THE ANALYSIS OF LAND USES AND WATER USES IN PART OF ARPA RIVER BASIN OF DISTRICT BILASPUR [CG] THROUGH GEO-INFORMATICS

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Abstract

Arpa river basin by it's majority belongs to old district of Bilaspur [CG]. The representative area of Arpa river basin as 20 Sq. Km. has been studied for it's two prevailing resources namely: Land & Water as non-renewable and renewable resources in terms of their uses respectively. The adapted methodology includes: Conventional and Advanced as Geo-informatics. The objective of study has been the scientific documentation of land-use and water-use in existing socio-economic infrastructure for the living society with their further improvement in better /desired condition. The study advocates for utilization of latest Satellite data, Drone Technology for comprehensive evaluation of land and water resources in their totality cum environmental conservation.

Introduction

The land and water are two primary resources for socio-economic development and regional planning of an area. The land resource as non-renewable in nature has been essential for human living and related activities. The water resource as renewable in nature has been most important element of life for survival of any kind of creature. Historically, the human civilization had been developed along river bank and river valley as case of Indus civilization. The Land/Water use may be explained as human imposed function on Land/Water portion by living society.

An area of about 20 Sq. Km. of Bilaspur district, belonging to Arpa river basin has been selected for the present study. The area has been dominated with Agricultural, Urban, Residential and Commercial activities by the living society in harmonious way. The objective of study is: documentation cum evaluation of different categories of land-use and water-use in existing socio-economic infrastructure with provision of better living and livelihood condition to the society.

Area of study

Twenty Sq. Km representative area of Arpa river basin, as area of study has geographic coordinates as follows:

Latitude N 22^{o} 06' 30" to N 22^{o} 13' 30", and Longitude E 82^{o} 05' 30" to E 22^{o} 16' 00" .

The Arpa river divides the area into two parts as eastern and western portion with flowing in the middle way. The river regime by large in area has 20% water and remaining 80 % area has been occupied by sediments cum dry river bed. The area of study has agricultural, urban, commercial, educational, medical and administrative localities, as true representation of Bilaspur city as well as district. The location map of area of study is illustrated as Fig.1 [2]

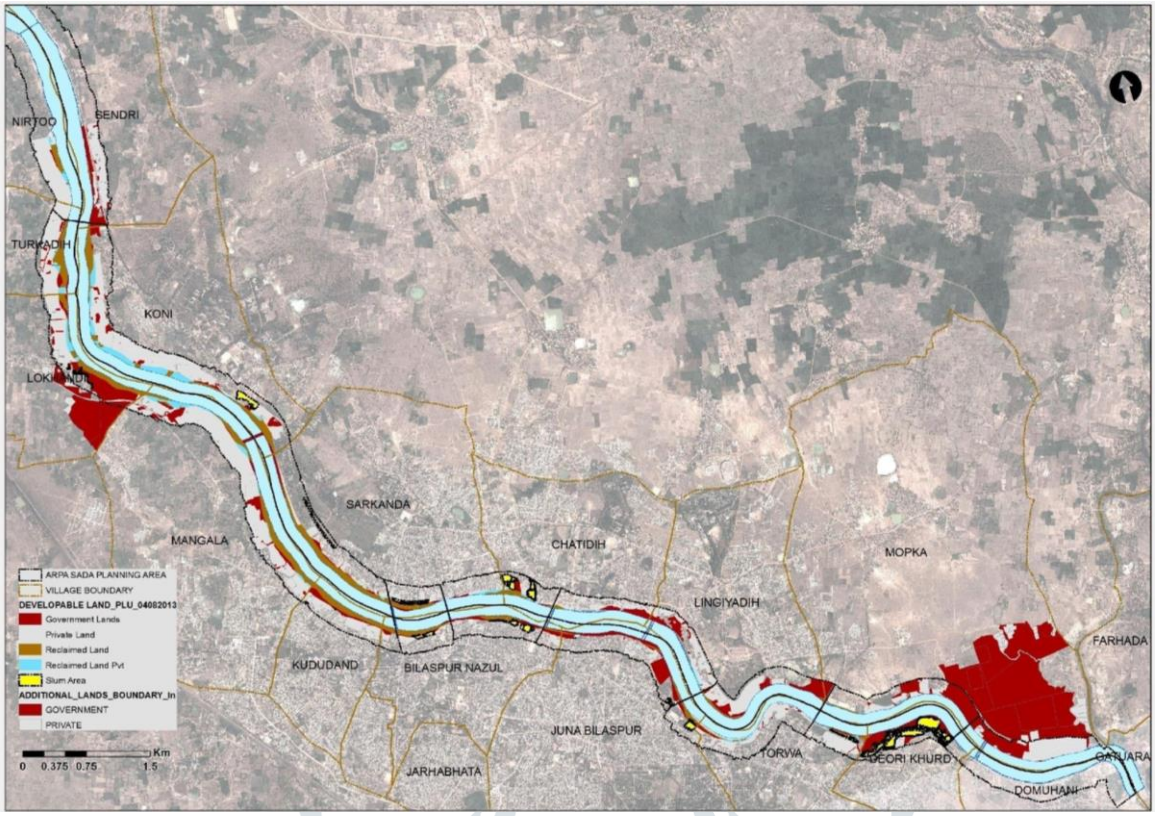

Fig. 1 Location map of area of study

Methodology

The evolved methodology has two approaches namely: Conventional & Advanced. The conventional approach has been based upon- literature review, collection of auxiliary data. The advanced approach has been based upon Geo-informatics including interpretation of Satellite data [Goggle image], Drone photography along-with relevant ground truth data collection, followed with integration of all data and analysis for fulfilling the required objective of the study [5].

Result & Discussion

Both the land and water resources are the gift of nature to Arpa river basin, with limitation. The land resource being non-renewable and possess two main categories namely: Land-waste & Land-use, as per developmental activities, prevailing socio-economic infrastructural set-up of the living society. The Land-waste has been unrecoverable cum unwanted item of living society at un-affordable cost as per present circumstances of technology. The Land-use is the wisdom of regional planning by living society, with it's detailed review in present investigation. The land-use pattern for Mopka area has been studied with use of Remote Sensing & GIS [7]. The water resource being renewable and mostly either abused or over-exploited by our living society. The water-use has been required by all, but not paid the desired attention due to it's availability at nominal cost.

The land-use and water use for the area of study has been studied in eight sub division in order to have detailed documentation and is summarised as Table 1.

S N	Subdivision	Description of area with prominent locality	Main Feature
1	I	Lofandi to Kachhar	SMWD Site
2	II	Kachhar to Sendri	Mental Hospital Site
3	III	Sendri to Koni [Turkadih] Bridge	Rest House Site
4	IV	Turkadih Bridge to Bilasa Tal	Recreational Site
5	V	Bilasa Tal to Indra Bridge	Educational Hub
6	VI	Indra Bridge to Lingyadih Bridge	Medical Hub
7	VII	Lingyadih Bridge to Bilaspur Barrage	Jal-Kumbhi in River
8	VIII	Bilaspur Barrage to Domohani Anicut	Sewage Treatment Plant Site

Table 1: Major Sub- division of area of stu

[I] Lofandi to Kachhar:

It has geographic area of 320 Hectare along eastern portion of Arpa River. Two prominent Land-uses have been identified namely: Agricultural land and Forest land with geographic size of 162.8 and 39.2 Hectare respectively. There has been also a small land of 2.3 Hectare of Residential category for forest personnel.

The Water-use has one category Surface water with it's further two classification namely River water & Pond water. The River water has been used for navigation purpose. The Pond water has been used towards natural groundwater recharging purpose in Forest land and irrigation purpose in Agricultural land.

Kachhar has been Solid Municipal Waste Disposal [SMWD] site as per Bilaspur Nagar Nigam, but is beyond it's geographic limit without adequate recycling procedure.

[II] Kachhar to Sendri:

It has geographic area of 286 Hectare along eastern portion of Arpa River. Three prominent Land-uses have been identified namely: Agricultural land, Residential land and Road network land with geographic size of 56.8, 55.8 & 18.0 Hectare respectively. There has been also a small land of 6.2 Hectare of Public to semi public land.

The water-use has two categories namely: Pond water & Ground water. The Pond water has been used for irrigation purpose in Agricultural land. The Ground water has been used through Pheratic aquifer in Residential land.

The Mental hospital only of it's kind in Bilaspur has been located at Sendri.

[III] Sendri to Koni [Turkadih] Bridge:

It has geographic area of 201 Hectare along eastern portion of Arpa River. Four prominent Land-uses have been identified namely: Agricultural land, Residential land, Road network land and Public to semi public land with geographic size of 44.7, 24.8, 13.4 & 7.8 Hectare respectively.

The water-use has two categories namely: Pond water & Ground water. The Pond water has been used for irrigation purpose in agricultural area at both banks of Arpa River. The Ground water has been used through Pheratic aquifer Agricultural & Residential land.

The overall terrain condition for the area has been observed on Google image and illustrated as Fig.2 [4].

Fig.2 Google Image for Sendri to Koni [Turkadih] Bridge

[IV] Koni [Turkadih] Bridge to Bilasa Tal:

It has geographic area of 297 Hectare along eastern as well as western portion of Arpa River. It belongs to urban area of Bilaspur Nagar Nigam. Four prominent Land-usesbeen identified namely: Residential land [35.8 Hectare at eastern bank and 32.4 Hectare at western bank], Road network land [23.6 Hectare at eastern bank and 22.2 Hectare at western bank], Commercial land [24.4 Hectare at eastern bank and 10.2 Hectare at western bank] and Recreational land [11.0 Hectare at eastern bank- as play ground, open space in G G U campus, 10,2 hectare at western bank- as Park, open space].

The water-use has two categories namely: Pond water & Ground water. The Pond water has been used as Bilasa Tal for recreational purpose at eastern bank and several ponds for multiple purposes at western bank. The Ground water has been used through Pheratic aquifer to semi confined aquifer in Residential land.

The overall terrain condition for the area has been observed on Google image and illustrated as Fig.3 [4].

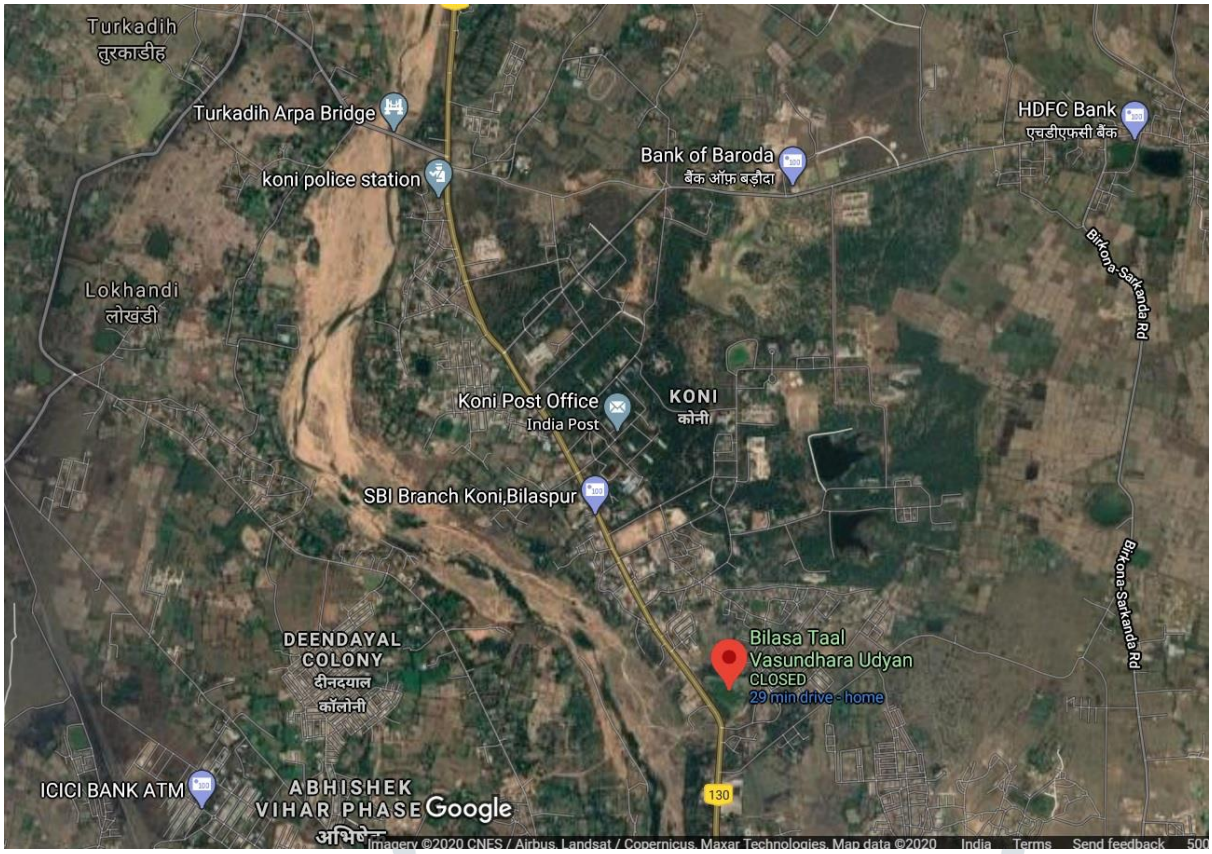

Fig.3 Google Image for Koni [Turkadih] Bridge to Bilasa Tal

[V] Bilasa Tal to Indra Bridge:

It has geographic area of 215.4 Hectare, belonging to both banks and under Bilaspur Nagar Nigam. Six prominent land-uses have been identified and their details summarised as Table 2.

S N	Type of Land-use	Aerial coverage [Hectare] at eastern bank	Aerial coverage [Hectare] at western bank	Remark
1	Residential land	34.5	11.1	Several colonies of private nature developed
2	Commercial land	24.4	12.1	More development at eastern bank
3	Road network land	19.2	15.8	To be maintained
4	Mixed [wet] land	1.5	1.5	To be preserved
5	Recreational land	2.9	2.6	To be preserved
6	Public-semi public land	1.5	2.1	

Table 2: Prominent Land-uses for Bilasa Tal to Indra Bridge

The water-use has two categories namely: Pond water & Ground water. The Pond water has been at western bank [37.4 Hectare] and at eastern bank [32.7 Hectare] for multiple purposes at both banks. The Ground water has been used through Pheratic aquifer to semi confined aquifer in Residential land.

[VI] Indra Bridge to Lingyadih Bridge :

It has geographic area of 298 Hectare [almost equal to IV sub division] with maximum development along the both banks of Arpa River. It belongs to Bilaspur Nagar Nigam and Heart of Bilaspur city. It has two

additional Bridges for crossing river in middle portion namely: Pratap pur Bridge and Shanichari Rapta Bridge, constructed at more than hundred years ago.

It has four prominent Land –uses and two major water-uses. The nomenclature of prominent Land-uses is -Residential, Commercial, Road & street network and Wet [Mixed] land. The western bank has residential Land-use developed at Juna Bilaspur, Imali-para, Masan ganj, Dayal bundh and Gond para localities. The commercial Land-use has been developed along western bank at Gol Bazar, Sader Bazar. The variety of Road & street network has been developed including several clinical shops/medical centres as Sardar Vallabh Bhai Patel hospital and Chhatisgarh Institute of Medical Science [CISM].The eastern bank has residential Land-use developed at Anjali para, Chingaz para, Surya Vihar and Raj Kishor Nagar localities. The commercial Land-use has been developed along eastern bank at Seepat Road & Sarkanda. The variety of Road & street network has been developed including several kinds of shops and Apollo hospital. All these Land-uses have been illustrated through Google image as Fig.4.[4]

The Wet [Mixed] land has been identified along river front at western bank. This stretch has natural growth vegetation, shrub and act as geo-environmental buffer in between Land & Water regime under sustainable eco-system. It has to be preserved as per statuary norm of National Green Tribunal [NGT]. It is illustrated through Drone Photography as Fig.5.[3]

The water-use has two categories namely: Pond water & Ground water. The Pond water has been at western bank [45.0 Hectare] and at eastern bank [54.3 Hectare] for multiple purposes at both banks. The Ground water has been used through Pheratic aquifer to semi confined aquifer in Residential and Commercial lands.

All these Land-uses and water uses have been summarised as Table 3.

S N	Type of Land/Water Use	Western bank	Eastern Bank
1	Residential Land	27.0	23.7
2	Commercial Land	19.1	10.6
3	Road & street network Land	22.2	19.1
4	Wet [Mixed] Land	21.6	11.4
5	Pond water	45.0	54.3
6	Ground water	Semi confined Aquifer	Pheratic Aquifer

Table 3: Land & Water Use at Indra Bridge to Lingyadih Bridge

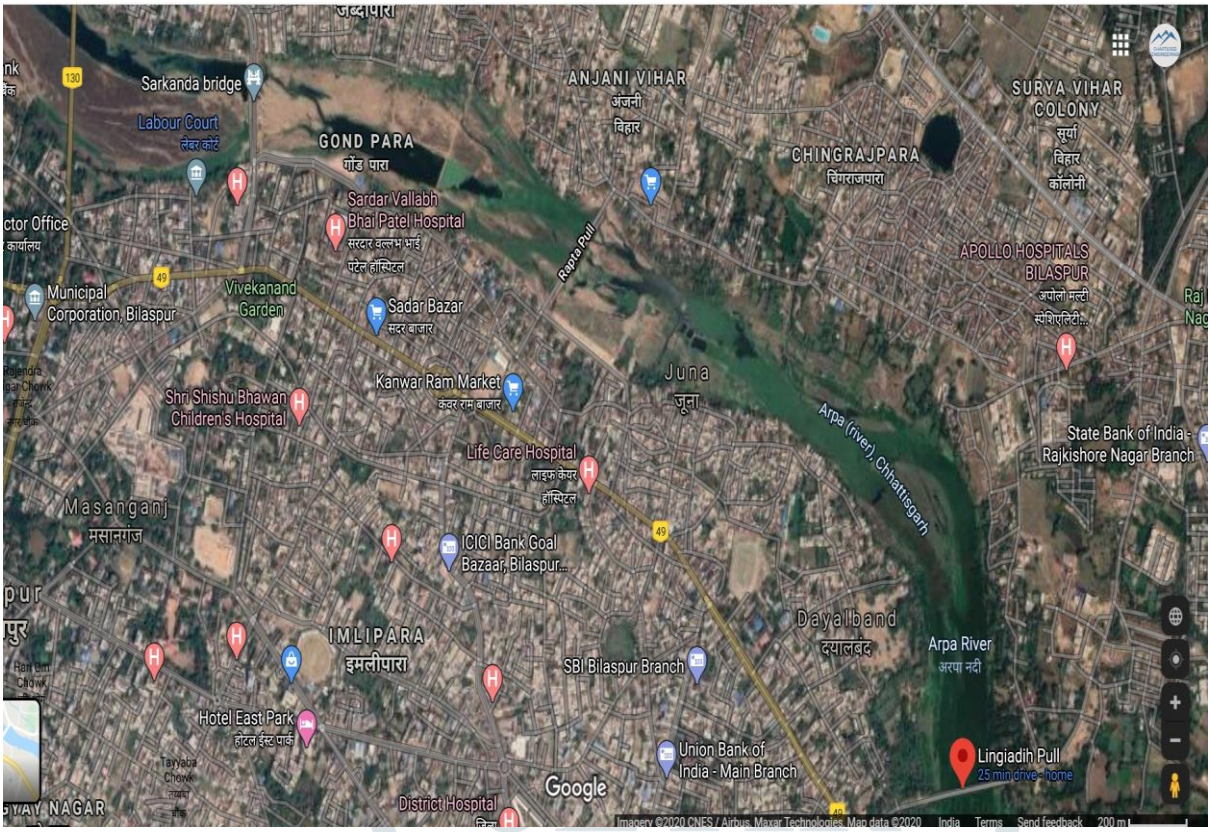

Fig.4 Google Image for Indra Bridge to Lingyadih Bridge

Fig.5 Drone Photography for Indra Bridge to Lingyadih Bridge

[VII] Lingyadih Bridge to Bilaspur Barrage:

It has geographic area of 249.6 Hectare along eastern as well as western portion of Arpa River. The western portion belongs to urban area of Bilaspur Nagar Nigam. Four prominent Land-uses have been identified namely: Residential land [28.4 Hectare at eastern bank and 17.3 Hectare at western bank], Road

network land [17.3 Hectare at eastern bank and 28,5 Hectare at western bank], Commercial land [6.4 Hectare at eastern bank and 8.8 Hectare at western bank] and Recreational land [9.2 Hectare at eastern bank- as play ground, open space in college campus, 26.9 hectare at western bank].

The water-use has two categories namely: Pond water & Ground water. The Pond water [46.7 Hectare] has been used for multiple purpose at western bank and several ponds [43.4 Hectare] for natural ground water recharge purposes at eastern bank. The Ground water has been used through Pheratic aquifer to semi confined aquifer in Residential land.[6]

The river water has been associated with JAL-KHUMBI.

[VIII] Bilaspur Barrage to Domuhani anicut:

It has geographic area of 125 Hectare along eastern as well as western portion of Arpa River. Four prominent Land-uses have been identified namely: Residential land [4.8 Hectare at eastern bank and 11.9 Hectare at western bank], Road network land [9.0] Hectare at eastern bank and 9.0 Hectare at western bank], Commercial land [3.8 Hectare at eastern bank and 4.3 Hectare at western bank] and Recreational land [5.0 Hectare at eastern bank, 7.5 hectare at western bank].

The water-use has two categories namely: Pond water & Ground water. The Pond water [27.5 Hectare] has been used for multiple purpose at western bank and several ponds [23.4 Hectare] for natural ground water recharge purposes at eastern bank. The Ground water has been used through Pheratic aquifer in Residential land.

Kharun river water has been associated with Water Sewerage Treatment Plant at Chilhati.

The overall land-use classification for the area of study has been identified as eleven with surface water body [extra] as pond prevailing over land surface. The percentile of geographic area for thus twelve types of land-use is illustrated as Fig.6.

The concept of water-use has been governed by it's potable nature. The broad and basic classification of water-use has been three-fold namely: Potable Water, Semi-potable Water and Un-potable to non-potable Water.

The potable water must possess: Transparency, Colourless, Odour-less, Tasteful and Digestive as per social norms. It must ensure the standard of quality norms, as prescribed by State Pollution & Control Board / Ministry of Environment & Forest/ World Health Organisation [WHO] from hygienic point of view. The potable water has been classified into

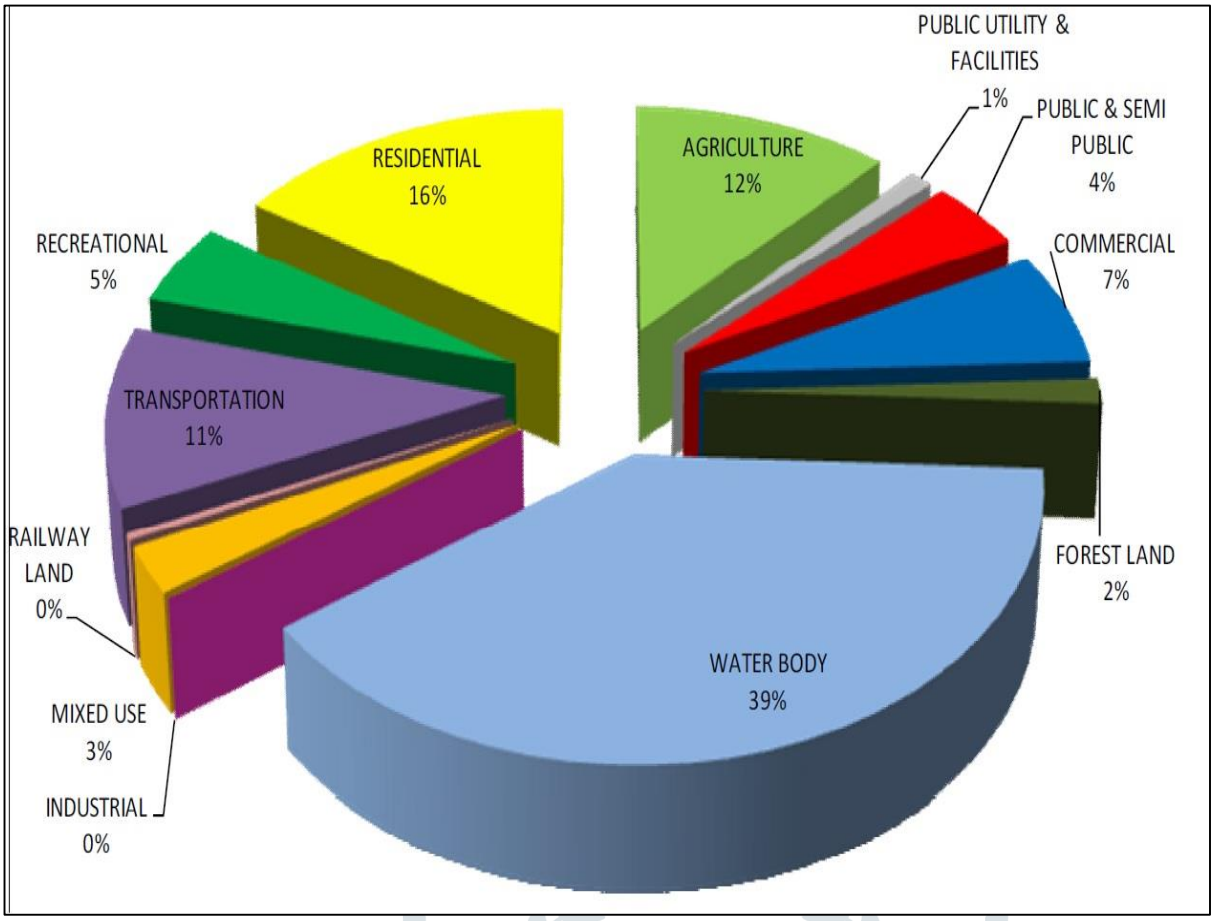

Fig. 6 The percentile of geographic size of twelve Land-uses for area of study

FIVE categories namely: Municipal Water [one], Spring Water [two], Commercial Water [three, four & five], Irrigation Water [six, seven && eight] and Ground Water [nine, ten & eleven]. The silent aspects of each category with emphasis on water-use has been summarised as follows: [The quantity expressed in word indicates NUMBER OF WATER-USE]

The Municipal Water in Bilaspur has been catering by Nagar Nigam in cooperation with State Public Health Engineering Department. The urban water supply is used to carry through conjunctive use of water in terms of surface water and groundwater during normal period and in summer through Tanker water supply also.

The Spring Water is not available in Bilaspur city area. It is available in hilly area for just name sake under forest land and used by wild animals.

The Commercial Water has been used under three categories namely: Mineral water [three], Restaurant/Hotel water [four] and Soft drink industry [five]. The Mineral water is used through plastic bottle supply [one time used] during official meeting, special function of food arrangement like marriage party. The Restaurant/Hotel water supply has been in bulk quantity in cooking, washing cum cleaning utensils. The Soft drink industry requires large amount of water for processing, cleaning and supply purpose, [Once, a part of local river was sold to Soft drink industry in Chhattisgarh]

The Irrigation Water has been used for agricultural purpose under three categories namely: Rain water [six], Canal water [seven] and Pond/Tank water [eight]. The Rain water is used for direct irrigation as per nature during monsoon season. The Canal water is used as in-direct irrigation method during non monsoon period. The Pond/Tank water is used during summer season for irrigation and domestic purpose.

The Ground Water of Arpa river basin has been classified in- to further three categories as per aquifer disposition by Central Ground Water Board namely: Pheratic aquifer [nine] [shallow depth & useful for dug wells], Un-confined aquifer [ten] [middle depth & useful for bore wells] and Semi confined aquifer [eleven] [higher depth & useful for deep bore wells]. Hydro-geologically, pheratic aquifer belongs to un-consolidated formation along river as alluvial deposit. The unconfined and semi confined aquifer belongs to semi unconsolidated to fractured formation as limestone. [6]

The Semi-potable water may not be useful directly for drinking purpose, but has it's usefulness in other human related activities. It has been classified into three categories namely: Bathing & Fishing [twelve], Gardening & Horticultural [thirteen] and Sanitization [fourteen]. The Bathing and Fishing in surface water bodies has been common practice in Bilaspur – as it's name is derived by BILASA DEVI- local Fisher women. The gardening, horticultural and sanitization have been practiced at the cost of utilization of potable water, locally.

The Un-potable water has three categories for utilization, though not being practiced locally. These categories are Industrial Water [fifteen], Sewage Water [sixteen] and Fire fighting Water [seventeen]. The Industrial water has utility for cooling purpose of plant machine and refrigeration after it's recycling and mist spraying purpose. The Sewage water after treatment has utilization in vegetable cultivation, rather direct allowing in nearby river stream. The Fire fighting water has utility in emergency by fire brigade people, as and when occurs in the area.

Thus, the area of study exhibit eleven land-uses for non-renewable Land resource and seventeen water-uses for renewable water resource. The majority of primary resources belonging to non-renewable and renewable nature have been utilizing for sustainable purpose by the living society in prevailing socio-economic infrastructure and reached to their maximum development [1]. Almost, every household nowadays have been accustomed to use Reverse Osmosis [R O] water in kitchen for water to be utilized in cooking and drinking purpose.

Conclusion

The conducted study has documented in authentic manner eleven land-uses, seventeen water-uses in prevailing socio-economic infra structure with urban risk for Bilaspur city and it's around in representative area of Arpa river basin. The Bilaspur and it's surrounding has been under development process since more than two hundred years and yet awaiting for such kind of systematic study. The investigation with advanced approach has following concluding remarks:

- The non-renewable Land resource has eleven land-uses under prominent land cover namely: Agriculture, Urban, Residential, Commercial and Road-network.
- The renewable Water resource has eleven existing water-uses of potable nature, with six more potential water-uses of semi-potable to un-potable nature in prevailing socio-economic infra structural set up.
- The wet [mixed] land has to be cared, being more sensitive to our environmental conservation for the living society.

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