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Reaserch Article

Study on the Effects of Land cover Changes on Surface Albedo and Surface Temperature in Bangladesh Using Remote Sensing and GIS

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Abstract

Dynamic changes in Earth's land cover characteristics and associated temporally evolving biophysical surface properties, as well as their ultimate impacts on surface radiative (surface albedo) and climatic properties (land surface temperature), have been studied. The study area includes a part of south–western Bangladesh covering a period of about twenty years from 1988 – 2011. The widely used Surface Energy Balance Algorithm for Land (SEBAL) has been applied in conjunction with satellite–derived radiative measurements. Relatively important land use types such as water, soil, sand, settlement, shrimp farm, forest and agricultural crop have been considered. Feature type conversion of parameters i.e Normalized Difference of Vegetation Index (NDVI), surface albedo and land surface temperature have been noticed over the area under the present study. The highest surface albedo as well as surface temperature value has been noticed over the sandy area. Analysis revealed increases of surface temperature by about 1 °C and 3 °C for land cover conversion from (i) crop to settlement and (ii) water to soil, respectively. All other categories of land cover conversion generally experience decreases in surface temperature. Spatial vegetation coverage and amount of soil moisture play a dominant role in the radiative as well as climatic properties.

Keywords: Land Cover/Change, SEBAL, LANDSAT, NDVI, Land Surface Albedo, Land Surface Temperature

Introduction

Although the terms Land cover and Land use are often used synonymously, one refers to the physical cover observed on the earth, and the other refers to the use resulting from anthropogenic use (Islam et al., 2018, 2016; Büyüksalih, 2016). Due to the advancement and data availability, researchers are now using remote sensing (RS) technology and geographic information system (GIS) together or independently to monitor land use change. Nowadays, advanced techniques are used in the hybrid (Rai et al., 2017; Esetlili, et al., 2018; Ülker et al., 2018). Land use in southwestern part of Bangladesh is generally classified as agriculture, settlements, shrimp farming, salt production, forestry, ship–breaking yards, ports, industry, and wetlands, which undergo changes with time (Islam 2006). Physiography, climate, and land height in relation to water level are generally determined the land–covers besides human interventions also have a great influence on land–covers and land–uses of Bangladesh (Brammer 2002).

This region is historically enriched with traditional shrimp farming whereas croplands have been used as shrimp farming during dry month (December-July) (Rahman 2010), furthermore, some crop fields have been replaced with settlement area due to the rapidly increasing population. Moreover, with the advancement of irrigation facility, various crops are now being cultivated in earlier bare land in this region. Rahman (2010) estimated that the overall land areas have been increased by 4% during 1948–2006 due to land accretion in coastal areas, i.e., reclamation of char lands; whereas 0.1% cultivable land have been annually transformed into housing, roads, and industrial infrastructures in the same period. Agricultural land area has decreased from 13.3–12.17 million ha from 1976–2010, with the total loss of 1.11 million ha (Hasan et al. 2013). Conversion of one land cover to another would directly alter vegetation cover and structure (Bright et al. 2015). Vegetation and its underlying soil are important factors in global climatic variability (Hong et al. 2007; Rahman et al. 2007). NDVI, a sensitive indicator of amount and condition of green vegetation, which is mostly used for monitoring characteristics, changes in vegetation and assess whether the target contains live green vegetation or not (Allen et al. 2007; İncekara et al., 2017). Vegetation coverage, soil moisture, and snow exert a great effect on land surface albedo (Ma et al. 2011) hence the modification of land cover altered the biophysical and biochemical properties of earth surface (Claussen et al. 2011) which can disturb the earth surface energy balance through changing of surface albedo, that exerts impacts on regional and global climate systems (Zhai et al. 2015; Kaya et al., 2017).

Land surface albedo, is fundamental physical parameters in remote sensing of the surface properties from space which control the interaction process of incoming solar radiation with earth surface. This interaction process determines the fraction of incident sunlight absorbed which can raise the surface temperature and evaporates water (Coakley 2003), and the partitioning of this absorbed energy into latent and sensible heat flux is controlled by surface hydrology and vegetation transpiration characteristics (Feddema 2005). However, the latent heat flux at the land surface is reduced substantially due to the higher surface albedo and stomatal resistance and the sensible heat flux increased mainly because of the higher surface temperature (Gao and Wu 2014). Hereafter the destabilization of latent heat flux resulted in decreasing evapotranspiration and can produce a warming effect (Li et al. 2016). Furthermore, Wang et al. (2016) studied the variation of surface albedo and soil thermal parameters with soil moisture content at a semi–desert site on the western Tibetan Plateau and found that surface albedo decrease with increasing soil moisture content. In addition, Rechid et al. (2005) states that the effect of vegetation cover on surface albedo varies with soil color and light–colored soils vegetation cover reduces the surface albedo whereas dark soils increase the surface albedo. Furthermore the deforestation and the expansion of pastural and agricultural activity caused by human land use generally can lead to increased surface albedo whereas afforestation and reforestation activities could reduce surface albedo by absorbing more solar radiation (Zhai et al. 2015). Effect of deforestation and afforestation on land surface albedo and land surface temperature varies with latitude (Claussen et al. 2011). Tropical deforestation leads to temperature increase due to strong warming effect associated with reduced evapotranspiration (Li et al. 2016). In contrary at high latitude the deforestation resulted in the decrease surface temperature due to increase surface albedo which leads to lower shortwave radiation absorption (Li et al. 2016). In view of the above the present study has been initiated to study a) the effect of land cover change on surface albedo and surface temperature and b) the characterization of these parameters associated with land cover change in the southwestern part of Bangladesh through remote sensing technology.

Materials and methods

Study area

Seven (7) coastal districts namely Bagerhat, Barisal, Gopalganj, Jhalokati, Khulna, Pirojpur, and Madaripur in the south–western part of Bangladesh were selected for the study (Figure 1). As mentioned earlier in Bangladesh, the land cover is generally determined by physiography, climate, and land height in relation to water level (Brammer 2002). The study area is covered by four different physiographic units namely Ganges floodplain, Ganges tidal floodplain, Gopalganj–Khulna beels, and Meghna estuary floodplain and lies on the Ganges floodplain of the lower delta in southern Bangladesh and extended towards the Ganges delta and Meghna estuary region (Rashid, 1991). Both the Ganges river floodplain and Ganges tidal floodplain are dominated with clay soils deposits. The thick deposits of peat occupy perennially wet basins in Gopalganj–Khulna beel, but they are covered with clay around the edges and by calcareous silty sediments alongside the Ganges distributaries crossing the area. Meghna River (the largest river of Bangladesh) and numerous distributaries of Ganges run through the study area.

The present study area belongs to the tropical zone and has a monsoon climate. There are three distinct seasons namely pre–monsoon summer season (March through May), rainy monsoon season (June through October) and winter season (November through February) in Bangladesh. In pre–monsoon hot season the highest temperature generally rises up to 40 °C or more in a year with an average annual rainfall of about 15% (Faisal et al. 2017). The humidity is generally high throughout the period whereas the maximum amount of rainfall in an average of 75% to 80% occurs in the monsoon season, and most of the floodplain of the country remains inundated during this period. In these regards the variability scenario of mean monthly total rainfall, monthly mean temperature over fifty years' period (1961–2015) adjacent to present study area has been shown in Figure 2. Settlement vegetation and seasonal agriculture crops are the major natural vegetation type where Boro rice (local variety) is the most important crop in this area during pre–monsoon summer season.

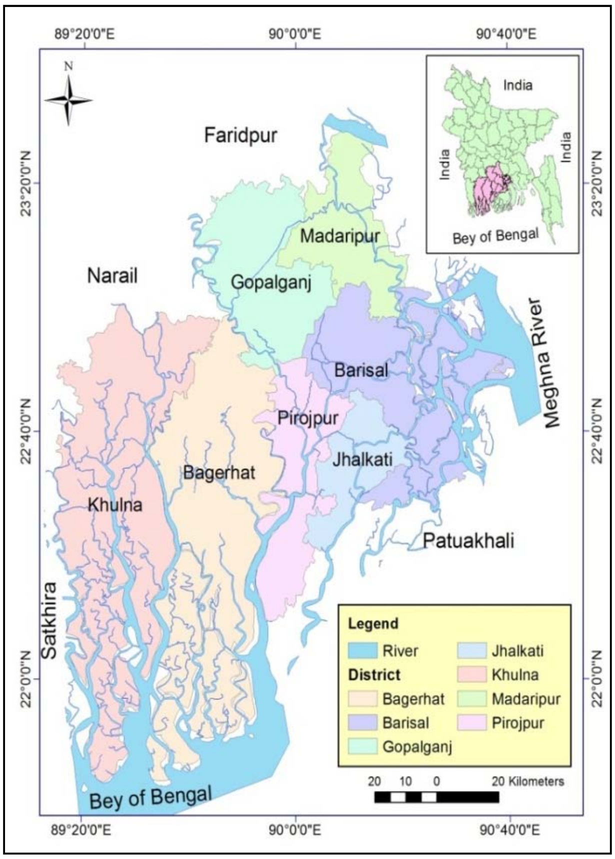


Fig. 1. Location map of the study area

Methodology

Accurate classification of land-use/cover based on remotely sensed data is important for interpreters who analyze time or event-based change on certain areas. Any method that has user flexibility on area selection provides great simplicity during analysis, since the analyzer may need to work on a specific area of interest instead of dealing with the entire remotely sensed data

(Kaya et al., 2014). Two images of LANDSAT 5 acquired on 7th March 1988 and 6th March 2011 have been acquired for this study and have been geometrically corrected and geo–referenced to ensure the proper mutual registration and geographic positioning. The Surface Energy Balance Algorithms for Land (SEBAL) algorithm has been implemented in a function–based geospatial computational platform of ERDAS imagine software applying Spatial Modeler Language (SML). The SEBAL algorithm incorporates major Earth's surface processes and process parameters through a series of mutually coupled analytical function for the soil–vegetation–atmosphere (SVA) interface (Bastiaanssen et al. 1998). By performing necessary SEBAL operation Normalized Difference Vegetation Index (NDVI), land surface albedo and land surface temperature have been derived by using LANDSAT Thematic Mapper (TM) data in this study. A point vector layer of 35 points have been generated (5 points for each land cover) based on spectral properties of 7th March 1988 image. These points have been chosen because at that point land cover undergoes change within the study time. Spectral properties have been analyzed to identify the different land cover (agricultural crop, settlement, dry soil, wet soil, water, shrimp farm, and Char land) types. NDVI, Surface albedo, and surface temperature values have been extracted by using values extraction tools of Arc GIS software for the vector points that represents each land cover.

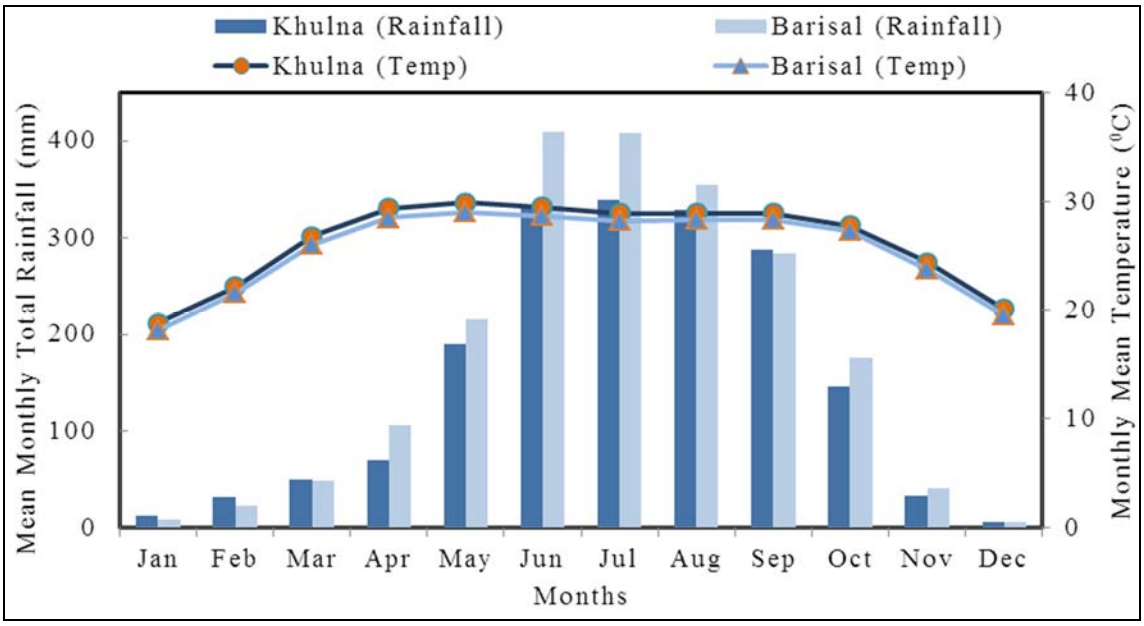


Fig. 2. Variation of mean monthly total rainfall, monthly mean temperature over the fifty years period from 1961 to 2015.

Results and discussion

For this study, the NDVI, surface albedo and surface temperature for water, soil (dry and wet), settlement, shrimp farm, agricultural crops and Char land (sand) have been computed to observe the effect of land cover changes and hence given in Table 1. Figure 3(a) and Figure 3(b) represent the spectral colour composite of LANDSAT TM images of 7th March 1988 and 6th March 2011, respectively. Each of color composite images is composed of bands 4 (red), 3 (green), and 2 (blue) of LANDSAT TM. In these figures dark red, bright red, turquoise, light turquoise and grey generally represent settlement, agricultural crop, shrimp farm (having confined boundary), water and soil, respectively. Rectangular box in Figure 3(a) and Figure 3(b) represents the representative points of each land cover which have been shown in Figure 4, where p1–p8 denotes land cover in eight different geographic locations. From these figures, it is evident that decadal changes in land cover are associated within the areas under consideration on different dates.

In present study area, the land cover undergoes changes with time due to various reasons notably the transformation of crop fields to settlement area, bare soil into the crop field area, depressed water logged area to shrimp farm etc. Figure 5 shows the scatter plot of surface temperature vs NDVI and surface albedo vs NDVI which exhibits that the points over the same land cover form a cluster and easily discernible from other land cover. Among the land cover conversion type, NDVI has been declined for modification of land cover from crop to settlement; soil to shrimp and water. On the other hand, NDVI has been increased for dry and wet soil to crop; soil to settlement; and water to char land (sand) and soil. Maximum reduction of NDVI is observed for the soil to shrimp and increased for wet soil to crop. Overall, the surface albedo fall for the transformation of land cover from crop to settlement; dry and wet soil to crop; soil to shrimp, settlement, and water; while surface albedo rises for changing of land cover from wet soil to crop; and water to sand and soil. High reduction of surface albedo is found for alteration of land cover from soil to shrimp farm whereas the rise of surface albedo is observed for water to sand. Dry and wet soil to crop; soil to shrimp, settlement, and water experienced dropping of surface temperature value conversely crop to settlement and water to sand and soil experienced rising of the surface temperature value.

The following section of this study will provide a concise and precise description of the experimental results, interpretation as well as the experimental conclusions.

Conversion of crop to settlement

In cropland to settlement area conversion, the NDVI (-33.3%) and surface albedo (-5.9%) decrease whereas the surface temperature increases of about 5.0% (Table 1). It is well known that areas covered with agriculture crop have a brighter surface than settlement area therefore the shifting of light land cover to darker land cover increases the absorption of sunlight and thus causes local warming (Streck et al. 2009). Consequently, the conversion of cropland (light land cover) to settlement (dark land cover) leads to a decrease in surface albedo. Cropland absorbed less solar radiation because of their higher surface albedo compare to the settlement, which presented significantly higher surface temperature compare to cropland about an average of 1.2 °C (Table 1).

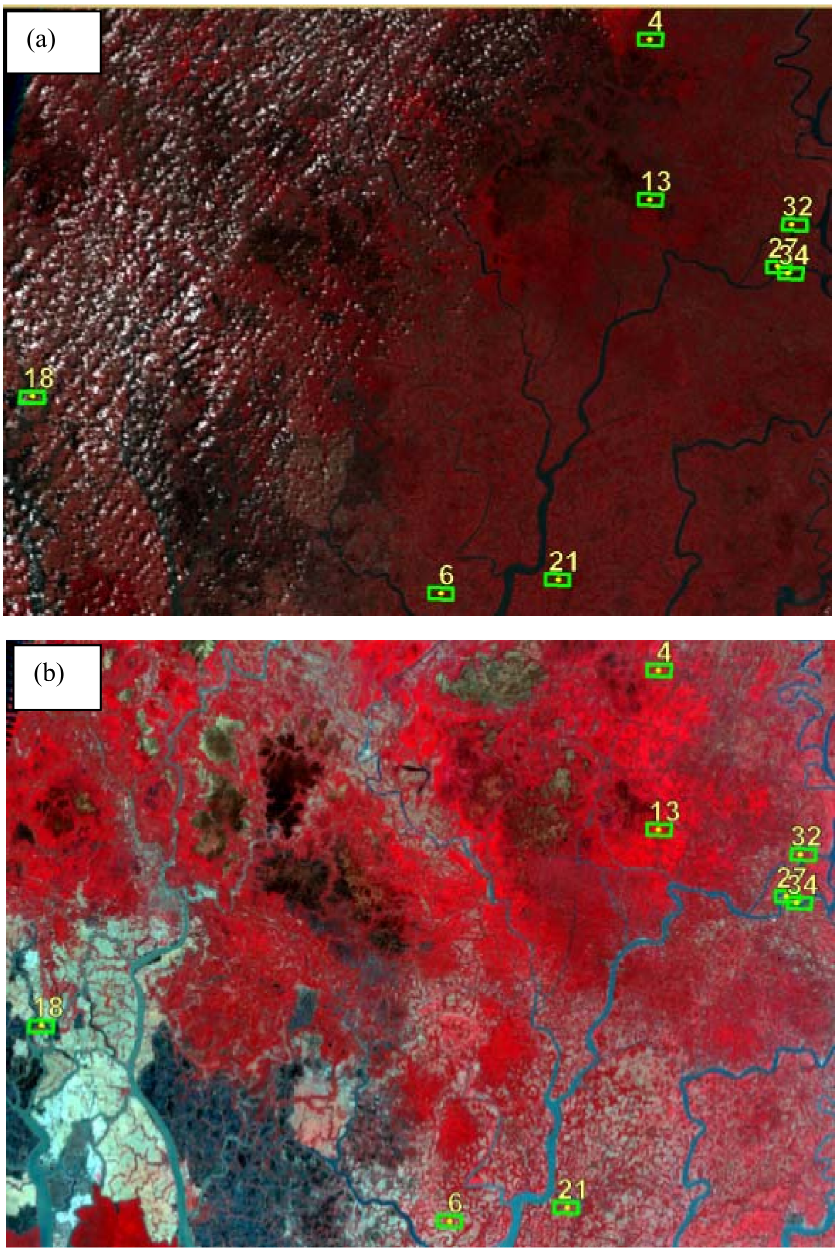
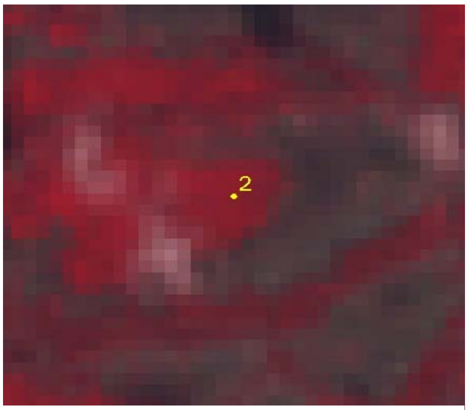
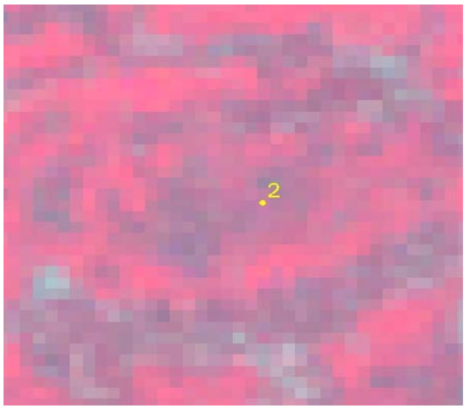


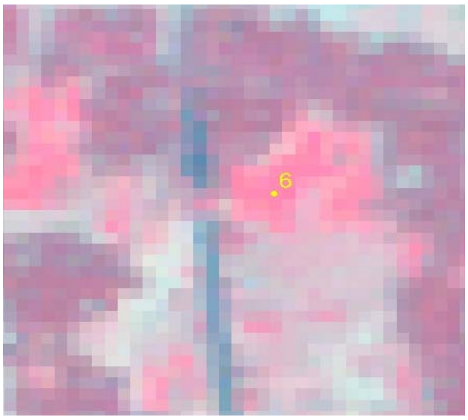
Figure 3. Spectral colour composite of LANDSAT TM image of 7th March 1988 (a) and 6th March 2011 (b).



a1. Crop at point ID 2 in 1988

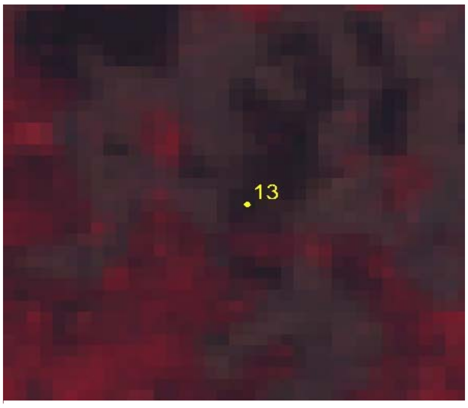


b1. Settlement at point ID 2 in 2011

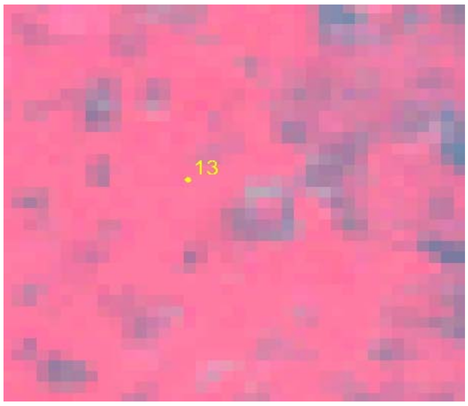


a2. Dry soil at point ID 6 in 1988

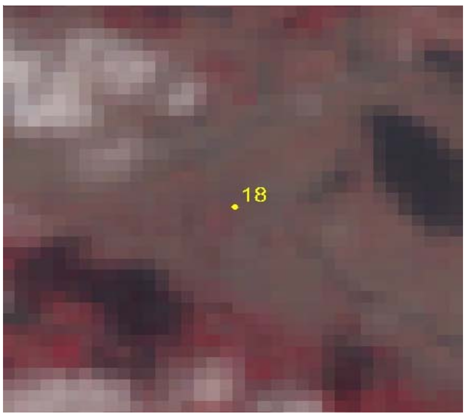
b2. Crop at point ID 6 in 2011



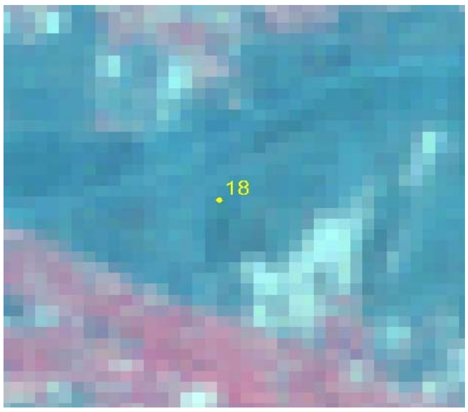
a3. Wet soil at point ID 13 in 1988



b3. Crop at point ID 13 in 2011

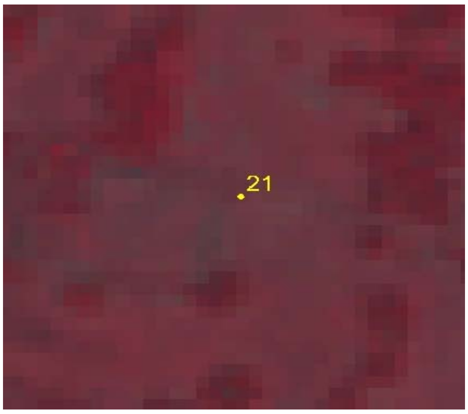


a4. Soil at point ID 18 in 1988

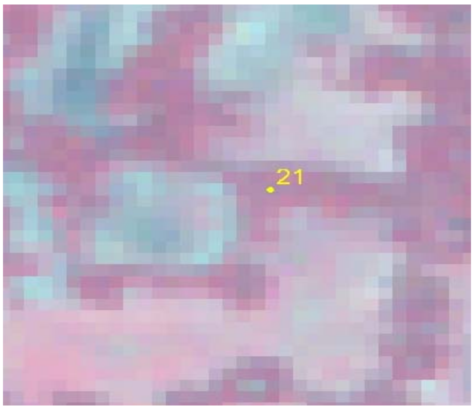


b4. Water at point ID 18 in 2011

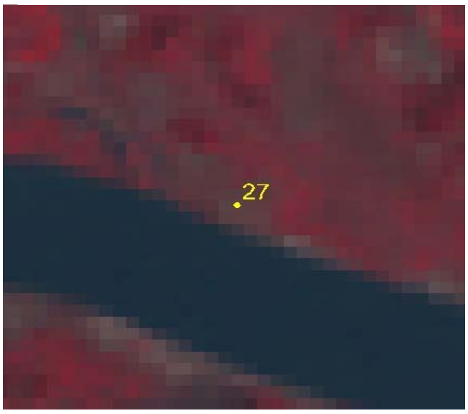
Fig. 4 Decadal land cover change from 1988 to 2011



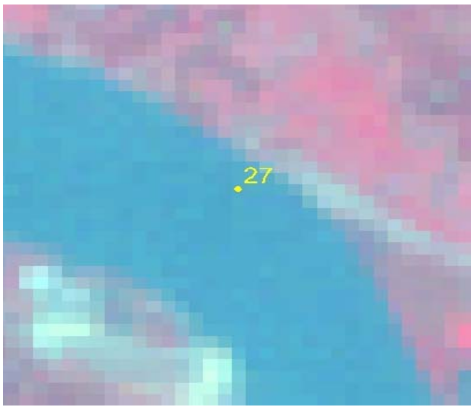
a5. Soil at point ID 21 in 1988



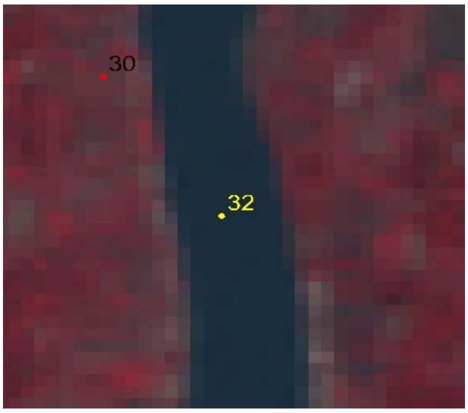
b5. Settlement at point ID 21 in 2011



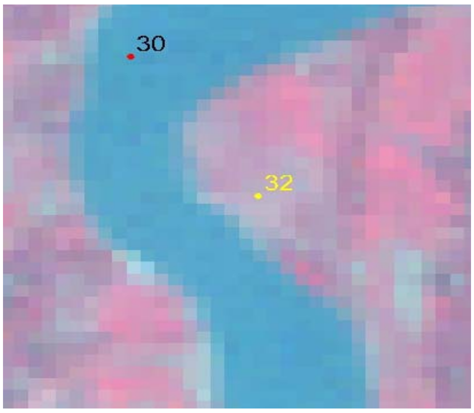
a6. Soil at point ID 27 in 1988



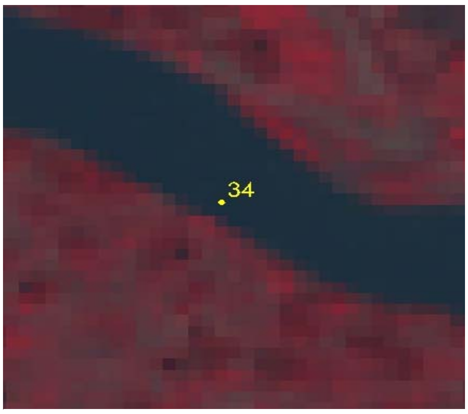
b6. Water at point ID 27 in 1988



a7. Water at point ID 32 in 1988



b7. Soil at point ID 32 in 2011



a8. Water at point ID 34 in 1988

b8. Sand at point ID 34 in 2011

Fig. 4 Decadal land cover change from 1988 to 2011 (Cont.)

Table 1: Image based statistics as retrieved from analysis of LANDSAT TM images of multiple dates

Point Id	Northing	Easting	1988				2011				Change (%) from 1988 to 2011		
			Land Use	NDVI	Surface albedo	S. Temp °C	Land Use	NDVI	Surface albedo	S. Temp °C	NDVI	Surface albedo	S. Temp °C
ID 01	524021	2561524	Crop	0.68	0.17	23.70	Settlement	0.42	0.15	25.31	-38.24	-11.76	6.79
ID 02	490777	2523707	Crop	0.66	0.16	25.05	Settlement	0.49	0.15	25.68	-25.76	-6.25	2.51
ID 03	525102	2552853	Crop	0.66	0.15	23.78	Settlement	0.42	0.16	25.30	-36.36	6.67	6.39
ID 04	514429	2551426	Crop	0.73	0.18	23.89	Settlement	0.45	0.17	25.70	-38.36	-5.56	7.58
ID 05	516122	2553626	Crop	0.72	0.18	23.94	Settlement	0.51	0.16	24.39	-29.17	-11.11	1.88
Average				0.69	0.17	24.07		0.46	0.16	25.28	-33.33	-5.88	5.03
ID 06	490272	2484822	Dry Soil	0.24	0.20	29.97	Crop	0.60	0.20	27.20	150.00	0.00	-9.24
ID 07	495062	2506023	Dry Soil	0.25	0.20	27.49	Crop	0.59	0.16	24.73	136.00	-20.00	-10.04
ID 08	489030	2522623	Dry Soil	0.23	0.17	26.67	Crop	0.59	0.17	25.56	156.52	0.00	-4.16
ID 09	495064	2516359	Dry Soil	0.23	0.20	27.50	Crop	0.58	0.16	24.74	152.17	-20.00	-10.04
ID 10	494233	2510019	Dry Soil	0.31	0.20	27.46	Crop	0.61	0.17	25.54	96.77	-15.00	-6.99
Average				0.25	0.19	27.82		0.59	0.17	25.56	136.00	-10.53	-8.12
ID 11	515151	2543862	Wet Soil	0.15	0.12	27.12	Crop	0.66	0.20	24.57	340.00	66.67	-9.40
ID 12	517637	2548529	Wet Soil	0.16	0.09	26.28	Crop	0.63	0.17	23.81	293.75	88.89	-9.40
ID 13	514819	2532316	Wet Soil	0.16	0.08	26.28	Crop	0.60	0.17	24.71	275.00	112.50	-5.97
ID 14	511480	2540311	Wet Soil	0.13	0.14	27.13	Crop	0.61	0.18	24.68	369.23	28.57	-9.03
ID 15	511580	2545588	Wet Soil	0.14	0.08	26.71	Crop	0.56	0.18	24.75	300.00	125.00	-7.34
Average				0.15	0.10	26.70		0.61	0.18	24.50	306.67	80.00	-8.24
ID 16	460242	2486618	Soil	0.23	0.22	26.66	Shrimp	-0.16	0.11	23.20	-169.57	-50.00	-12.98
ID 17	457015	2482980	Soil	0.40	0.23	28.23	Shrimp	-0.08	0.12	23.63	-120.00	-47.83	-16.29
ID 18	440107	2507338	Soil	0.17	0.26	27.10	Shrimp	-0.17	0.11	23.63	-200.00	-57.69	-12.80
ID 19	456836	2485919	Soil	0.38	0.22	27.83	Shrimp	-0.02	0.13	24.47	-105.26	-40.91	-12.07
ID 20	446055	2508295	Soil	0.24	0.15	23.20	Shrimp	-0.10	0.11	24.89	0.00	-26.67	7.28
Average				0.28	0.22	27.38		-0.11	0.12	23.96	-138.65	-44.56	-12.49
ID 21	504561	2486725	Soil	0.34	0.20	27.86	Settlement	0.37	0.15	27.44	8.82	-25.00	-1.51
ID 22	499470	2479107	Soil	0.26	0.17	26.23	Settlement	0.43	0.15	26.56	65.38	-11.76	1.26
ID 23	497433	2508734	Soil	0.26	0.21	27.90	Settlement	0.45	0.14	26.14	73.08	-33.33	-6.31
ID 24	500440	2499468	Soil	0.41	0.20	27.81	Settlement	0.46	0.15	26.97	12.20	-25.00	-3.02
ID 25	492195	2480279	Soil	0.29	0.22	28.30	Settlement	0.41	0.16	27.00	41.38	-27.27	-4.59
Average				0.31	0.20	27.62		0.42	0.15	26.82	35.48	-25.00	-2.90
ID 26	516992	2525586	Soil	0.30	0.18	26.63	Water	-0.11	0.14	21.93	-136.67	-22.22	-17.65
ID 27	530503	2524692	Soil	0.20	0.21	26.25	Water	-0.08	0.14	21.93	-140.00	-33.33	-16.46
ID 28	517988	2501562	Soil	0.17	0.25	29.59	Water	-0.12	0.15	21.93	-170.59	-40.00	-25.89
ID 29	513048	2519031	Soil	0.17	0.24	26.26	Water	-0.15	0.15	22.35	-188.24	-37.50	-14.89
ID 30	531830	2530025	Soil	0.26	0.19	27.07	Water	-0.09	0.14	21.93	-134.62	-26.32	-18.99
Average				0.22	0.21	27.16		-0.11	0.14	22.01	-150.00	-33.33	-18.96
ID 31	496090	2523331	Water	-0.15	0.11	22.78	Settlement	0.46	0.16	25.28	-406.67	45.45	10.97
ID 32	532110	2529672	Water	-0.25	0.12	22.78	Soil	0.30	0.18	26.21	-220.00	50.00	15.06
ID 33	518373	2501844	Water	-0.24	0.14	22.78	Soil	0.21	0.18	27.09	-187.50	28.57	18.92
ID 34	531783	2523867	Water	-0.21	0.13	22.78	Sand	0.16	0.22	28.36	-176.19	69.23	24.50
ID 35	512584	2518303	Water	-0.22	0.13	22.78	Sand	0.09	0.29	28.80	-140.91	123.08	26.43
Average				-0.21	0.13	22.78		0.24	0.20	27.15	-214.29	53.85	19.18

Conversion of dry soil to crop

Cropland shows high NDVI, low surface albedo and surface temperature values than dry soil over the present study area. In average, the alternation of dry soil by crops increased the NDVI by 136% (0.3 and 0.6 for dry soil and for crops respectively). On the contrary, other two parameters of surface temperature and surface albedo decreased by –10.5% (0.19 and 0.17 for dry soil and for crops respectively) and –8.1% (27.8 °C and 25.6 °C for dry soil and for crops respectively) respectively. Tian (2014) observed that the Tibetan Plateau surface albedo declined mostly in areas where the NDVI was increased which is very much similar to our observation (Figure 5 (a2) and 5 (b2)). As mentioned earlier, little amount of rainfall occur in pre–monsoon season create lacking of soil moisture due to the absence of significant rainfall besides the bare soil is more reflective thereby increase surface albedo values. With the conversion of bare soil by crop, irrigation facilities have been introduced to fulfil the crop requirement which resulted in increasing soil moisture in cropland. Additionally farmers add natural fertilizer to crop field that tends to soil darker and furthermore, before plantation farmer irrigate and plough land.

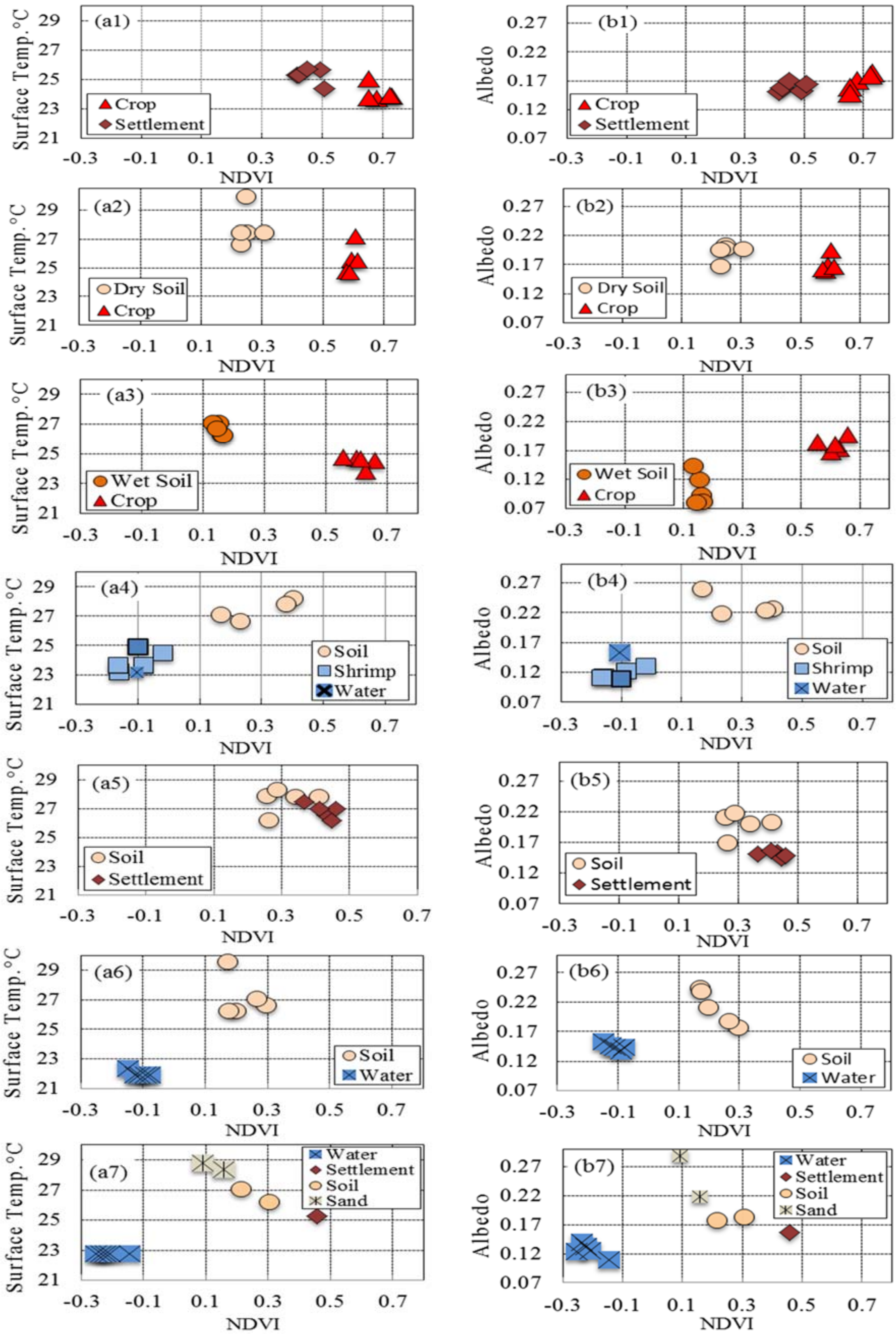


Fig. 5. Shifting of position due to conversion of land cover from 1988 to 2011 in; NDVI and surface temperature (a1–a8) scatter plot; NDVI and surface albedo (b1–b8) scatter plot. Conversion of land cover from: crop to settlement (a1 and b1), dry soil to crop (a2 and b2), wet soil to crop (a3 and b3), soil to settlement (a4 and b4), soil to shrimp (a5 and b5), soil to water (a6 and b6), water to settlement, soil, and sand (a7 and b7)

Influence of cultivation practice has been observed by Milton and Webb (1987) and found that cropland ploughing decrease soil reflectance that ultimately reduces soil surface albedo. Surface reflectivity also decreases with increasing organic matter, moisture, and roughness in soil (Cierniewski and Courault 1993). Due to the intensification of soil moisture, soil roughness and darken soil color cropland absorbs more energy furthermore the vegetation of that filed absorbs the solar radiation for their photosynthesis activity as a result cropland surface albedo value decrease compare to dry soil. Surface temperature is dependent upon the specific heat capacity of soil which is strongly controlled by soil porosity and water content (Kluitenberg 2002; İşcan and Yağcı, 2016) thus the specific heat increased with increased moisture content in the soil (Alnefaie and Abu–Hamdeh 2013). Hence soil moisture in cropland absorbs the incoming solar energy that lowers the land surface temperature (Khorrami et al., 2019; Orhan, et al., 2019). In contrary, due to the lack of soil moisture in dry soil little amount of incoming solar energy is used for evaporation and most of the incoming solar energy is used to heat the soil surface, therefore increase land surface temperature.

Conversion of wet soil to crop

In present study, significantly high variation of NDVI, surface albedo, and surface temperature have been observed for the alteration of wet soil by cropland compare to dry soil by cropland (Figure 5 (a2) and 5 (b2) and 5–(a3) and 5 (b3)). In LANDSAT 5 satellite, band 5 is water absorption band which shows lower spectral reflectance value if the land cover have high water content. For wet and dry soil, average reflectivity value of band 5 is 0.08 and 0.14, respectively. All the three–parameter exhibit considerably lower value compare to dry soil. Compare to wet soil, dry soil shows higher surface albedo (0.19 and 0.104 for dry and wet soil respectively) and surface temperature (27.82 °C and 26.7 °C for dry and wet soil respectively) by about 45% and 4%, respectively in average. As mention, earlier soil moisture has a great influence on surface albedo, which is observed in our observation. Further the surface albedo is negatively correlated with average water content in soil and at all wavelength, reflectance decreases with the level of soil saturation that enhances net radiation resulting in a larger total flux of heat from the surface into the boundary layer (Eltahir 1998). Although wet soil absorbs more solar radiation, compare to dry soil but wet soil exhibit low surface temperature because its absorbed energy is used to evaporate the soil water, which has a cooling effect, resulted in the lowering of surface temperature. For the above mentioned reasons, the transformation of wet soil to cropland display the significant variation of radiative parameter compare to dry soil converted to crop.

Conversion of bare soil to settlement

A portion of bare soil changed into settlement area resulted in the increase of NDVI by 35% (0.3 and 0.4 for soil and settlement respectively), decrease of temperature and surface albedo value by 25% (0.2 and 0.15 for soil and settlement respectively) and 3% (27.6 °C for soil and 26.8 °C for settlement) respectively (Table 1). Due to lack of rainfall in summer, season soil would desiccate which resulted in the formation of crust at the surface and moisture below these crusts has very little effect on soil spectral properties (Rahman et al. 2007). But when soil area changes into settlement area, plant root of settlement vegetation would absorb the soil moisture below that crust layer. For transpiration of plant, plant water absorbs solar heat and turns into vapor where some of the incoming energy is used for photosynthesis activity of settlement vegetation. As a result, the changes of bare soil into settlement area shows the increase NDVI value and decrease of temperature and surface albedo but not as prominent as soil changed into crop in this study (Figure 5–(a5) and (b5)).

Conversion of bare soil to shrimp farm and river

Another type of land cover change is bare soil converted to shrimp farm and river has been found in this study. This study found that surface albedo and land surface temperature decrease at an average of 45% (0.22 for soil and 0.12 for shrimp farm) and 13% (about 27 °C for soil and 24 °C for shrimp), 33% (0.21 for soil and 0.14 for river) and 19% (27.2 °C for soil and 22.0 °C for river) for land cover changed into shrimp and river respectively. Among all–natural terrestrial surfaces, water has the lowest average surface albedo although water absorbs most of the incoming solar radiation, but it shows the lowest surface temperature among all land cover because of evaporative cooling and high specific capacity of water. Moreover surface albedo over the water surface is affected by suspended sediment (sediment type, texture, and color), sensor view and sun angles, and water depth (Bailey et al. 1997). Besides the dynamic of surface albedo over water is governed by suspended sediments and therefore lowering of suspended sediments will decrease surface albedo value (Rahman et al. 2007). Additionally the shallow water body’s entire water column participates in absorption and scattering of solar irradiance and hence the bottom layer exerts a great influence on surface albedo (Bailey et al. 1997). Hereafter river water contains more suspended sediments, and it has large water column compare to shrimp farm. Because of high concentration of suspended sediment in river water it reflects more solar radiation and thereby decreasing surface temperature compared to shrimp farm in present study.

Conversion of water to new char land, stable char land, and settlement

Due to the erosional activity of the river in our country, some of the landmass has been lost and on the contrary new landmass has been formed in each year. In course of time, the new char land changed into stable char land and then it becomes stable as a settlement area or crop field. Following this transformation of land cover earth surface energy balance also altered as newly formed char tends to be sandier and highly permeable. On the other hand, because of weathering the sandy material grain size reduced to clay as a result the permeability of soil decrease. Sandy materials are whiter than soil and reflect more incoming solar radiation. Generally, the water holding capacity of sand is relatively poor as a result after a given rainfall event, the top sand layer rapidly transmits the intercepted water into the deeper level, thereby resulting in quicker drying of the top layer (Rahman et al. 2007). Moreover, agricultural activities are greatly influenced by soil moisture content that is controlled by the amount of rainfall and moisture holding capacity of the soil. Besides, the silty soil is more permeable than clay soil as a result clay soil shows high water retention capacity compare to silty soil. Morphological change of these lands reflected in the earth energy balance Surface temperature and surface albedo value as high as, 28.8 °C and 0.28 respectively are found over newly formed Char, 27.1 °C and 0.18 is found over stable char, and then 25.3 °C and 0.15 is found over settlement area respectively (Table 1).

Conclusions

Biophysical characterization of spectral radiative measurements provides enhanced capability and precision for radiative data interpretation. This study concludes that the decadal land cover change and its impact on NDVI, surface albedo, and surface temperature are very much noticeable in the study area. It has been found that spatial vegetation coverage and amount of soil moisture plays a dominant role in the radiative as well as climatic properties change. Hence for land cover zoning, it is very important to consider the effect of land cover change on radiative and climatic parameters. Therefore, it may be mentioned that if the changing pattern continues then it may put forth problems to agricultural production and the food security in the area.

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