Land use changes and their impact on Soil and vegetation properties over Kanshi watershed, Potohar Plateau, Pakistan

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Abstract

Large scale changes in land use pattern such as deforestation and machine-intensive farming process have increased carbon concentrations in atmosphere which negatively affects agricultural sector. Cross-disciplinary approaches were applied to investigate the land use changes and their impacts on the soil properties over Kanshi watershed. The results revealed that vegetation cover has been declined over the Kanshi catchment area during the last two decades. The deforestation and urbanization are the basic reasons for the fall of water tables in the Kanshi catchment area. Furthermore, the decreasing trend of rainfall and increasing trend of temperature was estimated during the last two decades. While the water discharge was decreased by 44.15 % during the last two decades in the Kanshi watershed. This substantial and significant change resultant due to climate change or increased intercession of anthropogenic activities on the earth surface. The highest stream flow was found in 1992 in the Kanshi catchment due to heavy rainfall. But in 2019, flow was on its peak value. Such variations in flow of stream increase due to fluctuations in rainfall pattern and vegetation cover resulted land degradation. 85% of local community is agreed that extensive agricultural practices, population growth, settlement patterns and brick industry have significant negative impact on vegetative cover and water discharge.

Keywords: land use pattern, Cross-disciplinary approaches, deforestation, degradation, brick industry.

1. INTRODUCTION

Land use is one of the principal factors of various methods of change in the environment. Such change in land use negatively influence the soil and water qualities in the landscape. The proper management of the soil quality is required for the land surface fertility to reduce the deteriorate the land structure (Lindo et al., 2009; Pugnaire et al., 2011; Erfanzadeh et al., 2014; Eghdami et al., 2019). However, the negative effect of land use changes might be happened. Information and conception of soil features and methods proves redress or recovery of unrecovered or harmed soils.

Degradation of land initiated by inappropriate way of land use is the problem in world overall that has restored natural and environmental sustainability (Bruun et al., 2015; de Oliveira et al., 2015).

A variation in vegetative cover is usually represented by the change in land use and cover. Such cover of land use indicates process of land surface which is linked to local climate and anthropogenic actions. In this perspective, spatial pattern and distribution of land cover change is the key factor for the growth, development, and management of the natural resource's conservation (Perugini et al., 2017). This concept is supported by many previous studies such as globalization, expansion of population, technology transformation and land cover changes (Grimm et al., 2008; Seaman et al., 2014; Abbas et al., 2016; Abbas et al., 2018).

Assessment of the land use and land cover change with respect to vegetation and soil properties are the primary elements of the IPCC AR5, which is giving more concerned for the last two decades. A relationship between land cover change (LULCC) and change in climate is the complex and sophisticated method that reveals the link between the geographical, geological, climatological, anthropogenic activities and hydrology. This was consistent with many previous studies (Turner et al., 1993; Zhen et al., 2009; Mahmood et al., 2010; Field et al., 2012; Deb et al., 2015; Rahman et al., 2016). Nevertheless, the current investigations existing focusing the association among land cover and climate factors that relays about the impacts of the land use on the local soil and vegetation features (Lambin et al., 2001; Pielke, 2005; Rounsevell et al., 2006; Mahmood et al., 2010; Mango et al., 2011; Fan et al., 2015; Findell et al., 2017).

Basically, the human induced activities have a strong relationship with magnitude of carbon quantity that entered to earth layer (Houghton and Skole, 1990; Alves and Skole, 1996; Houghton et al., 1999). Soil erosion is the main reason due to human induced activities in effective farming sector (Bryan et al., 2013). The cultivable land has changed into non cultivable land due to actions of extreme climate events. Furthermore, the anthropogenic activities have the negative effects on the patterns of land cover which converted the forest area into the agricultural land. Such conversion is reducing the natural vegetation cover and deteriorates the structure of the soil quality (Zhuang Liu, 1999; Alexander et al., 2006). Such change in land cover also brings the changes in the features of the soil at high and low level (Cao et al., 2020).

There are many studies which have been conducted about regional by the land use and land cover changes in Pakistan (Shakir et al., 2010; Ali et al., 2011; Babu et al., 2016; Mahmood et al., 2016; Shahid et al., 2018; Shaukat et al., 2020; Shahid et al., 2020). Shakir et al., (2010) indicated that variation in land use and land cover area is mainly linked with the river flows. The river flow pattern is entirely different in the previous decades that negatively affect the land cover. The recharge area under watershed downstream catchment is important for development of the landscape and seascape (Midgley et al., 2002). Babu et al., (2016) also indicated the high trends of annual flow in the RCP 4.5 and RCP 8.5 scenarios. The process of the watershed catchment is mostly affected by the variation in land use and land cover change (McDonnell et al., 1996).

The water discharge found to be increased 21.36 mm which linked to change in land use pattern in the Margalla Hills watershed (Shahid et al., 2020). Shaukat et al., (2020) exhibited the decreasing trend of the rainfall and stream flow in the Tarbela catchment. The contribution of the land use change pattern was 60.7% observed from the analysis. The intensity of climate extreme reduces the land use area that deteriorates the soil structure. From last 30 years, Pakistan is also facing the large numbers of the extreme events. confirmed that Pakistan frequently affected by climate extreme events of 152 from 1999 to 2018, resulting in an economic loss of $ 3.8 billion. Under such circumstances, presently, there is no detailed investigation found with respect to Land use changes and their impact on Soil and vegetation properties over Kanshi watershed.

Kanshi catchment (sub watershed of Mangala) that highly dependent on summer monsoon rainfall in Pakistan. This catchment is situated in the Punjab province. Punjab is the major agricultural hub of Pakistan. Punjab shares 52.95 % in total population and 26 % total area of Pakistan (Afzal et al., 2017). Climatic change in Pakistan strongly affecting river flow resultant reduced the cultivated land area. Mangala watershed is also suffering from large fluctuations in river flow. Therefore, looking into the current expected changes in climate and land use pattern in the Kanshi catchment. The main purpose of this study is to identify and examined the Land use and vegetation pattern of the Kanshi watershed, Furthermore, investigates the impacts of land use changes on Soil properties in the Kanshi catchment over Potohar Plateau region.

2. MATERIALS AND METHODS

2.1 Study site characterization

The Kanshi river and its catchment lies between latitude 33°14'54.59" N and longitude 73°36' E. Kanshi river is covered 1111.104 km^2 approximately. According to physiography, Kanshi River consists of three basic portions. The first portion covers the Gujar khan tehsil which is situated in the Potohar Plateau. The Potohar Plateau has an area of about 18000 km^2 with an elevation of 300-600. The Indus River is situated in the West, Kala Chitta and Margilla hills in the North and Salt range is laid in the Southern way. This catchment area is drained by the river Soan.

The second portion comprises of Murree, Kotli-Sattian and Kahuta tehsil in the Northern areas of Upper Indus Basin. The last and third portion consists of Rawalpindi, which start from Kahuta in and end into the Gujar Khan Tehsil. These two tehsils cover the Mangla catchment, Rawalpindi. (Fig.1). Mangla watershed has a steep and hilly slope. The discharge of water reached at absolute peak due to snow melt in the middle of the May that starts to rise in the month of March. Because, greater than 70 % flow of water enter the sink of the Kanshi watershed from March-August. Less than 30 % of water flow join river basin during September-February.

Climatologically, The Kanshi catchment lies in semiarid to sub hills region. The fluctuation in temperature is found in the Southern regions of Kanshi catchment areas. In these zones, elevation range is less than 1070 m was observed as compared to the northern part with elevation 3650 m. Furthermore, extreme maximum temperature is found 49.4 °C in the month of June and minimum temperature -1.6 °C in January. 31.9 ºC, 45.4 ºC and 2.9 ºC are annual, maximum, and minimum temperature respectively was noticed in this region. The highest amount of annual rainfall was noted 913 mm/annum in the 1998. 60-70 % of total rainfall was added from the summer monsoon season (JJAS). The main reason of the total rainfall in the catchment of the Kanshi area is the Indian summer monsoon mechanism and westerly depression in the winter season. There are two main dry seasons in the Kanshi zone that happens in the months of May-June and October-November.

[May be Inserted Fig 1]

Fig.1 Study area map (a) Mangla watershed and its sub-watersheds (Kunhar, Neelum, Jhelum, Poonch and Kanshi) (b) Elevation map of Kanshi watershed.

There is no geological set up of the area. On the other hand, the deteriorate soil taxonomy due to anthropogenic activities that adversely affecting the pattern of agricultural pattern and practices. The Pakistan economy primarily depends on the agricultural sector, that highly affected by variation of rainfall and temperature all over the country. There are two major crops seasons; Rabi and Kharif which is backbone of rural livelihood. Cultivation in this area totally depends upon total precipitation and at two or three spots on the mountain streams. The local community of such area highly depends on the ground water for drinking and household purpose. Rainfall is considered as more significant parameter in this area than other climatic parameters for the increasing rate of soil erosion (Abbas et al., 2018).

2.2 Data and analysis

The present study investigates the land use changes and their impact on Soil and vegetation properties over Kanshi watershed, Potohar Plateau region using the Cross-disciplinary approaches. The topography, soil and land use data used in this investigation (Table 1). The elevation map is showed in the Figure 1. The current investigation was designed into three phases. In the first phase, pre-ground activities included collection of the primary data; literature reviews from the previous studies and questionnaire-based structure, formal approach were endorsed in the investigated study area. In the second phase, field surveys in sub watershed areas with the help of compatible Government and Non-government administrations have been done.

During the field surveys in Kanshi sub watershed areas, focus group discussion approach was used. It usually consists of both qualitative and observational data. This approach is collected data to local community about issues related to land use change, agricultural practices, and water conservations. Diagnostic surveys were made to estimate the land cover patterns, waterways; urbanization, agriculture structure, soil & water erosion, and forest cover features. Such kind of analysis enables decision makers to develop strategies for crop managements, capable to enhance the land productivity and allowed classifying the main controlling factors for the agricultural production.

Table 1. Detailed information on the data used for current study

Data Layer	Description of the Data layer	Sources
Topography	90 × 90 m resolution digital elevation model (DEM) used to estimate the slopes	Shuttle Radar Topography Mission (SRTM) http://srtm.csi.cgiar.org/
Soil data	Map of soil 10×10 m resolution map; soil layer attributes for each soil layer	Geological Survey of Pakistan https://www.gsp.gov.pk/ United states Department of Agriculture, Soil Survey Manual (1993, 2017)
Land use data	Land use 30 × 30 m resolution map of 1987 and 2019	Punjab soil survey office, Government of the Punjab https://soil.punjab.gov.pk/

Different types of the land units were found which is based on variation of the physiographic features. Such land units were further categorized that depends on the physical features, color, tone, texture, pattern, association, and land use. Simultaneously, a physiographic legend was prepared. The ability of land units includes a potential of the water conservation that vary from one place to another. Thus, negative relationship was observed level of constraints and land suitability. With increase the level of constraints, the land capability was observed decline.

Through combination of the slope, soil physiographic and land capacity maps, the investigation zone were categorized according to land suitability and capability. Different type of soil types has been identified through evaluation of variation in parent materials, component, and climatic conditions. The soil types were further subdivided according to texture, color, and spatial association. Boundaries were drawn after the determination and categorization of land units with their specific characteristics.

3. RESULTS

3.1 Impacts of Land cover patterns: Deforestation as a Socio-climatic issue

According to image processing and classification (Landsat™ 30x30), a vegetation cover has been declined extremely. The agriculture, brick companies and settlement are detected rise and changing the complete landscape. The results showed that presently vegetation cover almost disappeared as compared to past near city of Gujar Khan Settlements and bounded towns. The water flow channels and water storage reservoirs are key elements along the vegetation cover. These are the basic factors for the fall of the water tables in the Kanshi area. The other reason was observed a large deforestation in the past due to advanced agricultural practices and urbanization. Reconnaissance survey of Rawalpindi, (1987) confirmed that loss in the vegetative cover is mainly due to increase of agricultural practices. The forest area is converted into the agricultural and grass land. These changes drastically reduces dry seasonal water flows and raise the peak flow that foremost to higher water shortage during last 20 years (Mango et al. 2011). The extensive practices in the agricultural sector are consistent and reliable for the conversion of the bare land into the green sector. The zones of Kanshi catchments in the Pothohar Pleateu were shown in the Fig. 2.

[May be Inserted Fig 2]

Fig.2 Agroecological zones of Kanshi watershed in Pothohar region, Pakistan

The results revealed that there are two zones: dry farmed and highland zone. The highland zone has the semi-arid and sub-humid warmed climate. A dry farmed zone is characterized by Rawalpindi-Chakwal region. The zonal distribution of the Kanshi watershed is compulsory. Every region has an equal series of the populated area, agricultural, forest, vegetation, and bare land. However, every region of the Kanshi contributes to its own solidity. Thus, catchment area remains maintenance and stable. The practices related to agriculture are accelerated and vegetative cover is disappearing throughout last two decades. This change in vegetation cover stemmed the soil erosion. Another cause of vegetation loss which is the changing climate. The population of the study area is also increasing (Fig. 3). Mostly the vegetation cover is converted into agricultural land and in brick industries. As indicated by field perceptions, no building forms were designed to decrease speed of flow and reduce soil erosion and sedimentation threats.

[May be Inserted Fig 3]

Fig. 3 Land use of Kanshi watershed in the Pothohar region, Pakistan

Just one wall was found close to Missa-Keswal. The main reasons behind are costs of mismanagement, nonappearance of establishments and local government inattentiveness. Corrosion is predominant issue in view of delicate topography, steep slope, and higher altitude. Loss of high rich layer brought about numerous sections of land of ineffective land. As indicated by the field data, four kinds of erosion were identified, but most ordinarily is found rill and gully erosion, like gullies 43%, rills 27%, sprinkle 9%, and sheet 21%. Poor administration practices, traditional methods and lack of modernization mechanisms were examined. Fig 4 and 5 is indicated the Land use capability map of 1987 and 2019 of Kanshi watershed in the Pothohar region, Pakistan.

[May be Inserted Fig 4]

Fig. 4 Land use capability map of 1987 of Kanshi watershed in the Pothohar region, Pakistan

The Land use pattern is changed from forest land to agricultural land due to the increased settlements and anthropogenic activities on earth (Kovyazin et al. 2020). The deterioration issues in the mid of the summer monsoon period, water runoff is found high in Kanshi catchment which increase rate of sedimentation (Zhu et al. 2017). Contaminated water is mixed into freshwater wetlands which can deteriorate wetland surface layers. A farmer told about deterioration the water wall in rainfall season and is highlighted requirement of the dams to decline the speed of runoff. The need of check dam was observed near to the Bhai Khan Bridge to decrease speed of run off in the investigated zones. Such types of the constructions are needed to reduce the runoff speed in the summer monsoon rainfall.

[May be Inserted Fig 5]

Fig. 5 Land use capability map (2019) of Kanshi watershed in the Pothohar region, Pakistan

The factors were highlighted towards agribusiness failure as beneath; Poor water framework, tough geography, Lack of legitimate waste channels, Poor quality seeds, Lack of advancement and utilization of traditional methods, Lack of planned administration, lack of community participation mechanism implementation, unemployment, and ways of livelihood due to lack of knowledge (Alexandratos 1995). Extensive agriculture and farming are predominantly liable for the alteration of non-vegetative land into agricultural. The extensive agricultural practices and forest degradation is observed in the investigated Kanshi region (Fig. 6A).

[May be Inserted Fig 6]

Fig.6 (a) Land use and Agricultural practices (b) Land use patterns and water conservations
Source: Collected using Focus Group Discussion approach.

Lack of motivation (5%) and awareness (32%) is reported about the extensive agricultural practices from field survey. This indicates that deforestation is increasing and changed the forest cover area into agriculture land. The most prominent cause of forest cover declined due to soil erosion. The productive utilization of conventional environmental knowledge can encourage the local people's adaptation to improve and sustain the ecosystem practices (Hostyánszki et al. 2017). A major part of the population in this area depends on the agriculture. The thick cycle of the poverty and change in seasonal rainfall disturbs the environment's ability for their livelihood. Therefore, 70 % out of 100 % was related to the agriculture, while 30% were identified with different professions that incorporate wood business and domesticated animals generally.

Most of the farmers near to 86 % is utilized mulch to increase land fertility. The large portion of uncovered land was reported near the Dongi and Missa Keswal region, where unarable land area was changed over into farmlands for cultivation purposes. There were no measures taken for the agricultural land maintenance and sustain that can lead towards the sustainable growth and development. During physical field studies, peoples is emphasized the restraints of constrained resources to regulate the most recent agrarian traditions and lack of capacity creating mechanism to increase the regular rural methods for the growth of sustainable agriculture sector.

The forest sector is covered 54 %, mini dams 21%, wastewater management issues 3%, stream bank maintenance issues 4% and Agro-forest 3%. But the erosion control approaches implementation is 4 % (Fig. 6b). Gujar Khan, which the main city is to onwards Qazian jabber where demand for the housing societies is increased. Thus, vegetative cover was diminishing at high rates, while settlement and agricultural land is increased. From the survey, the more than 80 % of local people supported and declared that urbanization, horticulture, contamination, and deforestation are the primary factors for the change in land cover pattern.

3.2 Effects on the Soil properties: Soil erosion as climatic issue

According to soil survey of Pakistan (1987) stated that different kinds of soil series are present, our study area contains four kinds of series Gullied land, Missa complex, Rough broken land and torrent bed land. Missa complex is usually situated in the dry framed crop zone. The soils features are reported with well drained silty and loamy which highly suitable for dry farmed crops. However, with adequate irrigation supply ensures a good crop production can be achieved. Gullied land is occurred in loess plains. It consists of intricate gullies, deeply separated by streams and their associated ravines in soft loess materials are deposited during Pleistocene epoch. The runoff is high and geological erosion is found active. A vegetation cover consists of sparse, scrub and grass which are used as grazing. The Rough broken land occurs on the flanks of all major streams. It comprises steep and very steep, deeply dissected outcrops of sand stones, shale, and conglomerates. The vegetation consists of the spars and moderately dense scrub and grasses. Most of the area is overgrazed. Some areas are under protected forests. The torrent bed land consists the course of Kanshi river. The new Kanshi soil codes were shown in Fig. 7.

[May be nserted Fig 7]

Fig. 7 Soil characteristics of Kanshi watershed in Pothohar region, Pakistan

Code 1 contains the mountain valley system. Mountains are moderately deep non calcareous slight aid, gravelly, medium to fine textured excessively drained soils generally underlain by high calcareous materials at depth. The valleys are deep, non-calcareous/calcareous, and slightly alkaline to acid, textured medium range, well to somewhat extremely drained soils, generally overlying gravel/stones bed. Code 2 consists of ridge trough system that nearly level/gently sloping, moderate level deep/shallow, calcareous, moderately alkaline; moderately fine/fine textured, moderately well drained soils over sandstone. Code 3A consists of gently sloping, moderately deep/deep, calcareous, non-calcareous, slightly alkaline, medium textured soils, whereas 3B is nearly level, gently sloping, moderately deep/deep, calcareous, moderately alkaline, medium/moderately fine textured. Code 4 shows the level/nearly level, deep, mainly moderately fine/medium textured soils.

Code 5 explains the gently sloping locally dissected, deep/very deep. Code 6 consists a network of deep channels produced by erosion, i.e., plateaus, terraces etc. inhabiting above the drainage base line that called gullied land. Code 7 consists of Steep land, stony, broken by numerous drainage channels, with vegetation cover used for grazing or wood production, occurs mostly in northern high land is known as rough broken land. Mostly the soil formation comprises of surficial stores, Soan arrangement, Dhok Pathan development and Nagri formation. The pH value of the soil was around 8.0. The structure of soil is weak, usually moderately calcareous but local non-calcareous. They are constantly low in organic material substance. This sort of Pedology boosts the erosive movement. Mud stores are very accessible to water and a little downpour water can erode the soil easily.

4. DISCUSSION

The results have documented about the changes in Land use patterns and their impact on soil and vegetation properties over Kanshi, Pakistan. The analysis indicates that a vegetation cover has declined extremely. The landscape area is changing due to increase the area of agriculture, brick companies and settlement. The results also declared that presently patterns of land cover are disappeared as compared to past near city of Gujar Khan. Furthermore, dry farmed and highland zone were observed. The highland zone has semi-arid and sub-humid warmed climate. A dry farmed zone is characterized by Rawalpindi-Chakwal region with tropical climate. Each distributed area is characterized by equal series of populated area, agricultural, forest, vegetation, and bare land. Local community is faced difficulties in the brick activities to improve living standard and income level. Though, poor farmers who have not sufficient assets for farming sector, they give their lands on tenure. Be that as it may, these practices are a great idea to improve the financial condition. From the field analysis, peoples are emphasized to regulate the modern agrarian mechanisms and practices.The forest sector is covered 54 %, mini dams 21%, wastewater management issues 3%, stream bank maintenance issues 4% and Agro-forest 3%.

A four type of course soil is observed over Kanshi watershed. Kahuta, Qazian course of action, Guliana course of action and a Missa game plan. The balkassar, qazian and the tirnual soil are interconnected with the Kahuta series. The clay of outline zone has been categorized into four parent materials is included: alluvium, piedmont alluvium, loess, and residuum. Soils made in the piedmont alluvium is covered the genuine bit, while those from conduit alluvium are basically bound to floodplains of the Jhelum River. The soils made in residuum get their parent material from the essential rocks. The soils are generally weakly sorted out with a pH regard around 8.0. They are continually low. Furthermore, some retaining walls were found in Kas near Kanshi catchment to decrease speed and intensity of flow and decrease strength. The highest magnitude of water during flooding is smashed the wall, riverbanks and increase the soil eroded activity (Kanevskiy et al., 2016; Recking et al., 2019; Oberhagemann et al., 2020).

The common feature in all soil series indicates that soils are well drained and cannot hold water for longer period. However, within the off season, they are dry and erodible. From 1991-2010, the vegetative cover is decreasing due to decreasing trend of precipitation. Furthermore, Soil erosion exercises and their attributes of not holding water, the supplements and nutrients which were available in the clay are filtered down or washed out (Pimentel, 2006; Hazelton & Murphy, 2016; Bünemann et al., 2018). Therefore, without manures and fertilizers it is less beneficial, and utilization of manures can expand the productivity. The all-soil types are significant; all around exhausted, non-calcareous, sensibly well, and standard completed soil made from the shrouded tertiary granite and are uncommonly arid and erodible. The clay got from sandstone wealth in earth, keeping minerals happen in evaluations connecting range from 3 to 8 %.

The soil consists of the seven series, which are Sambrial associated, Rajar complex, Dhulian association, Gullied land, Missa complex, Rough mountainous land, Kahan river and Rough broken land (Soil Survey of Pakistan, 2011). The Rajar complex is 36 % of the total study area, Gullied land is 15 %, Rough broken land is 17 %, Mountain land is 2 %, Missa complex is 1 %, Dhulian association is 15 %, Sambarial association is 5 %, Kahan river is 9 %. Gullied land, Missa complex and Rajar complex are found in Mohal and Bharampur. Mal Deo is totally situated in the Rough broken land. Sambarial association is usually used for cropping wheat, gram, millets, and vegetables with residual moisture.

The classification shows that rock outcrop with mainly loamy partly gradually; soil, Loamy clayey soils and loamy saline soils are found in the Kanshi watershed. The main reason of change in the soil characters is the erosion (Montanarella et al., 2015; Soil Survey of Pakistan 2016; Silva et al. 2018). Abbas et al., (2018) indicated that soil erosion increase due to more misuse of Kanshi watershed land above the Mangla basin, which is threatening life of the basin. The only Dongi dam near the Dongi Village (Gujar Khan) observed for the water storage. Otherwise, there are no such reservoirs to store the overflow during the rainfall of monsoon season. Due to lack of storage structures and reservoirs, the high rainfall in Kanshi watershed becomes useless. The ground water recharge and flow of the streams depends on the summer monsoon rainfall (Ahmad & Butt, 2019).

The various types of the water harvesting structures like farm pools, percolated reservoirs, check barrages might increase the productivity level and decline the barren land (Ayanu et al. 2016). Jhelum, Kanshi, Poonch, Kunhar and Neelum are major tributaries of the Mangala. Particularly, Neelum and Kunhar have satisfactory measure of vegetation cover and the topography of their stream catchment is not as erodible as of Kanshi and Poonch waterways. The investigation region is profoundly helpless against the flood and erosion threats in the summer monsoon season (Barber et al., 2017). During the monsoon period, a flooding level increase due to increase the runoff. These high runoffs dissolve the soil particles and take residue to the Mangla store. There are many kinds of erosion, but most well-known kind of the erosion is Rill and Gully erosion. The opinion of the mostly local people shows that rainfall runoff is the main cause of such type of erosion.

5. CONCLUSIONS

In this study, cross-disciplinary approaches were applied to evaluate the land use change patterns and their impacts on soil and vegetation properties over Potohar Plateau region of Kanshi watershed. The climate of the Kanshi agroecological zones are semi-arid to sub-humid subtropical and sub-mountainous. Results revealed that vegetation cover has been declined over the Kanshi watershed area during the last two decades. The agriculture, brick companies and settlement area have increased and changed the complete land pattern. Comparatively, the difference between present and past land use pattern indicates that the vegetation covers almost disappeared near city of Gujar Khan and is bounded in towns and settlements. The channels of water flow, water storage reservoirs, deforestation and urbanization are the basic reasons for reduction of water tables over Kanshi area. The practices related to agriculture are accelerated and disappearing the vegetative cover throughout the last two decades.

From the field survey, more than 80 % of local community agreed that extensive agricultural practices, population growth, settlement patterns and brick industry have significant impact on vegetative cover and water discharge. The total seven soil series observed which are Sambrial associated, Rajar complex, Dhulian association, Gullied land, Missa complex, Rough mountainous land, Kahan river and Rough broken land. From 1987-2019, the loss of the vegetation cover is the basic reason of the increasing the soil erosion in the Kanshi watershed area. The unexpected decreasing trend of rainfall during the last two decades is the main reason of the loss of vegetation cover. Such variation in vegetative cover increased the soil erosion. the water discharge was decreased by 44.15 % during the last two decades.

Furthermore, Soil erosion exercises and their attributes of not holding water, the supplements and nutrients which were available in the clay are filtered down or washed out. This substantial and significant change resultant due to climate change or increased intercession of anthropogenic activities on the earth surface. The highest flow of water discharge was found in 1992 in Kanshi river catchment due to heavy rainfall. The average water release from study span was declined, but the 2010 flow was on its peak value. Such variations in stream flow of the Kanshi river increase due to changes in rainfall pattern, land use and vegetation cover. Therefore, the current study recommended that water harvesting structure should be constructed for the better vegetation cover and water resource management to reduce the impact of climate on the vegetative cover of Agro-zones of the Kanshi watershed.

CONFLICT OF INTEREST STATEMENT

Authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

Sohail Abbas is contributed to the hypothesis of study area, design and data tabulation and analysis. Material preparation and survey has been done by Shehla Jabeen. The manuscript was written by Sohail Abbas and Shehla Jabeen.

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