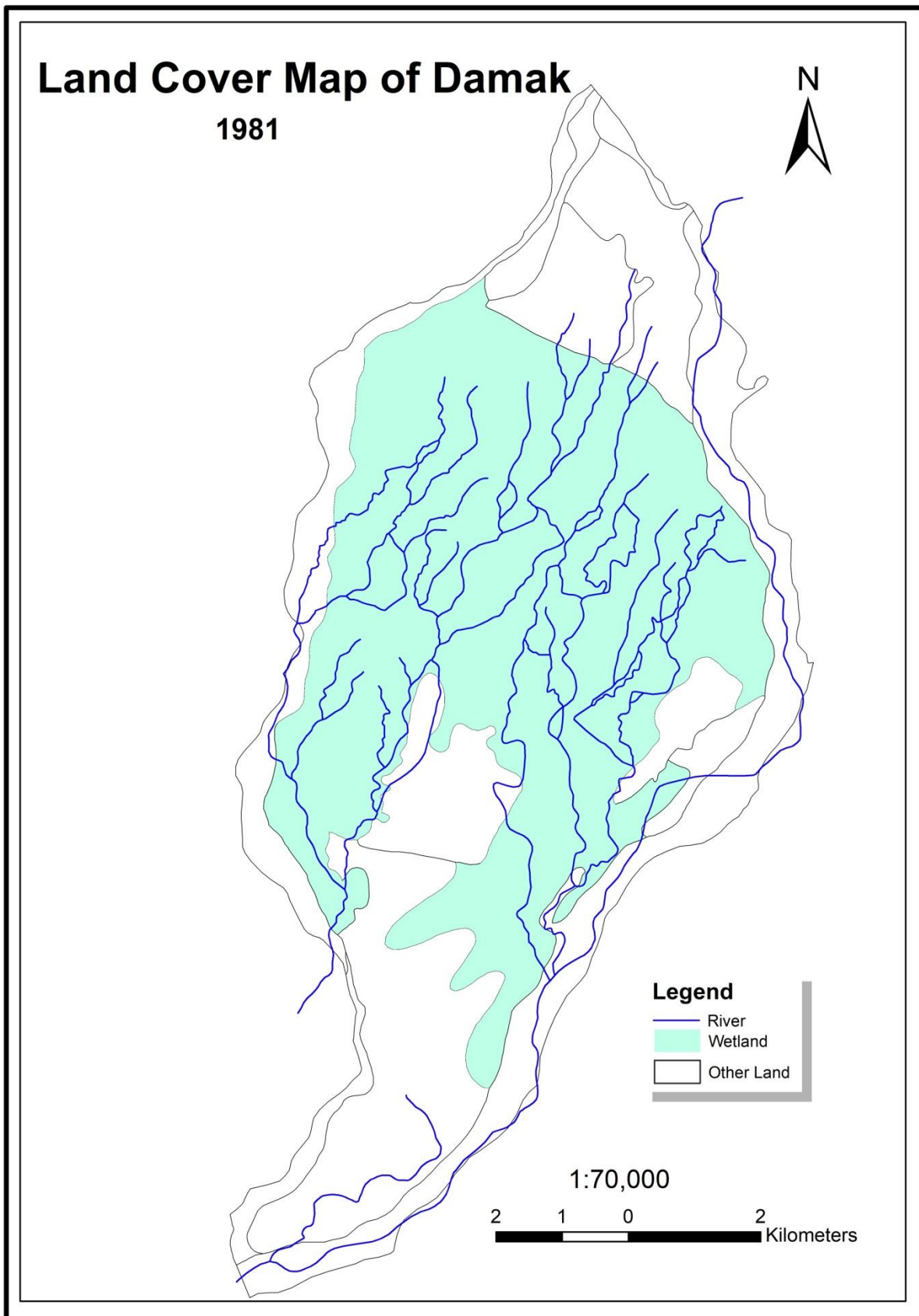
The ever increasing demand for economic growth during the last fifty years (1960s to till now) with utter disregard for the long term ecological consequences has led to over exploitation of wetlands environments. Realizing their importance, steps have been initiated to community level now, for preservation and conservation of this vital resource. Monsoons had been playing the most important role in the hydrology of wetlands before 1981 in the study area. During the monsoon there was broadly becoming wetter with maximum rainy days. Monthly rainfall depth, number of rainy days and maximum daily rainfall were positive in the study area. But summer monsoon rainfall exhibits temporal fluctuations. Number of rainy days has been decreasing in surrounding area of Damak. Every year 0.028 rainy days has been decreasing in the study area for the period 1963 - 2010(Pokhrel, 2017). According to Key Informants number of rainy days has been decreasing since 1981. Local people were hardly experienced visible days in the case of Damak, with only 17 days without precipitation on average during the summer monsoon (June-September). The intensity of rainfall was helping to expansion of wetlands area. Till 1993 B.S. there were only 2450 Bigaha land which was cleared the dense forest and made cultivated land by local indigenous people of Damak. It was surveyed in 1994 B. S (1937 A. D) and the land was registered on the old land revenue record (*Jimidari Patuwari System*). It was the first land survey of *Aathamauja* (group of villages or division of a district) under the Damak Dhanpura administrative unit. Remaining area of existing municipality was covered by forest and wetlands. Second land survey was conducted in 2012 B.S (1952).

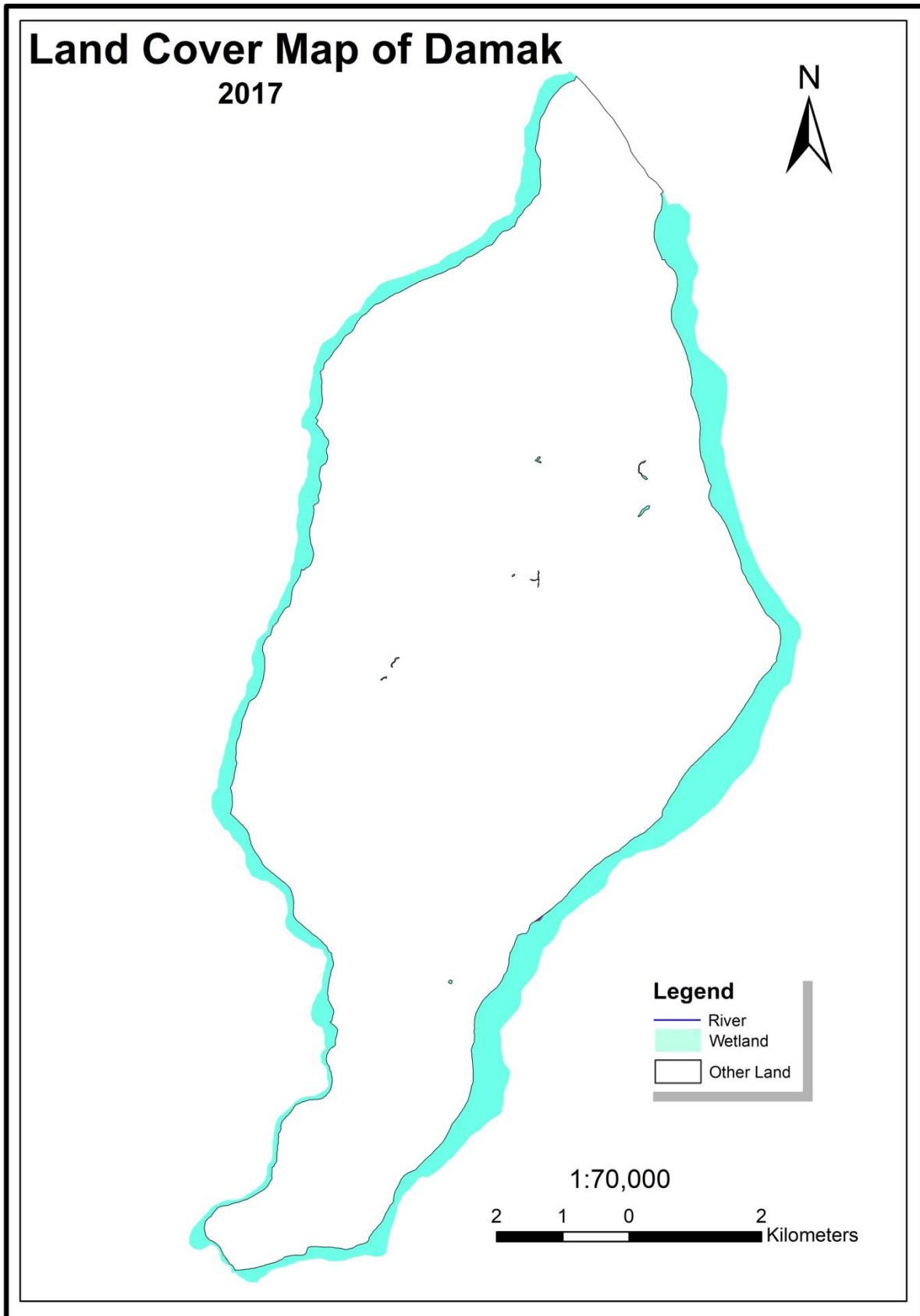
Table: 1 Decreasing trends of wetland areas in Damak Municipality

S. N.	year	Wetland covered area (area in square kilometer)	Total area of municipality (area in square kilometer)
1	1954	44.03	75.3
2	1981	41.47	75.3
3	2016	9.05	75.3

Source: Topographical Map Sheet No 72 N/10, Survey of India Offices, Land utilization map, 1982 and Google earth 2016.







GIS-based estimated and projected temporal changes in the spatial extent of land use types within the periphery of study area. The table 1 and map 1, 2, and 3 is showing the wetlands pattern of Damak in different time. During the year of 1959 there were 44.03 square kilometer wetlands areas in Damak. In other word 58.03 percent of area of Damak covered by wetlands. According to octogenarians' key informants who have been living since 1950s, there were many oxbow lake, marshes, ponds and Hollies. Damak was endowed with great diversity of aquatic flora and fauna. Toad rush, cattail, wetland dependent bird (Greater Adjutant, Lesser Adjutant and swan) and different species of indigenous fish were the main wetland resources. Wetland resources were the means of economic activities and sources of nourishing elements of local people. Similarly, Wetlands are favourable environments for rice production during the rainy season and for the cultivation of various arable crops and vegetable during the dry seasons.

Until 1973 Damak was a little market center of Jhapa district, so farmers of Damak use to sell their agricultural products (rice, jute and mustard) at Rangeli Bazar of Morang. From there all agricultural products were exported to India. In the same way, there was limited market of wetland resources specially fishes. At that time local fishermen were dealings of fishes in two ways, on the one hand, they used to sell fish weekly in local market and surplus fish used to exchange with rice. Some fishermen of Dakini and Dhukurpani used to go Madhumalla market of Morang (which is adjoining the study area) to exchange fish with potatoes for fulfill the demand of curry. According to qualitative survey there were 48 households of fishermen who had exchanged fish with rice to the landlords, money lenders and wealthy persons to provide for two meals (hands to mouth problems). Till 2038 B.S. (1981), there were 18 permanent fisher men who had used to sold fish in Damak and Urlabari weekly markets. According to record of Damak Village Panchayat 2035 B.S., they paid 3100 rupees annually for fishing associated wetlands of Damak . The statements of Key Informants also proved the above facts of topographical map of 1959.

Till 1981 there was 55.07 percent of land under the wetlands environment. Whenever, Damak Village Panchayat changed into a Nagar Panchayat in 2039 B.S. (1982 AD). Then the urbanization process was begun. After that every census decade has been increasing urban population. The population pressures have been modifying wetland on agricultural lands.

Table: 2 Trends of Population in Damak

S. no	Year	Population	Population Growth rate
1	1961	5100	
2	1971	13993	6.36
3	1981	23319	4.0
4	1991	41321	4.35
5	2001	35009	- 1.80
6	2011	75102	5.34

Source: CBS 1972, 1982, 1992, 2002, 2012 and field survey 2017.

Table 2 shows the population trends of different census periods. Every census period population is growing at a faster rate. Population and Urbanizations are the major drivers of changing pattern of wetlands. In the recent years, however, deterioration of wetlands environments has been to make move faster (accelerated) due to human interventions. The population of Damak has fifteen times increased over the last 50 years and this rising population has been wielding (exerting) prodigious (enormous) pressure on the available wetland environment.

Since 1990, after successful peoples movement and declaration of multiparty system of Nepal wetlands of study area has been encroaching, shrinking and filling rapidly than the past by the land hunger, land traders and landless people.

Nonetheless, considerable impact of human activities within the study area is reflected in the considerable decline in areal extent of the wetland area from 44.03 square kilometer in 1959 to 9.05 square kilometer by 2016 apparently giving way for the agricultural and built-up area had expanded (See Table 1). Results show that the total area of the wetland reduces dramatically compared to 1059 the total area of wetland reduces by 400 percent. Furthermore, the temporal and spatial changes in Wetlands pattern are clearly evident as highlighted in Fig. 1, 2 and 3. Clearing and filling marshes shallow lakes, has, Holies and deep paddy field, often for agricultural expansion, and residential purposes are the main reasons for the loss and degradation of wetlands landscapes. According to qualitative survey 65–70 % of swamps and marshes (including streams small lakes and ponds) had been filled and drained since 1971 - 2016 for extent intensive agriculture and housing. Since the mid 1980s, wetlands have undergone great changes, and total wetland areas have been decreasing every year. Lakes, streams and ponds took on continuous shrinking trend, but swamps and marshes had a continuous filling trend till now.

According to key informants there were not atmospheric turbidity (Mist or cold wave) during the winter before 1981. The large area of wetland had controlled the Tarai region, to be very cold and hot. We had no experienced the present situation of cold wave. Local people who have been living in the study area did not felt the present weather phenomena, very hot in a summer days. Till 1978 hilly people came to Tarai to bask in the sun. Now, the people of Tarai would be gone towards the hill to enjoy sunshine in winter. Because of, bright sunshine duration has been decreasing gradually in winter. According to experienced old age people these weather phenomena are creation of wetland degradation. Wetland helps to moderate local weather. Variability in the onset and quantum of rainfall during the monsoon season has profound impact on level of wetland water, resources, surrounding agricultural environment and ecosystem in the study area. The study shows wetlands of study area are Critically Endangered (CR).

5. Conclusion

Wetlands dynamics are consequence of interactions among various factors such as geological structure, climatic conditions especially number of rainy days, supplement pattern and anthropogenic activities of local areas. The wetlands of study area are increasingly facing several anthropogenic pressures, due to rapidly growing population, haphazardly land use planning, non ecological friendly development activities have been impacting large scale changes in the wetlands area. Every year, pattern of wetland ecosystem has been changing rapidly, due to urbanization processes. It is consequent demand of land and wetland has been going on rapidly shrinking and disappearing.

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