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Land Degradation Pattern

Spectral and Multi-Temporal

Highlights

Koreas Urban Regeneration

Transhumance Pastoralists

Discovering Thoughts, Inventing Future

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Contents of the Volume

i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Table of Contents
v. From the Chief Editor's Desk
vi. Research and Review Papers

1. Land Degradation Pattern Using Geo-Information Technology for Kot Addu, Punjab Province, Pakistan. *1-16*
2. Detection of Change in Vegetation Cover Using Multi-Spectral and Multi-Temporal Information for District Sargodha. *17-26*
3. Korea's Urban Regeneration Project on the Improvement of Urban Micro Climate: A Focal Study on the Case of Changwon City. *27-38*
4. Perceived Effects of Climate Change on Transhumance Pastoralists in Ogun State, Nigeria. *39-47*

vii. Auxiliary Memberships
viii. Process of Submission of Research Paper
ix. Preferred Author Guidelines
x. Index

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Land Degradation Pattern Using Geo-Information Technology for Kot Addu, Punjab Province, Pakistan

By Farooq Ahmad, Qurat-ul-ain Fatima & Kashif Shafique
University of the Punjab, New Campus, Lahore, Pakistan

Abstract - One of the most important global phenomena that are currently threatening the ecosystem is land degradation and is mainly caused by the climatic changes and human influence. Land degradation is the reduction in the capability of the land to produce benefits from a particular land use under a specified form of land management. Land degradation is the consequence of important processes, which is active in arid and semi-arid ecosystems, where water is the original limiting factor in execution of land application. Remotely sensed data provide timely, accurate and reliable information on degraded lands at definite time intervals in a cost effective manner. In this research, the TM/ETM+ images were used to study changes occurred in the first decade of the new millennium; May 2001 to April 2011. In the present study, efforts have been made to identify and map areas affected by land degradation in Kot Addu tehsil of Muzaffargarh, Punjab province, Pakistan.

Keywords : Change detection, Landsat TM/ETM, land degradation, NDVI, remote sensing.

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Land Degradation Pattern Using Geo-Information Technology for Kot Addu, Punjab Province, Pakistan

Farooq Ahmad [α], Qurat-ul-ain Fatima [σ] & Kashif Shafique [ρ]

Abstract - One of the most important global phenomena that are currently threatening the ecosystem is land degradation and is mainly caused by the climatic changes and human influence. Land degradation is the reduction in the capability of the land to produce benefits from a particular land use under a specified form of land management. Land degradation is the consequence of important processes, which is active in arid and semi-arid ecosystems, where water is the original limiting factor in execution of land application. Remotely sensed data provide timely, accurate and reliable information on degraded lands at definite time intervals in a cost effective manner. In this research, the TM/ETM+ images were used to study changes occurred in the first decade of the new millennium; May 2001 to April 2011. In the present study, efforts have been made to identify and map areas affected by land degradation in Kot Addu *tehsil* of Muzaffargarh, Punjab province, Pakistan. The Normalized Difference Vegetation Index (NDVI), change detection technique was applied upon TM/ETM+ images and further unsupervised classification was used for extraction of information regarding the desert, bare soil, cultivatable land and cultivated land. The NDVIs properties help mitigate a large part of the variations that result from the overall remote-sensing system. The result shows that the desert is 458.73 km^2 (17%), bare soil is 1160.33 km^2 (43%), cultivated land is 647.62 km^2 (24%) and cultivatable land is 431.75 km^2 (16%) in April 2011. The values of the Kappa statistics were used to compare the performance of the classifiers. The data sets were analyzed using ArcGIS software in the Geographic Information System environment and can be implemented in the drylands of Pakistan.

Keywords : Change detection, Landsat TM/ETM, land degradation, NDVI, remote sensing.

I. Introduction

Land degradation is an environmental problem that has major ecological-physical and social dimensions (Thomas, 1997), which has been contributing in number of ways. Land degradation or desertification has been high on the list of items of Global Environmental Agenda since 1970s, though the term was first conceived by Aubreville in 1949. Land degradation in arid, semi-arid and sub-humid areas resulting from various factors, including climatic variations and human activities (Glantz and Orlovsky, 1983; Warren and Agnew, 1988; Odingo, 1990; UNEP, 1992; Stiles, 1995; Ahmad, 2002; Kertész, 2009), and its proportion is increasing because of over-exploitation of premature meadows beyond quick rehabilitation (Babaev, 1999).

Remote sensing can offer unbiased view of large areas, with spatially explicit information distribution and time repetition, and has thus been widely used to monitor land degradation pattern and change detection at a regional scale (Quarmby et al., 1993; Baez-Gonzalez et al., 2002; Doraiswamy et al., 2003; Ruecker et al., 2007). Land degradation is usually detected efficiently by remote sensing analysis (Weismiller et al., 1977; Singh, 1989; Lu et al., 2004; Fadhil, 2009). Tappan et al. (1992) and Mout et al. (1997) used the Normalized Difference Vegetation Index (NDVI) as an indicator of land degradation or desertification since it related to vegetation greenness (Al-Bakri and Taylor, 2003).

The NDVI, spectral vegetation index which measures soil and vegetation moisture (Singh, 1989; Lyon et al., 1998; Mambo and Archer, 2007), has been widely used for environmental change monitoring (Young, 1998; Lillesand and Kiefer, 2000; Eastman, 2003; Lillesand et al., 2004; Mambo and Archer, 2007). The index can be used to identify areas showing distressed or degraded vegetation, leading to identification of possible degraded areas (Barrow, 1991; Booth et al., 1994; Mambo and Archer, 2007). The NDVI is used as a proxy; land degradation and improvement is inferred from long-term trends when other factors that may be responsible are accounted for. Rainfall effects may be accounted for by rain-use efficiency and residual trends of NDVI; temperature effects may be accounted for by energy-use efficiency (Bai and Dent, 2007; 2007a). Vegetation production and biomass have been successfully estimated with the NDVI derived from satellite data (Deering et al., 1975; Prince and Tucker, 1986; Tucker and Sellers, 1986; Prince, 1991; Jury et al., 1997; Myneni et al., 1997; Wessels et al., 2004).

The NDVI captures the marked contrast between the strong absorptance in the visible wavelengths and strong reflectance in the near-infrared wavelengths which uniquely characterizes the presence of photosynthetically active vegetation (Tucker, 1979; Wessels et al., 2004). The NDVI is an indicator of vegetation health, because degradation of ecosystem

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vegetation, or a decrease in green, would be reflected in a decrease in NDVI value (Meneses-Tovar, 2011).

The NDVI is highly correlated with vegetation parameters such as green leaf biomass and green leaf area (Justice et al., 1985), and it also is directly related to plant vigor, density, and growth conditions (Holben, 1986), now it is widely accepted as a primary tool for monitoring land degradation (Huang et al., 2010). In arid and semi-arid lands, seasonal sums of multi-temporal NDVI are strongly correlated with vegetation production (Prince and Tucker, 1986; Prince, 1991; Nicholson and Farrar, 1994; Nicholson et al., 1998; Wessels et al., 2004).

The Normalized Difference Vegetation Index (NDVI) is a normalized ratio of the NIR and red bands. The NDVI is computed following the equation:

$$\mathrm{NDVI} = \frac{\rho_{\mathrm{NIR}} - \rho_{\mathrm{Red}}}{\rho_{\mathrm{NIR}} + \rho_{\mathrm{Red}}}$$

Where, ρ_{NIR} and ρ_{red} are the surface bidirectional reflectance factors for their respective MODIS bands. The NDVI is referred to as the 'continuity index' to the existing 20+ year NOAA-AVHRR derived NDVI (Rouse et al., 1973) time series (Moran et al., 1992; Verhoef et al., 1996; Jakubauskas et al., 2001; Huete et al., 2002; Zoran and Stefan, 2006; USGS, 2010; Ahmad, 2012; 2012a; 2012b), which could be extended by MODIS data to provide a longer term data record for use in operational monitoring studies (Chen et al., 2003).

The NDVI (Figure 1) is the most commonly used index of greenness derived from multispectral remote sensing data (USGS, 2010), and is used in several studies on vegetation, since it has been proven to be positively correlated with density of green matter (Townshend et al., 1991; Huete et al., 1997; Huete et al., 2002; Debien et al., 2010; Ahmad, 2012c; 2012d; Zaeen, 2012). The NDVI provides useful information for detecting and interpreting vegetation land cover it has been widely used in remote sensing studies (Dorman and Sellers, 1989; Myneni and Asrar, 1994; Gao, 1996; Sesnie et al., 2008; Karaburun, 2010; Ahmad, 2012e).

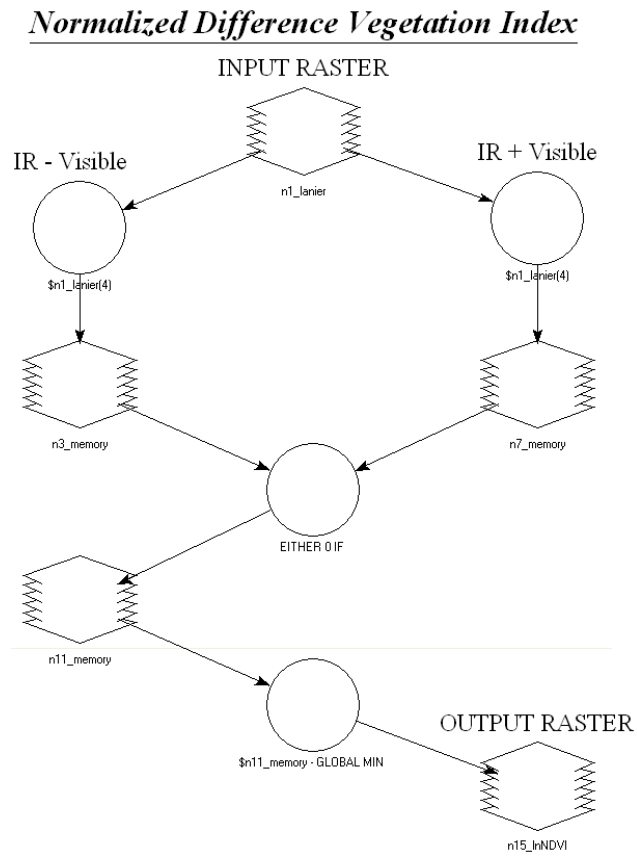

Figure 1 : Schematic view of the Model Maker window, illustrating the calculation of the NDVI

Source: http://geospatial.intergraph.com/products/ERDASIMAGINE/ERDASIMAGINE/Downloads.aspx

II. Study Area

The study area (Figure 2) lies in the southern Punjab province of Pakistan from 30° 05' 39" to 30° 45' 57" North latitude and 70° 47' 35" to 71° 33' 37" East longitude.

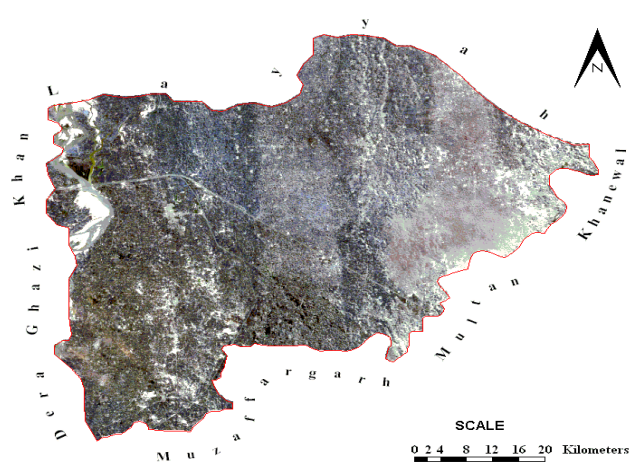

Figure 2 : Kot Addu - Landsat TM 25th April, 2011 image

Source : http://glovis.usgs.gov/

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III. Research Design and Methods

Los et al. (1994) and Sellers et al. (1996) were the first to derive land surface parameters with realistic seasonal and spatial variations for the globe from NDVI data collected by the AVHRR satellite (Los et al., 2000). Estimation of land surface vegetation parameters from satellite is based on the spectral properties of vegetation; vegetation strongly absorbs visible light, using the energy for photosynthesis, and strongly reflects near-infrared (NIR) radiation (Rouse et al., 1973; Los, 1998; Los et al., 2000; Ahmad, 2012e). The NDVI is based on differences in reflectance in the red region and maximum reflectance in the near infrared; it is the most widely used index in remote sensing (Aguilar et al., 2012; Ahmad, 2012b).

The NDVI values range from -1 to +1; because of high reflectance in the NIR portion of the EMS, healthy vegetation is represented by high NDVI values between 0.1 and 1 (Liu and Huete, 1995; USGS, 2008; 2010). Conversely, non-vegetated surfaces such as water bodies yield negative values of NDVI because of the electromagnetic absorption property of water. Bare soil areas represent NDVI values which are closest to 0 due to high reflectance in both the visible and NIR portions of the EMS (Townshend, 1992; Ahmad, 2012a).

The theoretical basis for the NDVI lies with the red-NIR contrast of vegetation spectral reflectance signatures (Rahman et al., 2004). As the amount of live, green vegetation increases within a pixel, the red reflectance will decrease due to chlorophyll absorption while the non-absorbing NIR spectral region will generally increase especially leaf structure and amount (Baret and Guyot, 1991; Ahmad, 2012e). Because of these properties, the NDVI has become the primary tool for mapping changes in vegetation cover and analysis of the impacts of environmental phenomena. The NDVI can be used not only for accurate description of vegetation classification and vegetation phenology (Tucker et al., 1982; Tarpley et al., 1984; Justice et al., 1985; Lloyd, 1990; Singh et al., 2003; Los et al., 2005) but also effective for monitoring rainfall and drought, estimating net primary production of vegetation, crop growth conditions and crop yields, detecting weather impacts and other events important for agriculture and ecology (Kogan, 1987; Dabrowska-Zielinska et al., 2002; Singh et al., 2003; Chris and Molly, 2006; Baldi et al., 2008; Glenn et al., 2008; Ahmad, 2012e). The NDVI is the most commonly used index (Ahmad, 2012) and serves as a measure of photosynthetic activity within a certain area (Fontana, 2009; Ahmad, 2012b).

The NDVI can be a useful tool to couple climate and vegetation distribution and performance at large spatial and temporal scales (Pettorelli et al., 2005; Aguilar et al., 2012; Ahmad, 2012b) because vegetation vigor and productivity are related to temperature-precipitation and evapotranspiration. The NDVI serves as a surrogate measure of these factors at the landscape scale (Wang et al., 2003; Groeneveld and Baugh, 2007; Aguilar et al., 2012; Ahmad, 2012b).

Remotely sensing derived NDVI data have been successfully used for monitoring of vegetation activity and environmental changes at regional and global scales (Kowabata et al., 2001; Tucker et al., 2001; Xiao and Moody, 2004; 2005; Propastin and Kappas, 2008), detection of droughts (Kogan, 1997; Propastin and Kappas, 2008), land degradation and desertification studies (Thiam, 2003; Wessels et al., 2004; Propastin and Kappas, 2008).

The NDVI product works optimally with cloud filtering, radiometric calibration, precise geolocation, and a snow mask. In addition, the product performs best using top-of-canopy reflectance inputs, corrected for atmospheric ozone, molecular scattering, aerosol, and water vapour (Huete et al., 2006; Ahmad, 2012b). Various methods using daily NDVI data have been developed for monitoring natural vegetation (Akiyama et al., 2002; Saito et al., 2002; Xiao et al., 2002; Sakamoto et al., 2005; Ahmad, 2012b).

ERDAS imagine 2011 and ArcGIS 10 software were used for application of NDVI model and calculation upon Landsat TM/ETM+ images (path 151, row 39); May 2001, April 2003, May 2009 and April 2011 respectively and change detection technique was applied to explore land degradation pattern for the period of 2001 to 2011 and 2003 to 2009 at Kot Addu (Figure 3). Unsupervised classification was applied upon NDVI images for calculation the area of the desert, cultivatable land, cultivated land and bare soil classes. Further, comparative analysis of unsupervised classification using NDVI images were performed for description and evaluation of land degradation pattern at Kot Addu, Punjab province of Pakistan.

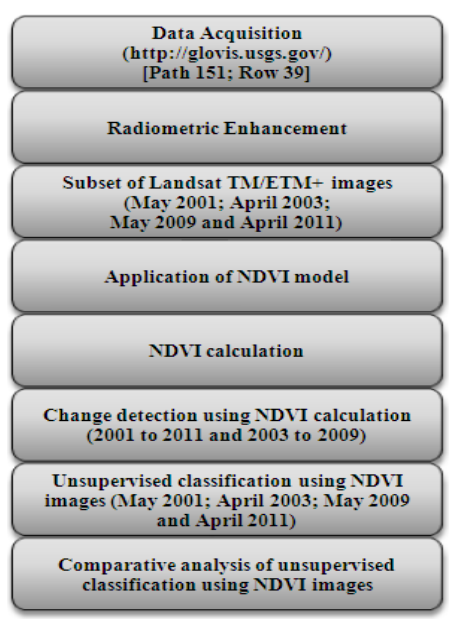

Figure 3 : Scheme for research design and methods

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IV. Results

Figure 4, 5, 6, 7 (Table 1) shows NDVI values of Landsat TM/ETM+ images for May 2001; April 2003; May 2009 and April 2011 respectively. The NDVI index was applied upon the Landsat TM/ETM+ using ERDAS imagine 2011 software while ArcGIS 10 was used for NDVI calculation. The findings showed that there was a relationship between desert, cultivatable land, cultivated land and bare soil and NDVI values. The NDVI is a measurement of the balance between energy received and energy emitted by objects on Earth. When applied to plant communities, this index establishes a value for how green the area is, that is, the quantity of vegetation present in a given area and its state of health or vigor of growth (Meneses-Tovar, 2011). The significance of NDVI index may vary according to habitat type (Pettorelli et al., 2005; Hamel et al., 2009).

Figure 8 shows change detection during 2001-2011 at Kot Addu, Punjab province, Pakistan. The findings showed that decreased in the desert was 978.55 km^2 (36%), some decrease was 1601.45 km^2 (59%), unchanged was 0.45 km^2, some increase was 96.17 km^2 (4%), while increased was 21.81 km^2 (1%). Decreased and some decrease > some increase and increased while unchanged was negligible. The change detection technique was performed upon NDVI images; May 2001 and April 2011. The results and accuracy assessment is given in Table 2.

Digital change detection is the process that helps in determining the changes associated with land use and land cover properties with reference to geo-registered multi-temporal remote sensing data (Prenzel and Treitz, 2004; Ramachandra and Kumar, 2004; Ahmad, 2012c).

A variety of change detection techniques have been developed and many have been summarized and reviewed (Singh, 1989; Mouat et al., 1993; Deer, 1995; Coppin and Bauer, 1996; Jensen, 1996; Jensen et al., 1997; Yuan et al., 1998; Serpico and Bruzzone, 1999; Lu et al., 2004; Ahmad, 2012c). Due to the importance of monitoring change of Earth's surface features, research of change detection techniques is an active topic, and new techniques are constantly developed (Lu et al., 2004; Ahmad, 2012c).

Figure 9 shows change detection during 2003-2009 at Kot Addu, Punjab province, Pakistan. The findings showed that decreased in the desert was 230.72 km^2 (9%), some decrease was 2300.76 km^2 (85%), unchanged was 2.35 km^2, some increase was 150.12 km^2 (6%), while increased was 14.48 km^2. Decreased and some decrease > some increase and increased while unchanged was negligible. The change detection technique was performed upon NDVI images; April 2003 and May 2009. The results and accuracy assessment is given in Table 2.

Remote sensing provides a viable source of data from which updated land-cover information can be extracted efficiently and cheaply in order to inventory and monitor these changes effectively (Mas, 1999). Remote sensing change detection is a hot issue in recent years (Yan and Xiao-xia, 2010). Change detection is an important application of remote sensing technology. It is a technology ascertaining the changes of specific features within a certain time interval. It provides the spatial distribution of features and qualitative and quantitative information of features changes (Shaoqing and Lu, 2008).

Prior to any change detection, it is imperative that the imagery be geometrically rectified so that the same pixel at one date overlaps the same pixel for the other date (Townshend et al., 1992; Macleod and Congalton, 1998). Usually, change detection involves two or more registered remotely sensed images acquired for the same ground area at different times (Dal and Khorram, 1999). Change detection using remote sensing data is the process of identifying and examining temporal, spatial and spectral changes of pixel signal (Wen and Yang, 2009). Long-term change detection results can provide insight into the stressors and drivers of change, potentially allowing for management strategies targeted toward cause rather than simply the symptoms of the cause (Kennedy et al., 2009).

Digital change detection essentially comprises the quantification of temporal phenomena from multi-date imagery that is most commonly acquired by satellite-based multispectral sensors (Coppin and Bauer, 1996). The critical requirement for successful change detection is that a common radiometric response is required for quantitative analysis of multiple images acquired on different dates (Hall et al., 1991; Coppin and Bauer, 1996). Radiometric correction is to remove or reduce the inconsistency between the values surveyed by sensors and the spectral reflectivity and spectral radiation brightness of the objects (Jianya et al., 2008).

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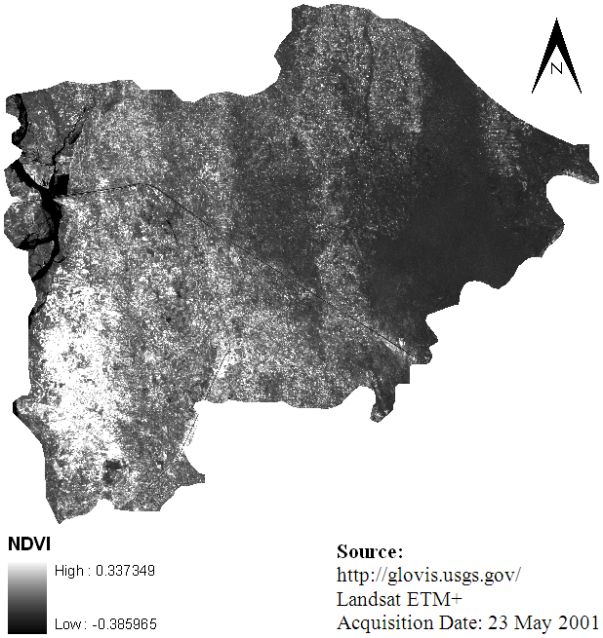


Figure 4 : NDVI 2001, Kot Addu, Pakistan

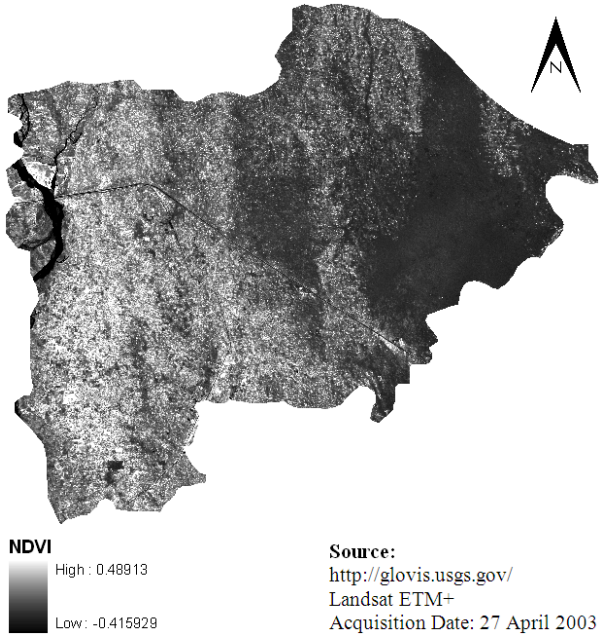
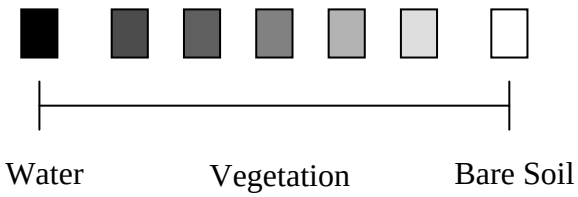


Figure 5 : NDVI 2003, Kot Addu, Pakistan

Legend



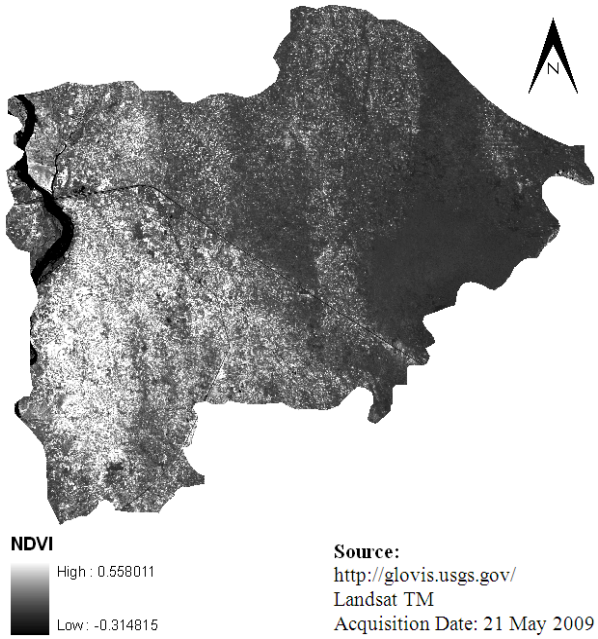


Figure 6 : NDVI 2009, Kot Addu, Pakistan

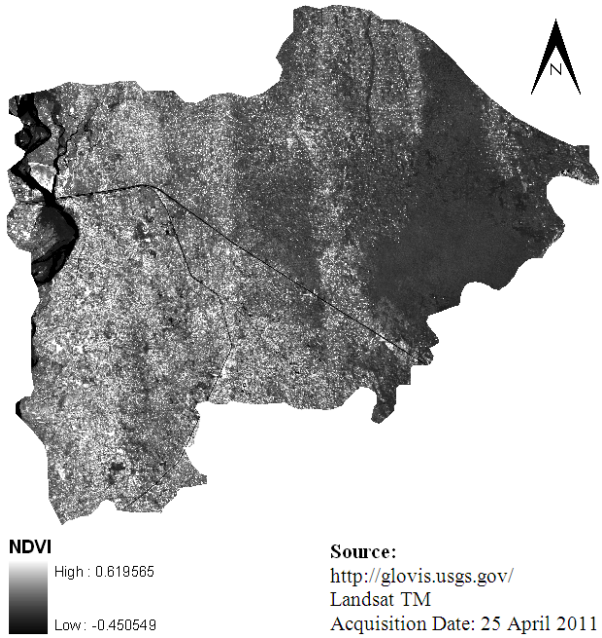


Figure 7 : NDVI 2011, Kot Addu, Pakistan

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Table 1 : NDVI values of Landsat images

Image Acquisition Date	Maximum NDVI	Minimum NDVI	Mean NDVI	Standard Deviation
23 May, 2001 (Landsat ETM+)	0.34	-0.39	-0.09	0.08
27 April, 2003 (Landsat ETM+)	0.49	-0.42	-0.05	0.08
21 May, 2009 (Landsat TM)	0.56	-0.31	0.05	0.10
25 April, 2011 (Landsat TM)	0.62	-0.45	0.06	0.09

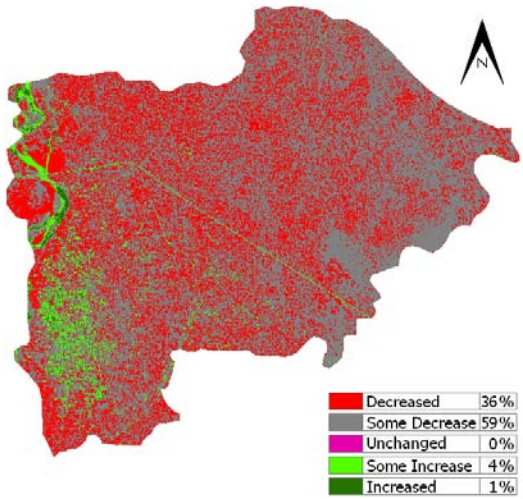

Figure 8 : Change detection during 2001-2011 at Kot Addu, Pakistan

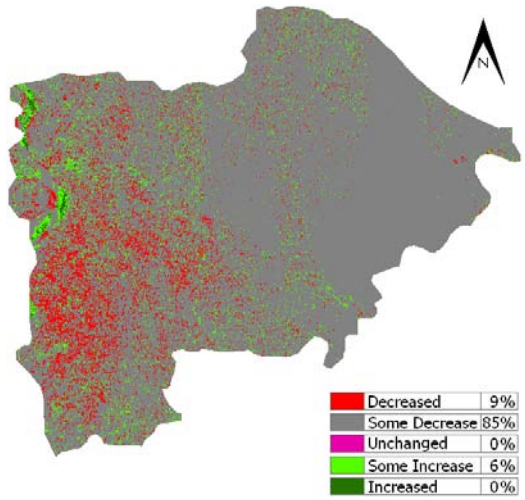

Figure 9 : Change detection during 2003-2009 at Kot Addu, Pakistan

Table 2 : Change detection using NDVI calculation

Classes	During 2001 to 2011			During 2003 to 2009		
	Area (km^2)	Area (%)	Accuracy Assessment (%)	Area (km^2)	Area (%)	Accuracy Assessment (%)
Decreased	978.55	36	85.79	230.72	9	87.31
Some Decrease	1601.45	59	92.14	2300.76	85	90.19
Unchanged	0.45	Negligible	89.32	2.35	Negligible	87.22
Some Increase	96.17	4	85.16	150.12	6	88.45
Increased	21.81	1	91.47	14.48	Negligible	92.21
SUM	2698.43	100	-	2698.43	100	-

Figure 10 shows comparative change detection, during 2001 to 2011 and during 2003 to 2009. The findings showed that sufficient decrease in desert area at Kot Addu, Punjab province, Pakistan. The area of the desert decreased from 1376.20 km^2, May 2001 to 458.73 km^2, April 2011 (Table 3). Change information of the earth's surface is becoming more and more important in monitoring the local, regional and global resources and environment. The large collection of past and present remote sensing imagery makes it possible to analyze spatio-temporal pattern of environmental elements and impact of human activities in past decades (Jianya et al., 2008; Ahmad, 2012c). The wider availability of large archives of historical images also makes long-term change detection and modelling possible (Jianya et al., 2008). Change detection has become a major application of remotely sensed data because of repetitive coverage at short intervals and consistent image quality (Mas, 1999). Over the past years, researchers have put forward large numbers of change detection techniques of remote sensing image and summarized or classified them from different viewpoints (Singh, 1989; Lu et al., 2004; Jianya et al., 2008). The problem of availability of cloud-free images in sub-tropical regions is very common and has been reported by many authors (Ducros-Gambart and Gastellu-Etchegorry, 1984; Nelson and Holben, 1986; Pilon et al., 1988; Alwashe and Bokhari, 1993; Jha and Unni, 1994; Mas,1999).

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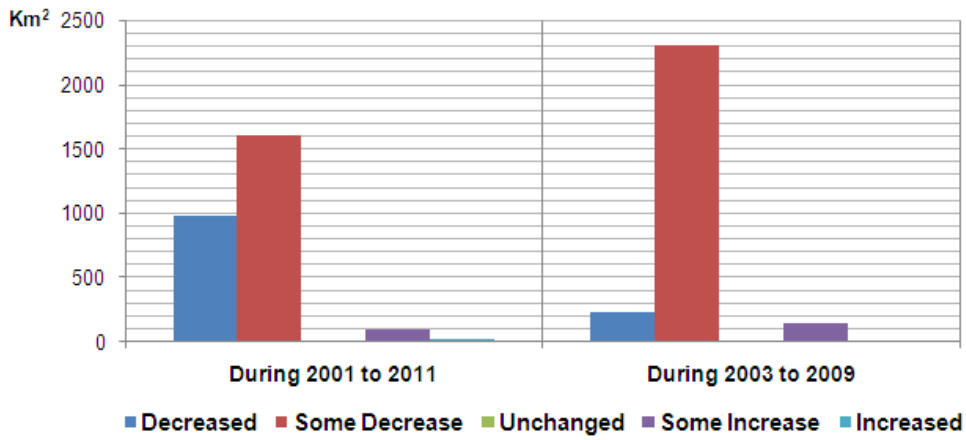

Figure 10 : Comparative change detection at Kot Addu, Pakistan

Figure 11 shows unsupervised classification using NDVI image 2001. The findings showed that the desert was 1376.20 km^2 (51%), bare soil 1241.28 km^2 (46%), and cultivated land 53.97 km^2 (2%) while the cultivatable land was 26.98 km^2 (1%). The accuracy assessment is given in Table 3.

The approach unsupervised classification which is part of post classification comparison method or direct classification method. This approach is based on the natural groupings of the spectral properties of the pixels which are usually selected by the RS software without any influence from the users (Al-Awadhi et al., 2011).

Figure 12 shows unsupervised classification using NDVI image 2003. The findings showed that the desert was 1214.29 km^2 (45%), bare soil 1268.27 km^2 (47%), and cultivated land 188.89 km^2 (7%) while the cultivatable land was 26.98 km^2 (1%). The accuracy assessment is given in Table 3. The accurate assessment of land degradation, their vulnerability to drought, or degree of degradation, requires information about the dominant vegetation types including spatial variations in coverage (Le Houérou, 1996; Geerken et al., 2005). This clearly emphasizes the need for a classification technique that gives more consideration to the biophysical information contained in NDVI time series, incorporating both vegetation type and spatial intra-class coverage variability (Geerken et al., 2005).

Figure 13 shows unsupervised classification using NDVI image 2009. The findings showed that the desert was 782.54 km^2 (29%), bare soil 1295.25 km^2 (48%), and cultivated land 269.84 km^2 (10%) while the cultivatable land was 350.80 km^2 (13%). The accuracy assessment is given in Table 3.

Unsupervised context-sensitive technique for change-detection in multitemporal remote sensing images (Patra et al., 2007). Automated classification can be performed upon NDVI by unsupervised cluster analysis (Sader and Winne, 1992; Sader et al., 2003).

Figure 14 shows unsupervised classification using NDVI image 2011. The findings showed that the desert was 458.73 km^2 (17%), bare soil 1160.33 km^2 (43%), and cultivated land 647.62 km^2 (24%) while the cultivatable land was 431.75 km^2 (16%). The accuracy assessment is given in Table 3.

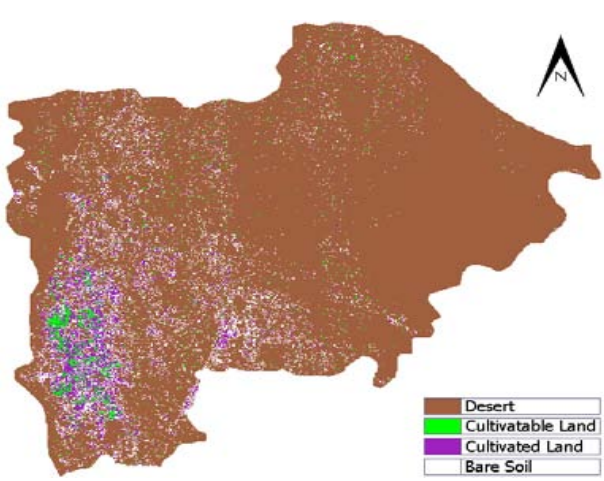

Figure 11 : Unsupervised classification using NDVI image 2001

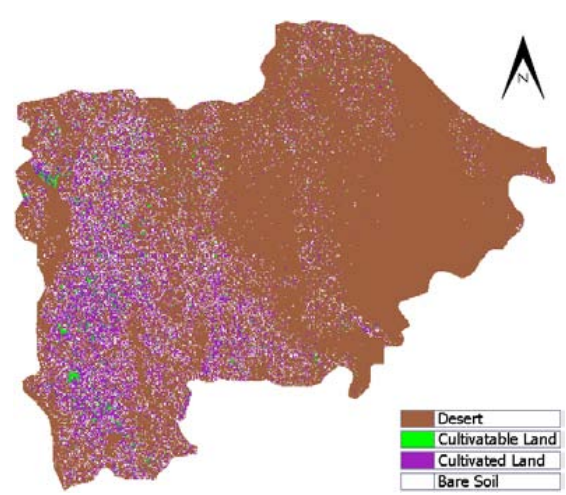

Figure 12 : Unsupervised classification using NDVI image 2003

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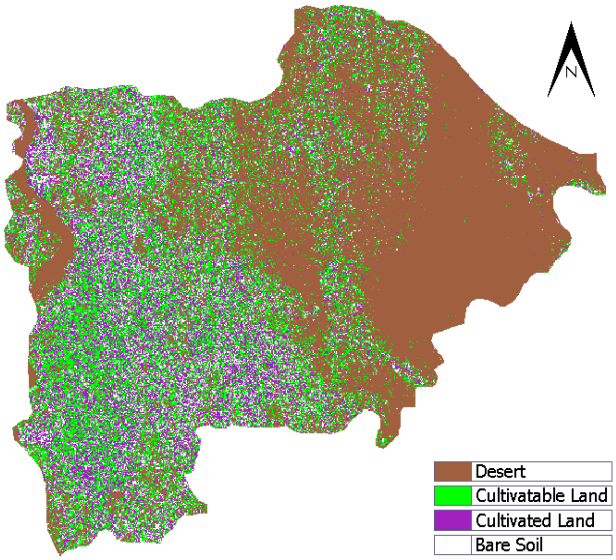

Figure 13 : Unsupervised classification using NDVI image 2009

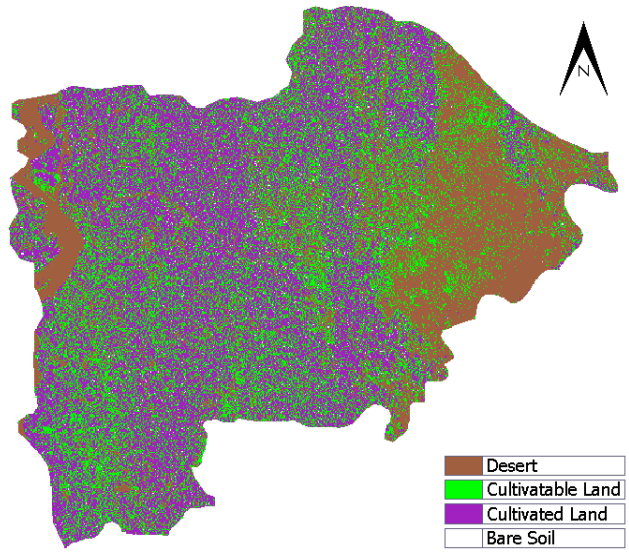

Figure 14 : Unsupervised classification using NDVI image 2011

Table 3 : Unsupervised classification using NDVI images

Image Acquisition Date	Classes	Area (km^2)	Area (%)	Accuracy Assessment (%)
23 May, 2001 (Landsat ETM+)	Desert	1376.20	51	91.23
	Bare Soil	1241.28	46	87.65
	Cultivated Land	53.97	2	85.42
	Cultivatable Land	26.98	1	87.39
	SUM	2698.43	100	-
27 April, 2003 (Landsat ETM+)	Desert	1214.29	45	89.61
	Bare Soil	1268.27	47	90.73
	Cultivated Land	188.89	7	87.94
	Cultivatable Land	26.98	1	86.92
	SUM	2698.43	100	-
21 May, 2009 (Landsat TM)	Desert	782.54	29	92.13
	Bare Soil	1295.25	48	88.76
	Cultivated Land	269.84	10	86.14
	Cultivatable Land	350.80	13	89.63
	SUM	2698.43	100	-
25 April, 2011 (Landsat TM)	Desert	458.73	17	90.81
	Bare Soil	1160.33	43	92.37
	Cultivated Land	647.62	24	87.71
	Cultivatable Land	431.75	16	85.49
	SUM	2698.43	100	-

Figure 15 shows comparative analysis of unsupervised classification using NDVI images for the period May 2001 to April 2011. The findings showed that the area of the desert was decreased from 1376.20 km^2 (51%) in May 2001 to 458.73 km^2 (17%) in April 2011, the bare soil decreased from 1241.28 km^2 (46%) in May 2001 to 1160.33 km^2 (43%) in April 2011, while cultivated land increased from 53.97 km^2 (2%) in May 2001 to 647.62 km^2 (24%) in April 2011, cultivatable land also increased from 26.98 km^2 (1%) in May 2001 to 431.75 km^2 (16%) in April 2011 (Table 3).

As the use of space and computer technology developed, humankind has a great advantage of produce this much important research projects with the help of technology in an easier, more accurate way within less time than other ways. As a result all these can have a very effective role in helping the country to increase the amount and the quality of agricultural products (Akkartala et al., 2004; Ahmad, 2012).

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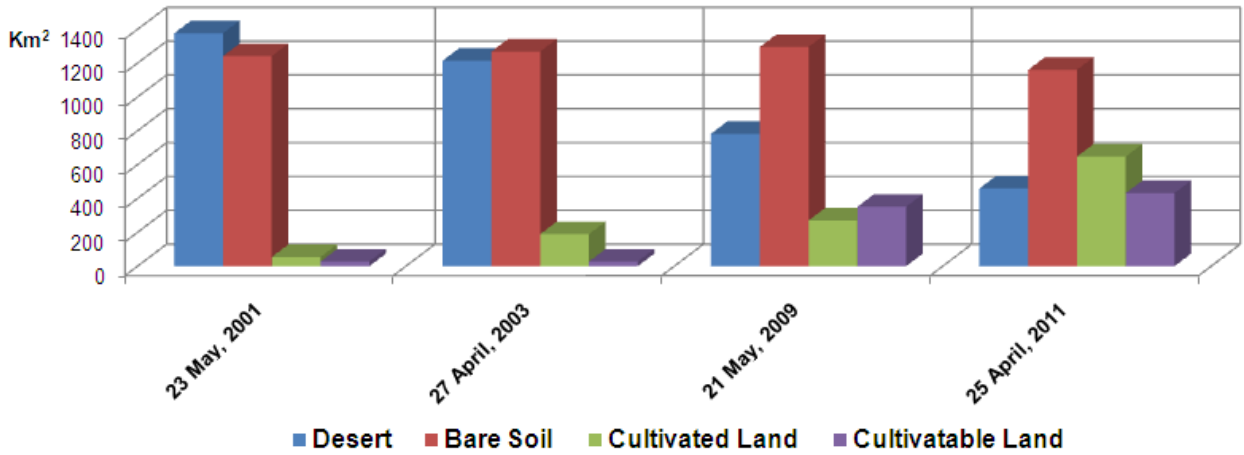

Figure 15 : Comparative analysis of unsupervised classification using NDVI images

V. Discussion and Conclusions

Remote sensing change detection techniques can be broadly classified as either pre or post classification change methods (Lunetta et al., 2006). The NDVI is the most commonly used of all the VIs tested and its performance, due to non-systematic variation as described by Huete and Liu (1994) and Liu and Huete (1995). The NDVI suppresses differential solar illumination effects of slope and aspect orientation (Lillesand and Kiefer, 1994; Sader et al., 2001) and helps to normalize differences in brightness values when processing multiple dates of imagery (Singh, 1986; Lyon et al., 1998; Sader et al., 2001).

Many studies have found the NDVI to be unstable, varying with soil, sun-view geometry, atmospheric conditions, and the presence of dead material, as well as with changes within the canopy itself (Sellers, 1985; Jackson and Pinter, 1986; Jackson and Huete, 1991; Myneni et al., 1992; Huete and Liu, 1994). As a result, several studies and developments have sought to improve upon the NDVI by correcting for soil and atmospheric sources of variance (Huete and Liu, 1994). The improved variants to the NDVI equation attempt to either incorporate a "soil" adjustment factor or a "blue" band for atmospheric normalization (Huete and Liu, 1994). The soil adjusted vegetation index (SAVI) introduced a soil calibration factor L to the NDVI equation to account for first-order soil-vegetation optical interactions and differential red and NIR extinction through the canopy (Huete, 1988; Huete and Liu, 1994).

Land cover classification techniques can be straightforward but at the same time very complicated. Depending on the methodology used, each classification technique can give different results. If attention is not given, the classification results could be misleading and erroneous (Nicandrou, 2010). The methodology presented in this research paper has several desirable properties. Since it treats each pixel individually without setting thresholds or empirical constants, the method is globally applicable (Vermote and Vermeulen, 1999; Vermote et al., 2002; Li and Guo, 2012; Ahmad, 2012c). In practice, different algorithms are often compared to find the optimal change detection algorithm for a specific application. A limitation of image differencing or ratio image differencing as a change detection method is that it does not specify the 'from-to' land cover type change information (Jensen, 1996; Sader et al., 2001), but only detects that a change did or did not occur (Sader et al., 2001). The overall accuracy of the change detection results exceeded 85%, the level that the US Geological Survey (Anderson et al., 1976; Sader et al., 2001) uses as a threshold to define acceptability (Sader et al., 2001). The approaches used in this study can be applied to other areas to examine land degradation pattern in Pakistan.

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Detection of Change in Vegetation Cover Using Multi-Spectral and Multi-Temporal Information for District Sargodha

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Abstract - Detection of change is the measure of the distinct data framework and thematic change information that can direct to more tangible insights into underlying process involving land cover and landuse changes. Monitoring the locations and distributions of land cover changes is important for establishing links between policy decisions, regulatory actions and subsequent landuse activities. Change detection is the process that helps in determining the changes associated with landuse and land cover properties with reference to geo-registered multi-temporal remote sensing information. It assists in identifying change between two or more dates that is uncharacterized of normal variation. After image to image registrations, the normalized difference vegetation index (NDVI), the transformed normalized differ-rence vegetation index (TNDVI), the enhanced vegetation index (EVI) and the soil-adjusted vegetation index (SAVI) values were derived from Landsat ETM+ dataset and an image differencing algorithm was applied to detect changes. This paper presents an application of the use of multi-temporal Landsat ETM+ images and multi-spectral MODIS (Terra) EVI/NDVI time-series vegetation phenology metrics for the District Sargodha.

Keywords : Change detection, EVI, Landsat, multi-temporal, multi-spectral, NDVI, Pakistan.

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DETECTIONOFCHANGEINVEGETATIONCOVERUSINGMULTI-SPECTRALANDMULTI-TEMPORALINFORMATIONFORDISTRICTSARGODHA

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Abstract - Detection of change is the measure of the distinct data framework and thematic change information that can direct to more tangible insights into underlying process involving land cover and landuse changes. Monitoring the locations and distributions of land cover changes is important for establishing links between policy decisions, regulatory actions and subsequent landuse activities. Change detection is the process that helps in determining the changes associated with landuse and land cover properties with reference to geo-registered multi-temporal remote sensing information. It assists in identifying change between two or more dates that is uncharacterized of normal variation. After image to image registrations, the normalized difference vegetation index (NDVI), the transformed normalized difference vegetation index (TNDVI), the enhanced vegetation index (EVI) and the soil-adjusted vegetation index (SAVI) values were derived from Landsat ETM+ dataset and an image differencing algorithm was applied to detect changes. This paper presents an application of the use of multi-temporal Landsat ETM+ images and multi-spectral MODIS (Terra) EVI/NDVI time-series vegetation phenology metrics for the District Sargodha. The results can be utilized as a temporal landuse change model for Punjab province of Pakistan to quantify the extent and nature of change and assist in future prediction studies. This will support environmental planning to develop sustainable landuse practices.

Keywords : Change detection, EVI, Landsat, multi-temporal, multi-spectral, NDVI, Pakistan.

I. Introduction

Assessing and monitoring the state of the earth surface is a key requirement for global change research (NRC, 1999; Lambin et al., 2001; Jung et al., 2006; Xie, 2008). Classifying and mapping vegetation is an important technical task for managing natural resources as vegetation provides a base for all living beings and plays an essential role in affecting global climate change (Xiao et al., 2004; Xie, 2008). Vegetation extraction from remote sensing imagery is the process of extracting vegetation information by interpreting satellite images based on the interpretation elements and association information (Xie, 2008).

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Preprocessing of satellite images prior to vegetation extraction is essential to remove noise (Schowengerdt, 1983) and increase the interpretability of image data (Campbell, 1987; Schowengerdt, 2006). The ideal result of image preprocessing is that all images after image preprocessing should appear as if they were acquired from the same sensor (Hall et al., 1991; Xie, 2008). Image preprocessing commonly comprises a series of operations, including but not limited to bad lines replacement, radiometric correction, geometric correction, image enhancement and masking although variations may exist for images acquired by different sensors (Schowengerdt, 1983; Campbell, 1987; Xie, 2008).

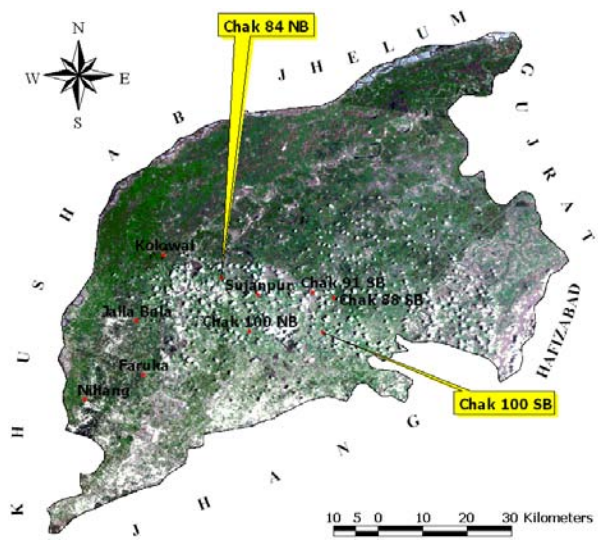

Figure 1 : District Sargodha - Landsat ETM+ 1999 mosaic image

Source : http://glovis.usgs.gov/

Change detection as defined by Hoffer (1978) is temporal effects as variation in spectral response involves situations where the spectral characteristics of the vegetation or other cover type in a given location change over time. Singh (1989) described change detection as a process that observes the differences of an object or phenomenon at different times (Adia and Rabiu, 2008). Land cover composition and change are important factors that affect ecosystem condition and function (Jones et al., 1997; Lunetta et al., 2006). Extraction of land cover maps for mapping surface

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composition and assessment of changes in surface cover composition over time are requirements common to each investigation. Applied remote sensing became more and more inevitable technology contributing to human's progress toward sustainability by support solving environment related tasks on local, regional and global level (Zoran and Anderson, 2006). Moreover, regularly acquired satellite data may be used for long-term surveillance of certain features (Aubrey et al., 1996; Zoran and Anderson, 2006). These data acquired by optical, infrared and microwave sensors yield information on chlorophyll content, the surface temperature, turbidity, hydrocarbon load respectively (Zoran and Anderson, 2006).

A remote sensing sensor is a key device that captures data about an object or scene remotely. Since objects have their unique spectral features, they can be identified from remote sensing imagery according to their unique spectral characteristics (Xie, 2008). A good case in vegetation mapping by using remote sensing technology is the spectral radiances in the red and near-infrared (NIR) regions, in addition to others. The radiances in these regions could be incorporated into the spectral vegetation indices (VI) that are directly related to the intercepted fraction of photosynthetically active radiation (Asrar et al., 1984; Galio et al., 1985; Xie, 2008). The spectral signatures of photosynthetically and non-photosynthetically active vegetation showed obvious difference and could be utilized to estimate forage quantity and quality of grass prairie (Beeri et al., 2007; Xie, 2008).

II. Study Area

The District Sargodha (Figure 1) is located in the Northeast of Pakistan between 31° 34' and 32° 36' North latitude and 72° 10' and 73° 18' East longitude (GOP, 1999), mainly comprises flat, fertile plains although a few small Kirana Hills exist along Sargodha-Faisalabad road. The River Jhelum flows on the northern and western, and the River Chenab lies on the eastern side of the district.

III. Research Design and Methods

This paper focuses on the comparisons of popular remote sensing sensors, commonly adopted image processing methods and prevailing classification accuracy assessments. The basic concepts, available imagery sources and classification techniques of remote sensing imagery related to vegetation mapping were introduced, analyzed and compared (Xie, 2008). The advantages and limitations of using remote sensing imagery (Schowengerdt, 1983; Campbell, 1987; Schowengerdt, 2006) for vegetation cover mapping were provided to iterate the importance of thorough understanding of the related concepts and careful design of the technical procedures, which can be utilized to study vegetation cover from remote sensed images (Xie, 2008).

Remote sensing imagery offer unique possibilities for spatial and temporal characterization of the changes. The basic requirement is the availability of different dates of imagery which permits continuous monitoring of change and environmental developments over time (Ayman and Ashraf, 2009). Change detection can be performed by restricting the analysis to a single sensor series or by using different satellite datasets. Two Landsat ETM+ scenes 1999 and 2002 for District Sargodha (path 150, row 37 and 38) were used to implement the vegetation indices. ERDAS Imagine and ENVI software have been used to generate the false colour composite by combining the near infrared, red and green bands (4, 3, 2 respectively) for Landsat ETM+ images. This was carried out for vegetation recognition, because chlorophyll in plants reflects very well for the near-infrared (NIR) band compared to the visible band of the electromagnetic spectrum (Hatfield et al., 1984). Vegetation indices were applied upon 1999 and 2002 ETM+ images and further change detection technique was used to develop the EVI, SAVI, NDVI and TNDVI maps.

In order to use these two scenes, several steps were followed to prepare for an accurate extraction and detection. These vital steps are: image registration, image enhancement and image mosaic as discussed by Macleod and Congalton (1998), Mahmoodzadeh (2007) and Al-Awadhi et al. (2011). These scenes were corrected and geo-referenced using projection UTM, zone 43 and datum WGS 84.

Methods incorporated in this research paper included the application of an automated MODIS (Terra) EVI/NDVI time series to support multi-temporal imagery analysis. MODIS (Terra) EVI/NDVI data preprocessing was conducted to provide a filtered and cleaned uninterrupted data stream to support multi-temporal or phenological analysis (MODIS, 1999).

MODIS (Terra) EVI/NDVI 16-days composite grid data in HDF format were acquired between February 2000 and February 2010 from the NASA Earth Observing System (EOS) data gateway. Details documenting the MODIS (Terra) EVI/NDVI compositing process and Quality Assessment Science Data Sets can be found at NASA's MODIS web site (MODIS, 1999; USGS, 2008).

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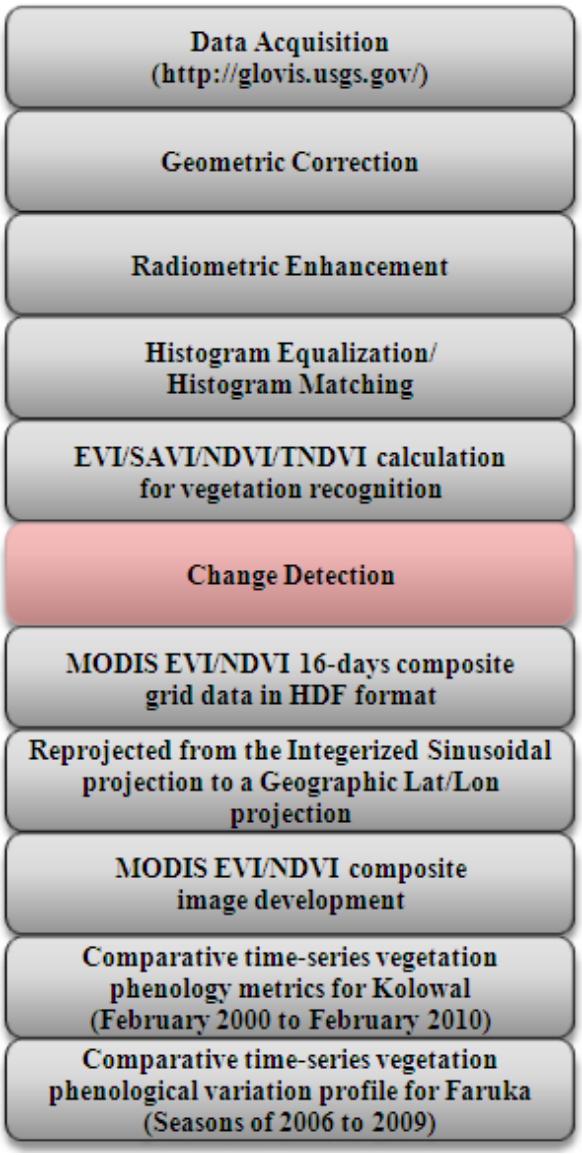

Figure 2 : Scheme for data and methodology

In this research paper (Figure 2), Landsat products have been applied for vegetation change detection assessment. Since Landsat has a long history of dataset, it is very helpful to map long-term vegetation cover and study the spatio-temporal vegetation changes (Schroeder et al., 2006; Xie, 2008). Landsat TM images, striding a long period of time from 1986 to 2002, were used to conduct quantitative analyses of wetland landscape patterns and their dynamic changes in the estuary of the Minjiang River (Zheng et al., 2006; Xie, 2008). Because of the different characteristics of spectral sensors in the Landsat image series, it is necessary to correct the spectral reflectance between images acquired by those sensors. This is especially necessary in long-term vegetation cover monitoring research where either Landsat TM or ETM+ images are used (Xie, 2008).

Spectral-based change detection techniques have tended to be performance limited in biologically complex ecosystems due, in larger part, to phenology-induced errors (Lunetta et al., 2002; Lunetta et al., 2002a; Lunetta et al., 2006). An important consideration for land cover change detection is the nominal temporal frequency of remote sensor data acquisitions required to adequately characterize change events (Lunetta et al., 2004; Lunetta et al., 2006). Ecosystem-specific regeneration rates are an important consideration for determining the required frequency of data collections to minimize errors. As part of the natural processes associated with vegetation dynamics, plants undergo intra-annual cycles. During different stages of vegetation growth, plant structures and associated pigment assemblages can vary significantly (Lunetta et al., 2006).

IV. Approach to Generating the Measurement

Vegetation Indices are seamless data products that are computed from the same mathematic formulae across all pixels in time and space, without prior assumptions of biome type, land cover condition, or soil type and thus represent actual, long-term measurements of the land surface (Huete et al., 2002). The VI product works optimally with cloud filtering, radiometric calibration, precise geolocation, and a snow mask. In addition, the product performs best using top-of-canopy reflectance inputs, corrected for atmospheric ozone, molecular scattering, aerosol, and water vapour (Huete et al., 2006). Hyperspectral vegetation research is still based on multi-spectral indices used as reference or contemporary data. These indices are readily adaptable to hyperspectral data but remain problematic in arid and semi-arid areas (Broge et al., 2000; McWire et al., 2000; Frank and Menz, 2003). Hyperspectral data could provide much more possibilities compared with multi-spectral data in detecting and quantifying sparse vegetation because it provides a continuous spectrum across a range in wavelengths (Kumar et al., 2001; Frank and Menz, 2003).

V. Results

Figure 3 shows change detection using EVI model. Landsat ETM+ images for 1999 and 2002 were used to extract temporal changes in District Sargodha. For balancing of an image, the geometric correction, radiometric enhancement, histogram equalization and histogram matching techniques were applied using ERDAS imagine software. The EVI model was applied upon Landsat ETM + 1999 and 2002 images and further change detection technique was used for extraction of land cover changes. The finding showed that during the period 1999 and 2002, increased vegetation and decreased vegetation percentage was same, while some increase > some decrease in district Sargodha (Figure 3 and Table 1). The result showed that the district Sargodha has a potential for agricultural

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enhancement especially in the areas adjacent to district Hafizabad and Gujrat, while western part of district Sargodha and adjacent to district Khushab, soil productively was decreasing.

Figure 4 shows change detection using SAVI model. For this experiment, Landsat ETM+ images for 1999 and 2002 were used. After geometric correction, SAVI model was applied upon ETM+ images and further change detection technique was used for extraction of potential agricultural sites in district Sargodha. The result showed that increased > decreased and some increase > some decrease. The SAVI model showed better performance than the EVI. The finding showed that central, northeastern and eastern part of the district has a great potential for agricultural enhancement, while the soil productively is lesser in southeastern and western part of district Sargodha. The value of *L* varies by the amount or cover of green vegetation: in very high vegetation regions, L=0; and in areas with no green vegetation, L=1. Generally, an L=0.5 works well in most situations and is the default value used (Huete, 1988). The SAVI is computed following the equation:

$$SAVI = (1 + L)*(NIR- R)/(NIR + R + L)$$

Rondeaux et al. (1996) introduced another model known as Optimized Soil-Adjusted Vegetation Index (OSAVI). The OSAVI is computed following the equation:

$$OSAVI = (NIR - R)/(NIR+ R+0.16)$$

The value L=0.16 appears to be the optimum adjusting factor for the SAVI family of indices. The OSAVI (Rondeaux et al., 1996) corresponds, in fact, to the Transformed Normalized Difference Vegetation Index (TSAVI) with the parameters a=1 and b=0, and is therefore not equivalent to the Normalized Difference Vegetation Index (NDVI).

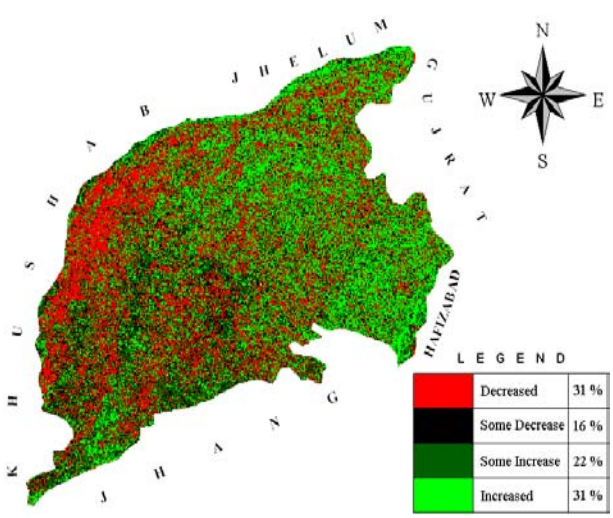

Figure 3 : Map showing change detection using EVI model

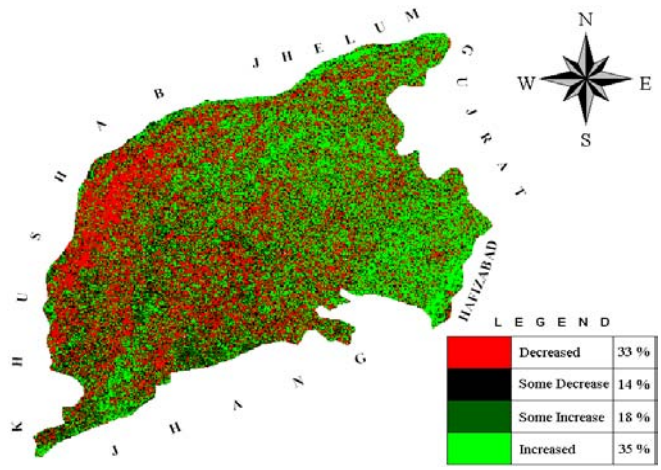

Figure 4 : Map showing change detection using SAVI model

Figure 5 shows change detection using NDVI model. In this experiment SAVI=NDVI (Huete, 1988). When L=0 makes SAVI equivalent to NDVI (Huete, 1988; Rondeaux et al., 1996). The NDVI (USGS (2010) approach is based on the fact that healthy vegetation has low reflectance in the visible portion of the EMS due to chlorophyll and other pigment absorption and has high reflectance in the NIR because of the internal reflectance by the mesophyll spongy tissue of green leaf. The NDVI can be calculated as a ratio of red and the NIR bands of a sensor system (Huete, 2005). The NDVI is related to the absorption of photosynthetically active radiation and basically measures the photo-synthetic capability of leaves, which is related to vegetative canopy resistance and water vapour transfer (Wan, 2003).

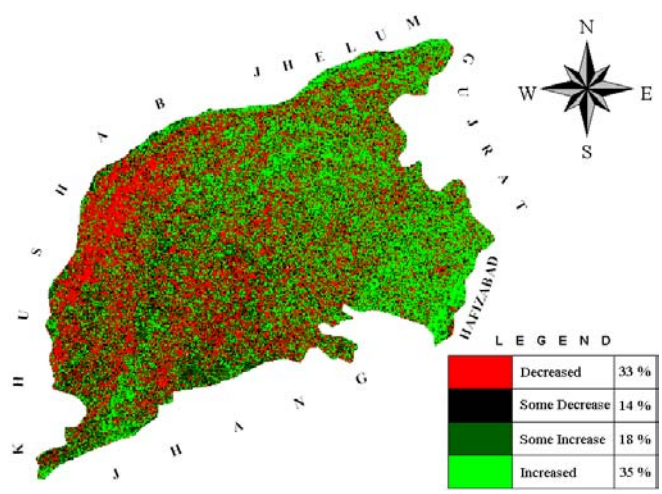

Figure 5 : Map showing change detection using NDVI model

Figure 6 shows change detection using TNDVI model. After geometric correction, TNDVI model was applied upon ETM+ 1999 and 2002 images and further change detection technique was used for extraction of

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soil potential sites in district Sargodha. The finding showed that increased > decreased and further some increase > some decrease. The TNDVI represents the vegetation biomass and is expressed as the ratio of near-IR reflection to red reflection (Tucker, 1979). Greenland (1994) expresses TNDVI as "an integrated function of photosynthesis, leaf area and evapotranspiration".

Table 1 : Vegetation matrix percentage for individual change classification

Vegetation Indices	Decreased (%)	Some Decrease (%)	Some Increase (%)	Increased (%)	Reference
EVI	31	16	22	31	Liu and Huete, 1995 Justice et al., 1998
SAVI	33	14	18	35	Huete, 1988
NDVI	33	14	18	35	Rouse et al., 1973
TNDVI	22	25	29	24	Tucker, 1979

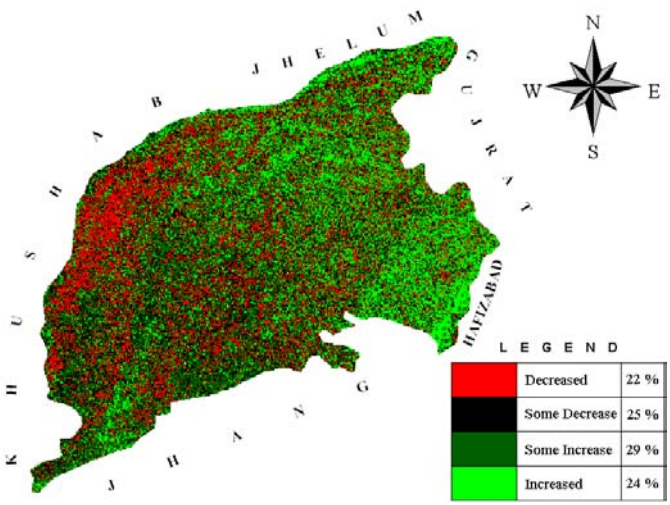

Figure 6 : Map showing change detection using TNDVI model

Figure 7 shows comparative analysis of vegetation indices. The modeling process is effective to estimate land cover from satellite images, even using a limited number of data (Bocco et al., 2007). The EVI is an 'optimized index' designed to enhance the vegetation signal with improved sensitivity in high biomass regions and improved vegetation monitoring through a de-coupling of the canopy background signal and a reduction in atmosphere influences (Liu and Huete, 1995; Justice et al., 1998; Huete et al., 1999).

Figure 7 : Comparative analysis of vegetation indices

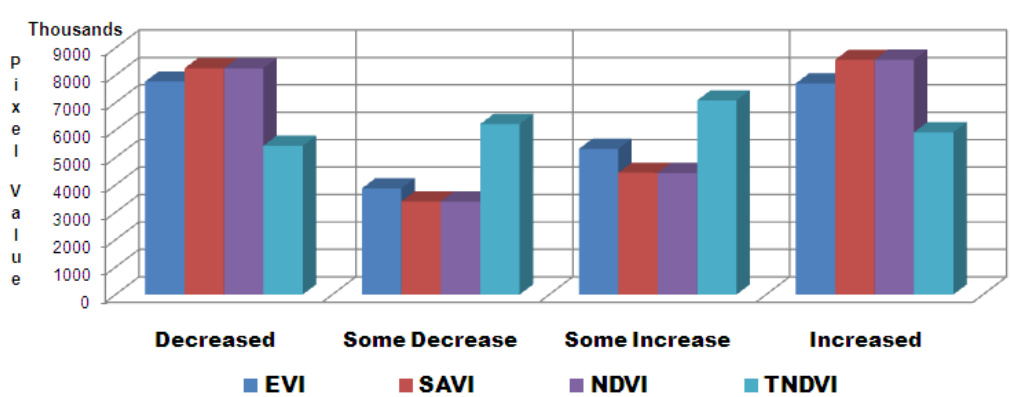

Figure 8 shows comparative time-series vegetation phenology metrics for Kolowal district Sargodha. In this vegetation phenology metrics EVI (Terra) 500 m and NDVI (Terra) 500 m data products for the seasons of 2000 to 2010 at 16-days interval have been evaluated for green cover fraction and biomass at the same location. The result showed that EVI differs from NDVI by attempting to correct for atmospheric and background effects. The EVI appears to be superior in discriminating subtle differences in areas of high vegetation density, situations in which NDVI tends to saturate. The NDVI has been used for several decades, which is advantageous for studying historical changes (Trishchenko et al., 2002). The EVI is a good indicator of the phenology of the land cover types, the research tested the contribution of EVI data to the land cover classification. Comparative time-series vegetation phenollogy metrics showed that climate was stable

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(start/end) and land degradation can't be seen during the seasons of 2000 to 2010. Variation in biomass and soil productivity can be seen due to summer monsoon and winter depression.

Figure 9 shows comparative time-series vegetation phenological variation profile for Faruka district Sargodha. In this vegetation index EVI (Terra) 250 m data product for the period 2006 to 2009 at 16-days interval have been evaluated for green cover fraction and biomass at the same location. The result showed that vegetation potential increased due to winter depression and summer monsoon. The impact of winter depression was stronger as compared to summer monsoon in district Sargodha. The climate was stable during the period 2006 to 2009 and land degradation can't be seen.

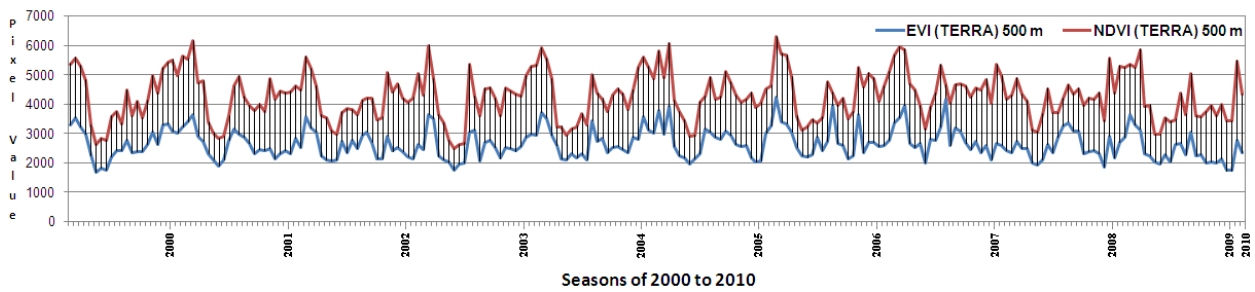

Figure 8 : Comparative time-series vegetation phenology metrics for Kolowal, District Sargodha

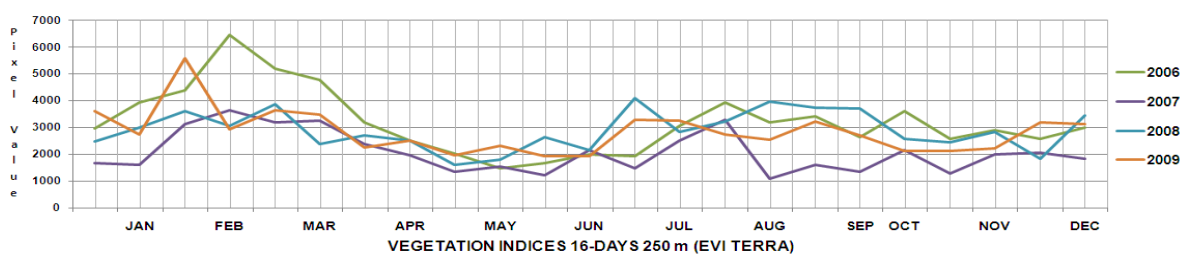

Figure 9 : Comparative time-series vegetation phenological variation profile for Faruka, District Sargodha

Phenology is the study of the times of recurring natural phenomena. One of the most successful of the approach is based on tracking the temporal change of a vegetation index such as NDVI or EVI. The evolution of vegetation index exhibits a strong correlation with the typical green vegetation growth stages. The results (temporal curves) can be analyzed to obtain useful information such as the start/end of vegetation growing season (Gao and Mas, 2008).

Figure 10 and 11 shows horizontal and vertical profile for Faruka district Sargodha. The profiles have been generated using ENVI software. Both the profile shows the variation in green cover fraction and biomass but showed that productivity was stable (start/end) and climatic variation can't be seen at this location. Pixel based digital extraction is the best technique for monitoring of climatic variation and vegetation stress. Hyperspectral imaging (Kruse, 1988) is a new technique in remote sensing that generates hundreds of spectral bands at different wavelength channels for the same area (Aspinall, 2002). In recent years, several efforts have been directed towards the incorporation of high performance computing models (Green et al., 1988; Harsanyi and Chang, 1994; Aspinall et al., 2002) in remote sensing missions (Aspinall et al., 2002; Marcus, 2002).

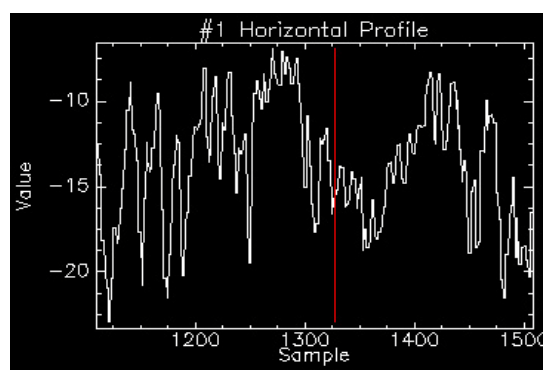

Figure 10 : Horizontal profile for Faruka

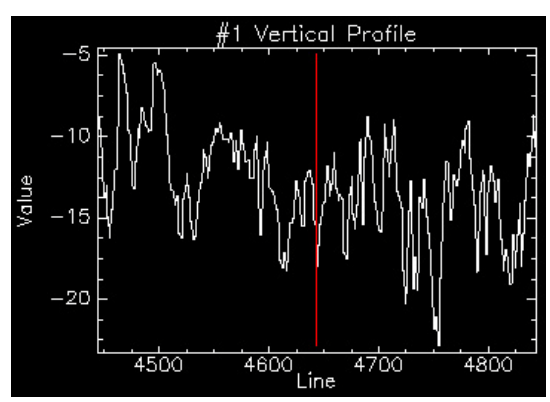

Figure 11 : Vertical profile for Faruka

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VI. Discussion and Conclusions

The availability of no-cost MODIS (Terra) EVI/NDVI data (MODIS, 1999) and new automated data processing techniques that provide high-quality continuous time series data represent a major advancement for the automated monitoring annual land cover change and vegetation condition. Major advantages of the EVI/NDVI based change detection approach presented in this research paper include (i) robust results, (ii) nominal computational requirements, (iii) automated data processing protocols, (iv) annual change alarm product capability, and (v) rapid product delivery (Lunetta et al., 2006). The importance of quantifying change omission errors is critical to the development of a robust assessment of change detection performance. It was shown that the multi-temporal and multi-sensor satellite data have a great success in biomass analysis (Akkartala et al., 2004).

Remote sensing change detection techniques can be broadly classified as either pre or post classification change methods. Pre-classification methods can further be characterized as being spectral or phenology based (Lunetta et al., 2006). The phenology metrics showed a clear relationship with the seasonality of rainfall, winter and summer growing seasons (Wessels et al., 2011).

When describing RS data it is useful to do so in terms of spatial, spectral, temporal, and radiometric resolution (Jensen, 1996; Prenzel, 2004). Collectively, these describe the most important features of RS data. Technological constraints associated with the sensor and platform have a large bearing on how these resolutions manifest themselves as part of the data. For satellite-based RS data, at least two key 'tradeoffs' emerge from these underlying technological challenges (Prenzel, 2004). One of the most important is that generally, the higher the spatial resolution, the lower the spatial coverage. This dramatically limits the breadth over which a particular change analysis can be conducted (Schowengerdt, 1983; Schowengerdt, 2006). The second important tradeoff is that the smaller the coverage, typically the longer the re-visitation time. This is important when RS data is required frequently (Campbell, 1987). Although there are other tradeoffs, these two are the most significant for change analysis studies. High-spatial resolution satellite systems have adopted pointable optics to compensate for the long periods of time required to revisit the same orbit track (Prenzel, 2004).

Landsat ETM+ different bands have used in order to estimate the vegetation quantities parameter based on vegetation indices. The gained result showed significant correlations between ETM+ bands and vegetation groups such as grasses, forbs, shrubs, and bushy trees (Solaimani et al., 2011). The NDVI is the most commonly used of all the VIs tested and its performance, due to non-systematic variation as described by Huete and Liu (1994) and Liu and Huete (1995). The soil background is a major surface component controlling the spectral behaviour of vegetation canopies and on which the retrieval of biophysical characteristics of the canopy depends. Although vegetation indices, such as the soil-adjusted (Huete, 1988) vegetation indices, considerably reduce these soils effects, estimation of the vegetation characteristics from the indices still suffers from some imprecision, especially at relatively low cover, if no information about the target is known (Rondeaux et al., 1996). This study focuses on change detection on pixel based methods using multi-temporal and multi-spectral images. Initial experimental results indicate that, the proposed indices perform sufficiently well in detecting changes on the test dataset.

VII. Acknowledgements

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Korea's Urban Regeneration Project on the Improvement of Urban Micro Climate: A Focal Study on the Case of Changwon City

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Keywords : urban regeneration project, urban micro climate, wind environment, KLAM_21, green city, stream restoration, green waterway.

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Korea's Urban Regeneration Project on the Improvement of Urban Micro Climate: A Focal Study on the Case of Changwon City

Daewuk Kim[α], Jiwon Ryu[σ], Jae-Gyu Cha[ρ] & Eung-Ho Jung[ω]

Abstract - The present study investigated Korea's urban regeneration project which combined social-economic-environmental regeneration and the efficiency of this project on the development of a green city. The study selected urban micro climate, which is closely related to urban public health and amenity, and analyzed the climate with cold wind speed as specified evaluation item to assess and compare its characteristics before and after the urban regeneration project. The result of analysis revealed the preferential need for a comprehensive plan which can reflect territorial and natural characteristics of a target area and its surroundings as they were found to be the base for a green city project. We concluded that a plan which adequately accounts for previously known conditions and combines additional eco-friendly methodologies can further promote green city projects and enhance the success of the relevant urban development projects.

Keywords : urban regeneration project, urban micro climate, wind environment, KLAM_21, green city, stream restoration, green waterway.

I. Introduction

Since 2008, Korean government has established and initiated diverse strategies to cope with potential climate changes under a low-carbon green growth paradigm. The green growth initiatives suggested a direction of urban development for green city development, and urban regeneration project has emerged as a mean of realizing a green city development.

The purpose of this study is to evaluate the efficacy of urban regeneration projects in terms of green city development in advance. The present study evaluates the improvements which resulted from planning factors of urban regeneration projects by specifically focusing on urban micro climate. Based on these results, the efficiency of urban regeneration projects on the development of green city is determined.

The study first introduces previous urban redevelopment policies and plans of Korea, and it discusses the significance of the urban regeneration projects. The investigation into the implications of urban micro climate on urban regeneration is followed by the case study of Changwon city on the improvements on urban micro climate. There are diverse methods to analyze urban micro climate but the present study conducts analysis based on the velocity of cold wind; hence, KLAM_21 model (Sievers, 2005), a method devised by the meteorological center of Germany to analyze and forecast the generation and flow of cold wind, is implemented to evaluate the improvement of urban micro climate.

II. History of Urban Regeneration Policies and Urban Regeneration (from Redevelopment to Regeneration)

The urban redevelopment project in Korea first started in the 1960's with the establishment of an urban planning act. The followings are chronological summary of redevelopment projects.

In the 1960's, urban redevelopment focused on redevelopment of substandard living districts and number of projects focused on the improvement of residential environment. In the 1970's, 'Urban Redevelopment Act' was legislated (1976) and urban redevelopments were covered comprehensively and systematically within the boundary of urban planning policies. In the 1980's, 'Temporary Measures for Residential Improvement for Low-Income Citizens' was legislated to carry out residential improvement projects for low-income families (Go, 2008; Kim, 2011).

In the 2000's, 'Maintenance and Improvement of Urban Areas and Dwelling Conditions for Residents Act' was established (2002) to integrate urban redevelopment, reconstruction and residential environment improvement projects, which were poorly evaluated. Furthermore, 'Special Act on the Promotion of Urban Renewal' was established (2005) to promote the urban rehabilitation project locally and nationally.

In the 2010's, the basis urban planning began to be shifted from physical redevelopment and rehabilitation to a sustainable regeneration with the goal of socio-economic and environmental comprehensive

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redevelopment. The legal basis supporting such initiative, 'Special Act on the Support and Activation of Urban Regeneration', has been proposed on June of 2012 and it is currently under deliberation (Kim, J.Y., & Nam, Y.W., 2012).

Urban regeneration policies in Korea have followed in the footsteps of 'Redevelopment to Regeneration' as suggested by Roberts (Roberts, 2000, p.14) and number of research and projects are being conducted (Kim, M.S., & Lee, W.H., 2012; Seo, J.K., 2006; Kye, K.S., 2010; An, H.S., 2012).

III. Urban Micro Climate in Urban Regeneration

The urban regeneration paradigm has shifted to secure sustainable living conditions of existing residents and to promote socio-cultural and economic activation. The current urban generation philosophy can be divided into environmental regeneration, economic regeneration and regeneration of urban living spaces (Kim, S.W. et al., 2011).

Environmental regeneration stresses the importance of environmental factors and the restoration of environment's genuine functionalities. It is vital to focus on the environmental factors for the conversion to a green city, especially for the improved quality of citizen's lives, and urban micro climate is assumed to play a pivotal role in the environmental terms.

Urban micro climate referred in this study is not restricted to its traditional sense in meteorology, but a climate directly affected by urban development practices, such as representative factors of wind and temperature. One of the urban problems resulted from the changes in urban climate is urban heat island and the influx of cold wind from mountain areas is important to address urban heat island. Cold wind can reduce the temperature in the urban centers, and ultimately address the issues of urban heat island. Recently, the importance of cold wind from nearby mountainous areas has been discussed widely (Oke, 1987, pp.284-297).

To sum up, urban micro climate is important for promoting an eco-friendly green city, which can promote the pleasantness and health of urban life. Therefore, it is necessary to analyze diverse approaches to improve urban micro climate and analyze the improvement effects.

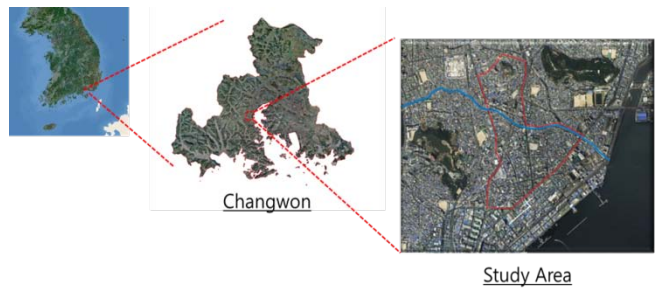
IV. Case Study : Improvement Effects of Urban Micro Climate Based on Urban Regeneration Factors

a) *Overview of the Target Area*

The target area is an urban regeneration project area in Changwon city, located in the southern part of Korea. The city has a population of 1,095,733 and total land area of 747.21km^2. It is a typical coastal city facing ocean to the east and the south.

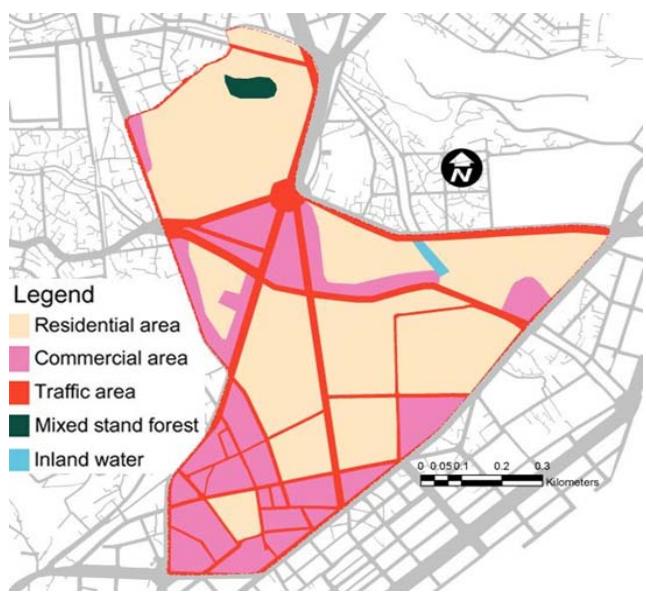
The target area is located at the center of Changwon city, with 0.54 km^2 area and a population of 21,453, and it is an urbanized area with typical residential and commercial places.

Figure 1 : Location of Study Area



As for the land use patterns, 59.2% are residential areas, 23.7% are commercial areas, and 15.6% are transportation-related area. The environmental condition is relatively poor with mixed stand forest and inland trees occupying less than 1% of proportion respectively (Fig. 2).

Figure 2 : Land Use Patterns of Study Area



With an elevation of 11m to 40m, the target area has a typical costal topography with a gentle slope descending from north to south (Fig. 3).

b) *Meteorology of the Target Area*

Monthly wind patterns of the area in 2011, based on the data from Korea Meteorological Association, can be represented in the figure 4. On average, southeaster winds with speed of 2.02 m/s blows into the area.

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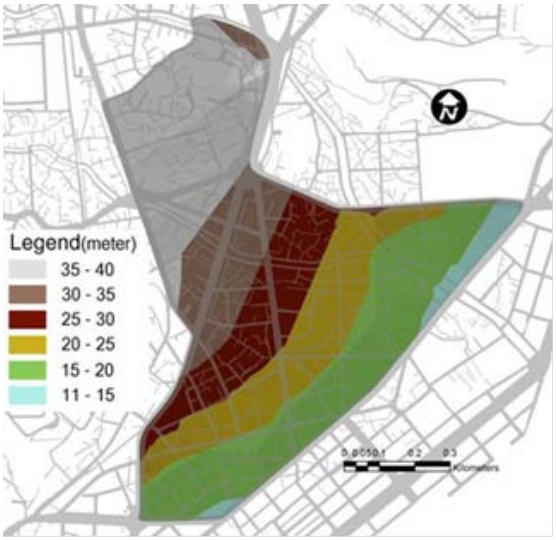
Divided by months, from January to March tends to be northeaster wind, from April to July southerly wind, in August westerly wind, and from September to December southeaster wind.

Figure 3 : Topography of Study Area



c) Planning Factors of Urban Regeneration

The goal of the urban regeneration project in the target area is to improve the quality of life and to reactivate the commercial district in deteriorating economy through restoration and regeneration of residential and commercial areas. The urban regeneration project in the area has the following urban planning factors.

- Factor Ⅰ: Green parking space project in the deteriorating residential areas in Nosan-dong
- Factor Ⅱ: Restoration of ecology of Gyobang stream
- Factor Ⅲ: Green Waterway project for Chang-dong and Odong-dong

i. *Factor Ⅰ: Green parking space project in the deterioration residential areas in Nosan-dong*

The project refers to the replacement of the 1 public parking space within the deteriorating residential area and 3 parking spaces annexed to the church into an eco-friendly area such as grass blocks. Through this project, more green spaces are established with expected result of considerable improvement of the pleasantness and amenity. Especially, the public parking spaces are planned to introduce a renewable energy generator using the solar power. The specific location and area of the generation facility is represented in the following figure 5.

Figure 4 : Wind Patterns of Study Area(Year 2011)

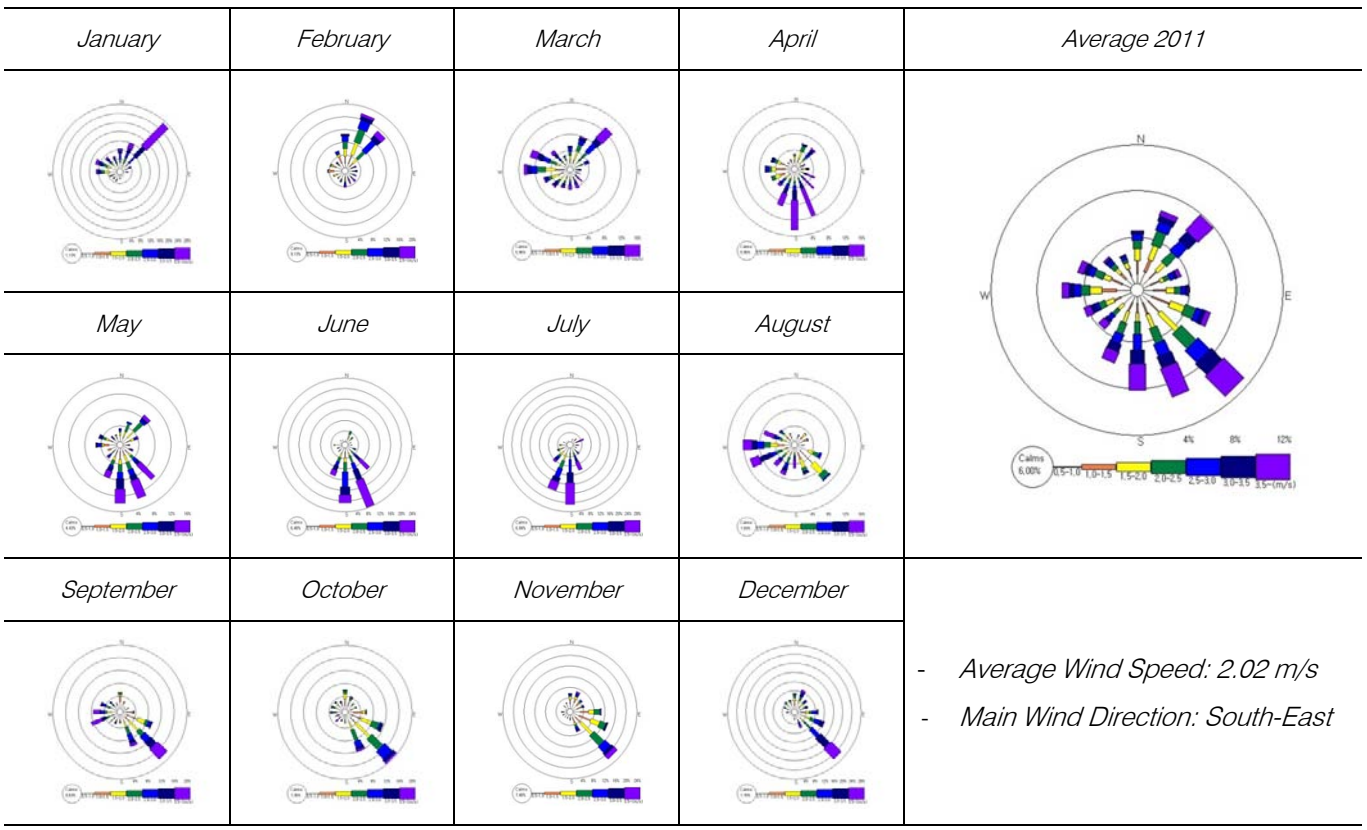


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Figure 5 : Location & Area of Green parking space

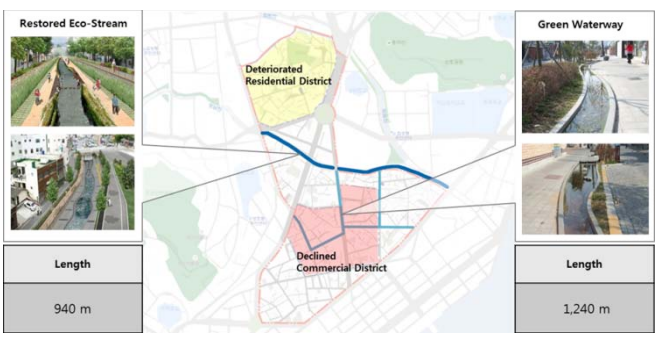
ii. *FactorⅡ: Restoration of ecology of Gyobang stream*

The restoration plan is to reinstate Gyobang stream, a covered stream running through the existing commercial district. A covered stream is a reminiscent of the rapid industrialization and urbanization in Korea and it refers to a stream which is covered with concrete to be transformed into a road for the city transportation.

Since 2000, considerable public interest focused on the pleasant and freshness of urban environments, and the projects to restore covered streams initiated with Cheonggye stream restoration project.

Gyobang stream in the target area was also decided to be restored in this respective, and the stream will be restored to a water-friendly space with walking paths. The stream is 0.94 km in length and the location is shown in the Fig. 6

Figure 6 : Location of Gyobang stream and Green Waterway



iii. *FactorⅢ: Green Waterway project for Chang-dong and Odong-dong*

Green Waterway project is the construction of a blue network by connecting the waterway to Gyobang stream. It will create pleasantness and cleanness by providing water spaces in the existing commercial district in addition to creating landmark water-friendly spaces without cars. Continuous provision of water streams will be supplied by green facilities using residential water and underground water. Total length of the stream is 1.24 km and location is presented in the figure 6.

d) Conditions for Analysis of Urban Micro Climate Based on the Planning Factors

The analysis factors for evaluating the improvement effects of urban micro climate based on the planning factors are diverse but the present study selected wind as the sole factor for the analysis.

Specifically, the present study focuses on the speed of the cold wind from nearby mountainous areas after a sunset in the summer season, hence makes use of a model appropriate for cold wind generation and flow. The implemented model is developed in Germany and it has a high reliability in analyzing and forecasting the origins and flow of cold winds in urban circumstances.

The modeling conditions for the cold wind speed analysis are represented in the following table 1. The major feature is the fact that local winds are considered to solely reflect the local characteristics in the model. The initial value for the local wind in the simulation is based on the 2011 KMA data of Changwon city.

The total duration of the simulation is set to 8 hours, starting from 20:00 when cold wind normally occurs and blows in the summer after sunset, and ending at 04:00 right before the dawn when the wind generation and flow is stopped.

Table 1 : Modeling Conditions for the Analysis of Cold Wind Speed

Items		Description
Adopted Model		KLAM_21
Range of Analysis	Area	0.93 ㎢
	Height	5m
Grid	Number of grids	429 X 542
	Interval	20m
Local Wind	Direction	135°(southeaster wind)
	Velocity	2.02 ㎧
Time	Start	8:00 PM (after sunset in summer)
	End	4:00 AM (right before the dawn in summer)
	Duration of Simulation	8 hours

e) Analysis of the Results of the Improvement of Urban Micro Climate Based on the Planning Factors

Based on the modeling conditions, the following analysis results are summarized according to the planning factors.

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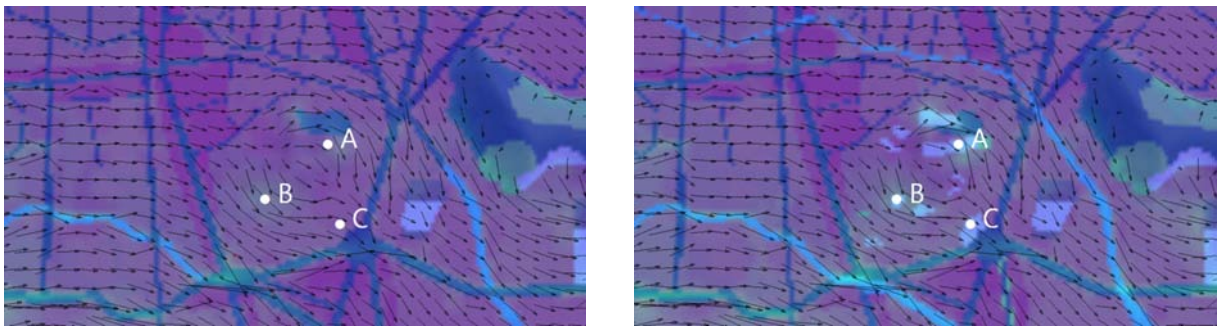
i. *Improvement Effects of Urban Micro Climate by Factor I*

The micro climate improvement effects were analyzed by comparing the speed of the cold wind in the three locations before and after the project. The results are represented in the following figure 7.

Figure 7 : Simulation Result of Cold Wind Speed by Factor I



Before After

First of all, within one hour after sunset, the cold wind reduced slightly after the project but the speed of the wind started to increase at 22:00, 2 hours after sunset. The difference in the speed of the wind was exhibited at 22:00 in location A with 5.6% increase rate while 14.5% in location B. Such differences remained consistent until at 04:00, right before the sunset, where it showed the greatest difference of with 17.4% increase rate. At the location C, the increase rate reached 4% at 22:00 similar to the other locations, and the rate was maintained until the time right before the dawn (see Tab. 3).

Comparing the measurements in different locations, the major differences were found in the location B located right behind a hill, with the average increase rate of 10.0%. The location C with the greatest area of green parking space was next with average increase rate of 9.5%. The differences of the speed of cold wind by time and location are summarized in the igure 10 where we can assume the speed of the cold wind to increase to some extent when the ground covers of the parking lots were changed from concrete to eco-friendly areas such as grass blocks.

In conclusion, it is crucial to consider territorial conditions for improved urban micro climate effects through increased speed of cold wind, and to reflect the area of the eco-friendly ground coverage.

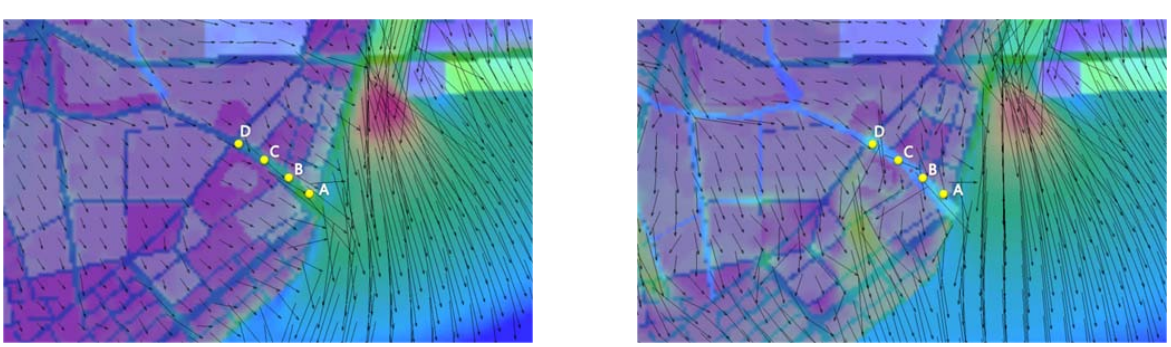
a) *Improvement Effects of Urban Micro Climate by Factor II*

The Gyobang stream, located to the southeast of the target area, is an urban stream in an ecologically important geography; however, it is still partly covered to provide paths for the vehicle and pedestrian transportation in the city.

The restoration plan has been established to restore the stream as an ecologically sustainable stream and to provide pleasant water-friendly space for the residents.

Four locations were chosen for the analyses of the speed of the cold wind as shown in the following figure 8. The characteristics of the four locations chosen for the comparison are as follows. The location A is situated in a coastal area facing the ocean. Moving northwest towards the city center from the location A following Gyobang stream, the locations B, C, D are located in the respective order.

Figure 8 : Simulation Result of Cold Wind Speed by Factor II



Before After

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According to the analysis results of each location, excluding the location D, all three locations (A, B and C) showed reduced cold wind speed when the comparison of the speed before and after the project was made. This may be a result of the characteristics of coastal areas; the roughness of interface between the surfaces of the sea and streams is increased after the project, thus obstructing the influx of the cold wind from streams in the northeast of the target area to the sea. On the other hand, the location D located in an established area, not in the coastal ones, exhibited an increase in the wind speed by 73% after the project, when the comparison of the measurement before the project was made.

Time analysis result showed that from 22:00, 2 hours after the sunset, the cold wind speed in the location D started to increase, while, in location A and C, the speed started to decrease from 23:00, 3 hours after the sunset, when compared to the speed before the project. In the location B, the speed slightly increased by 12% to 1.32m/s and steadily reduced from 23:00, compared to the previous speed (see Tab. 4).

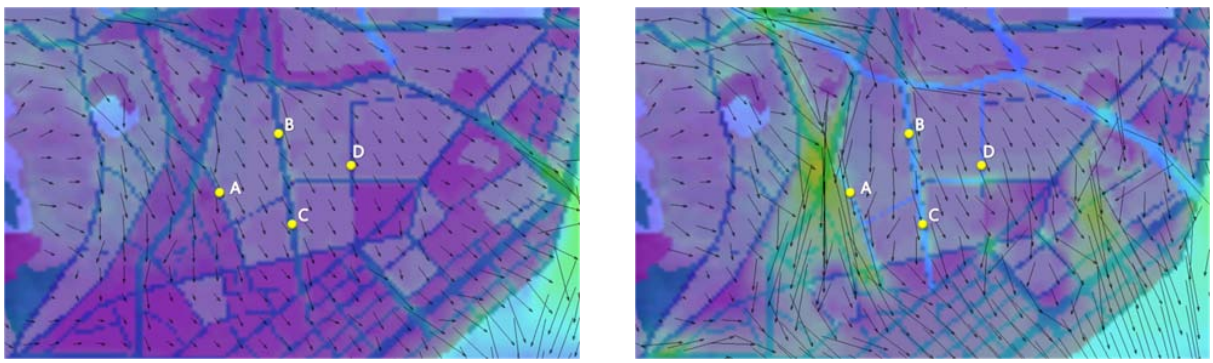
The analysis of results concluded that in all the locations, except for D, the stream restoration project had no significant impact on the improvement of the cold wind speed (see Fig. 11). This is probably due to the disturbance by the characteristics of coastal areas and surrounding area, hence a more detailed plans and strategies to cope with this problem are required.

b) Improvement Effects of Urban Micro Climate by Factor III

The Chang-dong and Odong-dong Green Waterway Project was established to create a streamlet along the part of the inner road to reactivate the deteriorating commercial district and to create more pleasant urban spaces. The present study measured the speed of cold wind in four locations in the target areas to evaluate the improvement effects from the green waterway development project.

The four locations are represented in the following figure 9; two locations are in the south-north line in the space which represents the locality (location B and C in the figure); one is in the Odong Buk-gil (location D); and another one in the Chang-dong Geori Gil (location A).

Figure 9 : Simulation Result of Cold Wind Speed by Factor III



Before After

According to the measurement results of each location, the speed of the wind increased in all four locations after the stream development project. Especially in the location D, the increases rate was the highest with average of 179.6%. Such a result implied that the location D was the place where the development plan affected most directly.

The speed of cold wind increased steadily as time elapsed in all locations and the differences also increased slightly. Especially in the location D, within an hour after sunset, the cold wind was most created and the difference was up to 746.4%, and the increase rate maintained at around 170%. The result suggested that the area was the most effected by the development project (see Tab. 5).

According to these results, we can assume that the green waterway development contributed to the overall increase in the speed of cold wind in all the four locations. Especially in the location D, situated in the

Odong-buk 5 gil, the improvement effect was the highest possibly due the stream development of the Gyobang stream largely affecting the speed of cold wind. This result directly demonstrated the importance of nearby natural resources in the urban micro climate improvement, and it can be suggested that this implication should be reflected in the relevant projects to maximize the improvement effects of urban micro climate (see Fig. 12).

c) Comprehensive Discussion on the Analysis Results on Urban Micro Climate

- Green Parking Space Project is targeted on an area in relatively high altitude, which can be classified as a hill, and the area has the characteristic of being

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windy. Although the level of improvement varied according to the location, the speed of the cold wind improved by around 10% on average after the project. The result represents the possibility that the speed of the cold wind can be an urban planning factor which can be ultimately used for the improvement of urban micro climate.

- The analysis of the result of the improvement effects by the Gyobang Stream Restoration Project demonstrated more significant effects in established locations and lesser effects in coastal area. However, as for the established locations, the wind speed improved by 73% after the project. The result suggests increase in the proximity to coastal region results in lower improvement effects. The roughness of interface between the surfaces of the sea and streams increased after the project, which resulted in the obstruction of the influx of the cold wind from streams in the northeast of the target area to the sea. Therefore, a more reasonable approach to handle these characteristics of coastal areas for the improved urban micro climate is needed in the future.
- In the Chang-dong and Odong-dong Green Waterway development project, the stream played the role of passage for the cold wind to travel, resulting in the increase in the wind speed by an average of 40% in all of the four locations. The result suggested that the possibility of green waterway project as not only improving the flow of cold winds and but also serving as a planning factor that contributes to the improvement urban micro climate (Tab. 2).

V. Conclusion

The present study demonstrates the shift in urban regeneration policies from physical redevelopment to social-economic-environmental regeneration, and shows that this is now a major paradigm for urban development. The present study evaluates planning factors of urban regeneration projects in Changwon city, a coastal city in the southern part of Korea to investigate whether the urban regeneration project can pave the way for a green city development.

The present study selected urban micro climate as an evaluation factor for a green city development, and speed of cold wind, which can address the urban heat island phenomenon, as specified evaluation item for the precise analysis of the improvement effect of urban micro climate.

The analysis result suggested that Green Parking Space Plan and Green Waterway projects increased the speed of cold wind, thus improving the micro climate. On the other hand, stream restoration project had no significant effect on the speed of cold wind as it even reduced the wind in 3 out of 4 targeted locations, which was probably due to the local territorial characteristics and their interferences.

According to the analysis results, the need for a comprehensive plan which can reflect territorial and natural characteristics of target area and its surrounding areas seemed eminent for the creation of green city project in the true sense. In conclusion, we can assume that when based on such plans, eco-friendly planning methodologies can promote green city projects and determine the success of the relevant development urban projects. These projects will pave the way for a green city development where healthy and pleasant environment is ensured.

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Websites

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2. Korea urban renaissance center: http://kourc.or.kr

Table 2 : Overall Improvement of Cold Wind Speed by Urban Regeneration Planning Factors

		60Min.	120Min.	180Min.	240Min.	300Min.	360Min.	420Min.	480Min.	Mean
Ⅰ	A	-0.3%	5.6%)	3.6%	2.5%	3.8%	2.5%	3.9%	3.9%	3.1%
	B	-19.5%	14.5%	13.9%	14.4%	16.0%	16.3%	16.7%	17.4%	10.0%
	C	-	4.7%	3.9%	5.1%	4.8%	4.4%	4.9%	4.9%	9.5%
Ⅱ	A	-	-20.9%	-28.2%	-28.0%	-28.7%	-28.8%	-29.0%	-29.3%	-23.5%
	B	-	12.3%	-6.5%	-7.0%	-6.5%	-7.0%	-6.6%	-6.2%	0.8%
	C	-	-42.4%	-37.0%	-35.5%	-34.9%	-34.4%	-34.2%	-34.2%	-32.0%
	D	-	46.2%	66.1%	65.9%	65.9%	64.7%	64.2%	64.2%	72.9%
Ⅲ	A	-	-8.5%	19.1%	29.7%	36.3%	38.9%	41.5%	41.5%	39.5%
	B	-	25.6%	40.8%	42.0%	42.0%	42.3%	43.7%	43.7%	47.3%
	C	700.0%	52.3%	96.4%	104.5%	110.5%	110.5%	110.5%	110.5%	108.6%
	D	746.4%	123.8%	177.2%	177.4%	177.9%	175.6%	175.6%	175.6%	179.6%

Table 3 : Comparison of Changes in the Speed of Cold Wind by Factor Ⅰ (Unit: m/s)

		60Min.	120Min.	180Min.	240Min.	300Min.	360Min.	420Min.	480Min.	Mean
A	Before	0.706	0.611	0.588	0.566	0.552	0.552	0.545	0.545	0.583
	After	0.704	0.645	0.609	0.580	0.573	0.566	0.566	0.566	0.601
	Increment (Rate)	-0.002 (-0.3%)	0.034 (5.6%)	0.021 (3.6%)	0.014 (2.5%)	0.021 (3.8%)	0.014 (2.5%)	0.021 (3.9%)	0.021 (3.9%)	0.018 (3.1%)
B	Before	0.570	0.690	0.512	0.439	0.412	0.405	0.396	0.396	0.478
	After	0.459	0.790	0.583	0.502	0.478	0.471	0.462	0.465	0.526
	Increment (Rate)	-0.111 (-19.5%)	0.100 (14.5%)	0.071 (13.9%)	0.063 (14.4%)	0.066 (16.0%)	0.066 (16.3%)	0.066 (16.7%)	0.069 (17.4%)	0.048 (10.0%)
C	Before	0.000	0.729	0.611	0.572	0.560	0.550	0.547	0.547	0.515
	After	0.199	0.763	0.635	0.601	0.587	0.574	0.574	0.574	0.563
	Increment (Rate)	0.199 (-)	0.034 (4.7%)	0.024 (3.9%)	0.029 (5.1%)	0.027 (4.8%)	0.024 (4.4%)	0.027 (4.9%)	0.027 (4.9%)	0.049 (9.5%)

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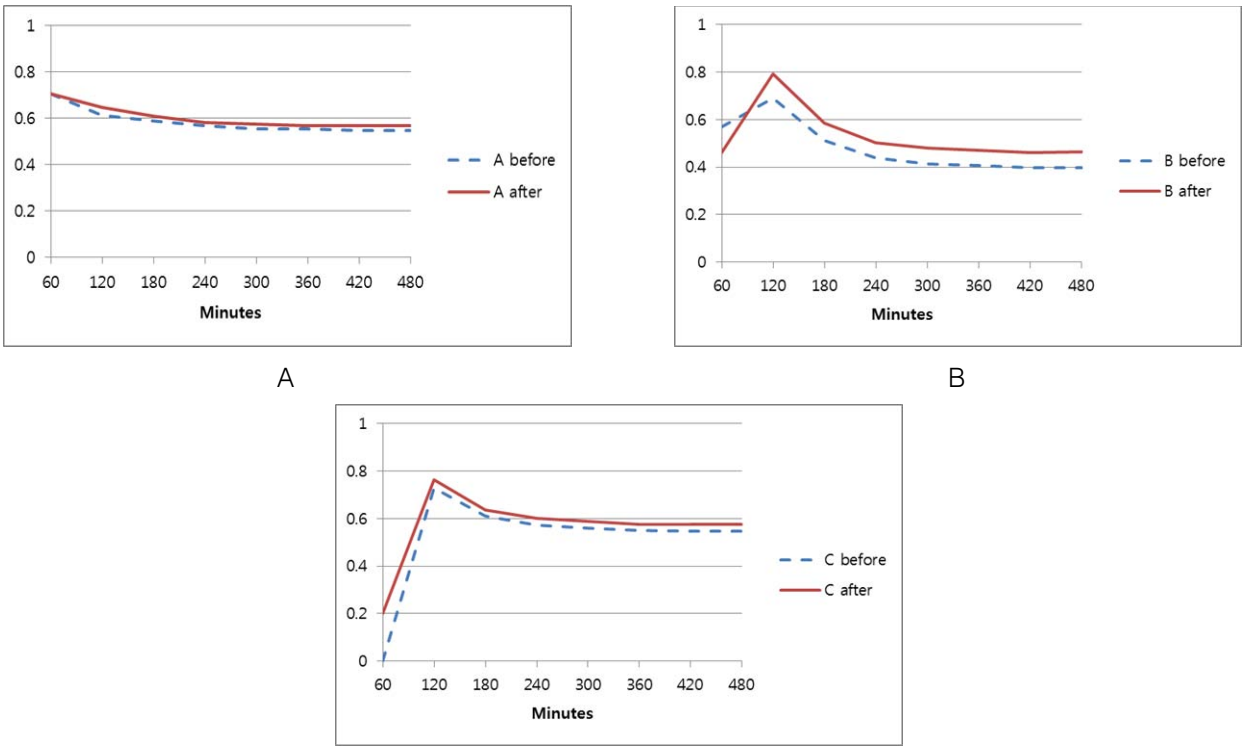
Figure 10 : Simulation Results Comparison of Cold Wind Speed between Before and After by Factor Ⅰ



A B C

Table 4 : Comparison of Changes in the Speed of Cold Wind by Factor Ⅱ (Unit: m/s)

		60Min.	120Min.	180Min.	240Min.	300Min.	360Min.	420Min.	480Min.	Mean
A	Before	0.000	1.454	2.032	2.168	2.238	2.266	2.287	2.295	1.474
	After	0.633	1.150	1.458	1.562	1.596	1.613	1.623	1.623	1.127
	Increment (Rate)	0.633 -	-0.304 (-20.9%)	-0.574 (-28.2%)	-0.606 (-28.0%)	-0.642 (-28.7%)	-0.653 (-28.8%)	-0.664 (-29.0%)	-0.672 (-29.3%)	-0.347 (-23.5%)
B	Before	0.000	1.174	1.634	1.634	1.620	1.620	1.613	1.606	1.090
	After	0.457	1.318	1.528	1.519	1.515	1.506	1.506	1.506	1.099
	Increment (Rate)	0.457 -	0.144 (12.3%)	-0.106 (-6.5%)	-0.115 (-7.0%)	-0.105 (-6.5%)	-0.114 (-7.0%)	-0.107 (-6.6%)	-0.100 (-6.2%)	0.009 (0.8%)
C	Before	0.000	1.586	1.685	1.657	1.643	1.629	1.629	1.629	1.146
	After	0.224	0.914	1.062	1.069	1.069	1.069	1.072	1.072	0.779
	Increment (Rate)	0.224 -	-0.672 (-42.4%)	-0.623 (-37.0%)	-0.588 (-35.5%)	-0.574 (-34.9%)	-0.560 (-34.4%)	-0.557 (-34.2%)	-0.557 (-34.2%)	-0.367 (-32.0%)
D	Before	0.000	0.835	0.778	0.771	0.771	0.771	0.771	0.771	0.547
	After	0.236	1.221	1.292	1.279	1.279	1.270	1.266	1.266	0.946
	Increment (Rate)	0.236 -	0.386 (46.2%)	0.514 (66.1%)	0.508 (65.9%)	0.508 (65.9%)	0.499 (64.7%)	0.495 (64.2%)	0.495 (64.2%)	0.399 (72.9%)

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Figure 11 : Simulation Results Comparison of Cold Wind Speed between Before and After by Factor II

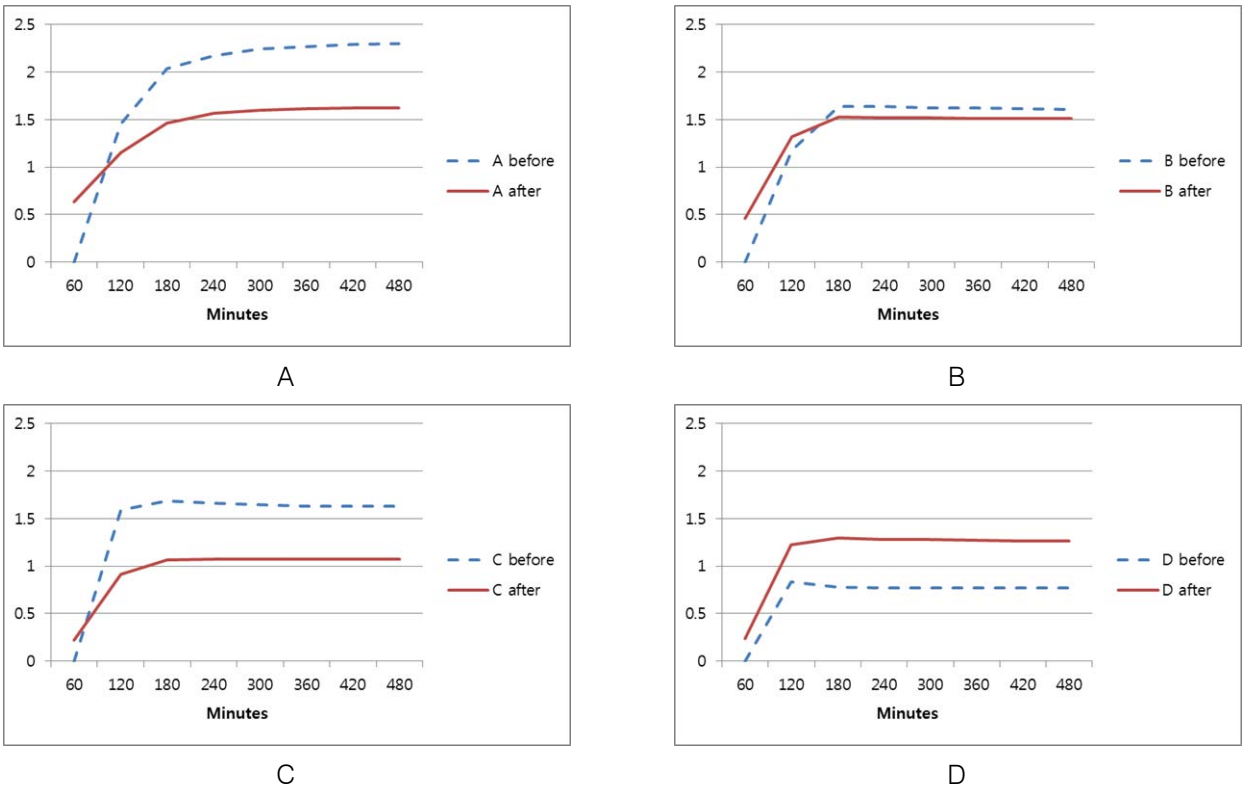

Table 5 : Comparison of Changes in the Speed of Cold Wind by Factor III (Unit: m/s)

		60Min.	120Min.	180Min.	240Min.	300Min.	360Min.	420Min.	480Min.	Mean
A	Before	0.000	0.749	0.650	0.623	0.609	0.604	0.595	0.595	0.443
	After	0.264	0.684	0.774	0.808	0.830	0.839	0.842	0.842	0.617
	Increment (Rate)	0.264 -	-0.064 (-8.5%)	0.124 (19.1%)	0.185 (29.7%)	0.221 (36.3%)	0.235 (38.9%)	0.247 (41.5%)	0.247 (41.5%)	0.175 (39.5%)
B	Before	0.000	1.180	1.048	1.031	1.031	1.028	1.019	1.019	0.735
	After	0.441	1.481	1.476	1.464	1.464	1.464	1.464	1.464	1.083
	Increment (Rate)	0.441 -	0.302 (25.6%)	0.428 (40.8%)	0.433 (42.0%)	0.433 (42.0%)	0.435 (42.3%)	0.445 (43.7%)	0.445 (43.7%)	0.348 (47.3%)
C	Before	0.014	0.721	0.603	0.598	0.592	0.592	0.592	0.592	0.430
	After	0.112	1.099	1.184	1.223	1.246	1.246	1.246	1.246	0.897
	Increment (Rate)	0.098 (700.0%)	0.377 (52.3%)	0.581 (96.4%)	0.625 (104.5%)	0.654 (110.5%)	0.654 (110.5%)	0.654 (110.5%)	0.654 (110.5%)	0.467 (108.6%)
D	Before	0.028	0.496	0.403	0.398	0.394	0.394	0.394	0.394	0.294
	After	0.238	1.110	1.117	1.104	1.095	1.085	1.085	1.085	0.821
	Increment (Rate)	0.209 (746.4%)	0.614 (123.8%)	0.714 (177.2%)	0.706 (177.4%)	0.701 (177.9%)	0.692 (175.6%)	0.692 (175.6%)	0.692 (175.6%)	0.528 (179.6%)

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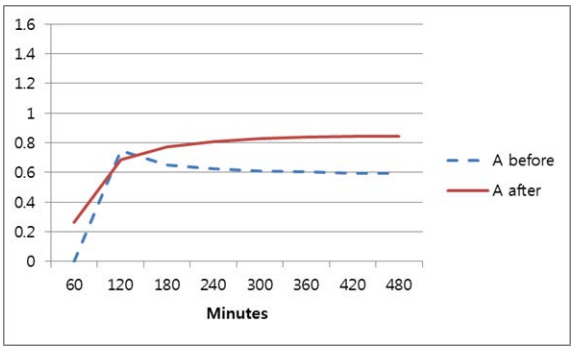
Figure 12 : Simulation Results Comparison of Cold Wind Speed between Before and After by Factor III



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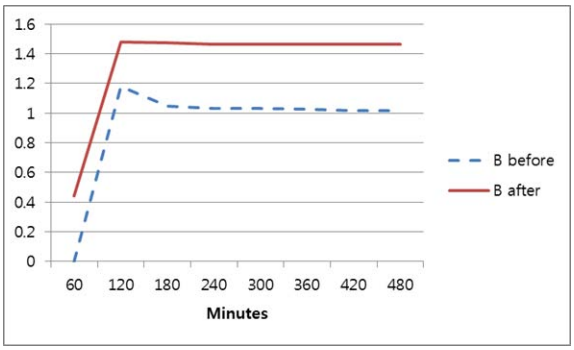

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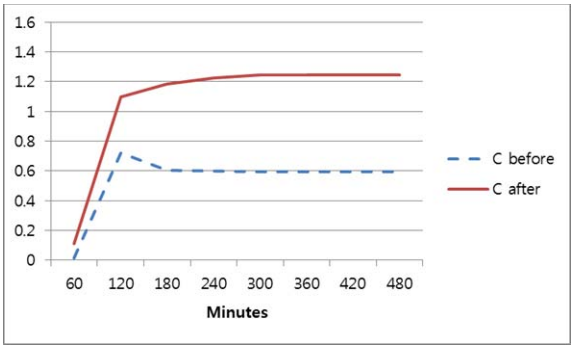

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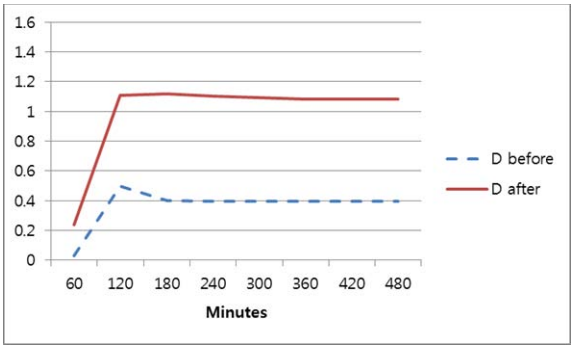

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Perceived Effects of Climate Change on Transhumance Pastoralists in Ogun State, Nigeria

By Ayanda, I. F. , Oyeyinka, R. A. , Salau, S. A. & Ojo, F.
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Abstract - The study examined perceived effects of climate change on grazing land, herds' performance and examined the coping strategies of the pastoralists to climate change. Multi-stage sampling technique was used to select 120 respondents for the study. Data were analyzed using percentages, frequencies, tables and Chi square statistical tools. The result of the study showed that 37.5% of the respondents were between the ages of 51-60 years with an average age of 49.8 years. The results revealed that 67.5% of the pastoralists strongly agreed that the pattern of rainfall in recent time affects pasture availability. Consequently 47.5% and 52.5% of them reported a decrease in milk production and increase in herd's mortality rate respectively due to the effect of climate change. A significance relationship was established between factors of climate change and milk production of the herd (calculated x2 = 52.00, tabulated x2=7.8147. $p \leq 0.05$). It is therefore recommended that the pastoralists be trained in forage conservation techniques. They should also be encouraged to pool their resources to enjoy economics of scale by the extension workers. Grazing reserves should be developed by the government to fast track the disposition of the pastoralists to sedentary life.

Keywords : pastoralist, climate, transhumance, change, nigeria.

GJHSS-B Classification : FOR Code : 760101

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Perceived Effects of Climate Change on Transhumance Pastoralists in Ogun State, Nigeria

Ayanda, I. F. [α], Oyeyinka, R. A. [σ], Salau, S. A. [ρ] & Ojo, F. [ω]

Abstract - The study examined perceived effects of climate change on grazing land, herds' performance and examined the coping strategies of the pastoralists to climate change. Multi-stage sampling technique was used to select 120 respondents for the study. Data were analyzed using percentages, frequencies, tables and Chi square statistical tools. The result of the study showed that 37.5% of the respondents were between the ages of 51-60 years with an average age of 49.8 years. The results revealed that 67.5% of the pastoralists strongly agreed that the pattern of rainfall in recent time affects pasture availability. Consequently 47.5% and 52.5% of them reported a decrease in milk production and increase in herd's mortality rate respectively due to the effect of climate change. A significance relationship was established between factors of climate change and milk production of the herd (calculated x^2 = 52.00, tabulated x^2=7.8147. $p \leq 0.05$). It is therefore recommended that the pastoralists be trained in forage conservation techniques. They should also be encouraged to pool their resources to enjoy economics of scale by the extension workers. Grazing reserves should be developed by the government to fast track the disposition of the pastoralists to sedentary life.

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I. Introduction

The world is witnessing the adverse effects of climate change which include frequency and intensity of storm, thunder, flood, drought, hurricanes, increased frequency of fire, poverty, malnutrition, reduced agriculture productivities, water need and supply, adverse effects on grazing land and pasture quality. Climate change also led to rise in sea level. It had a cumulative effect on natural resources and disruption of eco-system. The impact of climate change can be vast in Nigeria, this means that some stable ecosystems such as the Sahel Savanna may become vulnerable because warming will reinforce existing patterns of water scarcity, increasing the risk of drought in Nigeria and most countries in West Africa (BNRCC, 2008).

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Climate change as suggested by some researchers could impact the economic viability of livestock prod- uction systems worldwide. Surrounding environmental conditions directly affect mechanisms and rates of heat gain or loss by all animals (NRC 2002). Lack of prior conditioning of livestock to weather events often results to catastrophic losses in the domestic livestock industry. The potential risk associated with livestock production systems due to global warming can be characterized by levels of vulnerability, as influenced by animal performance and environmental parameters. When combined performance level and environmental influences create a low level of vulnerability, there is little risk (e.g. rate of gain, milk production per day, etc.). However, combining an adverse environment with high performance pushes the levels of vulnerability and consequent risk to even higher levels. Inherent genetic characteristics or management scenarios that limit the animals ability to adapt to or cope with environmental factors also puts the animal at risk. It also affects the feed intake of the animal because ingestion of food is directly related to heat production, any change in feed intake and /or energy density of the diet will change the amount of heat produced by the animal. The ambient temperature has the greatest influence on voluntary feed intake.

Climate change is attributable directly or indirectly to human activities that change the composition of the global atmosphere. It emanates from natural climate variability observed over a comparable time period (IPCC, 1996). It is obvious from the definition that climate change is an inherent attribute of climate, which is caused by both human activities (anthro-pogenic) and natural processes (bio geographical). As a result of climate change the pastoralists migrated from the northern part of the country to southern parts of the country including Ogun State. There are 651 pastoral households with about 5,937 people in 28 settlements in Ogun State (Omotayo, 2010). Some of the land-use practice of the pastoral Fulanis such as seasonal bush burning along the grazing orbits for regeneration of pasture, periodic movement of the huts, intensification of land use, shifting cultivation with short fallow periods and lack of commitment to investment in long-term land improvement initiatives is capable of compromising the

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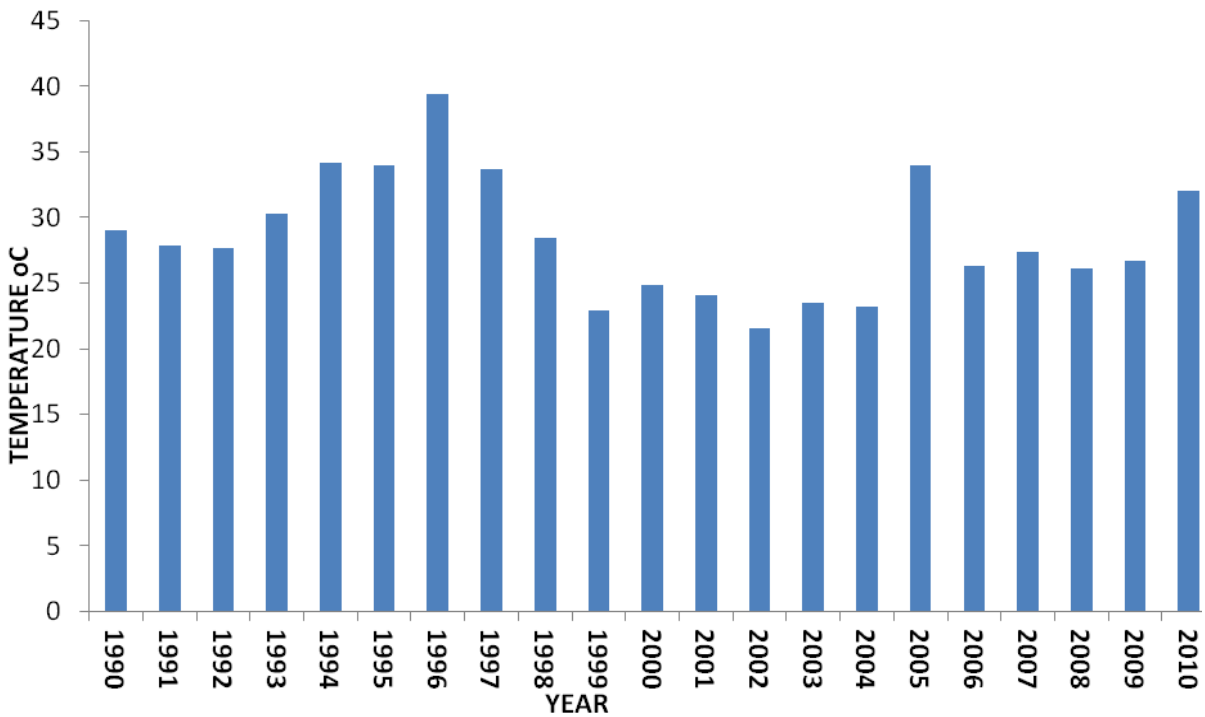
integrity and resilience of the ecosystem (Ayoade, 2004).

II. Problem Statement

Transhumance pastoralism was originally a way of life among communities whose lives and livelihood are in separately intertwined with cattle, goats, sheep and other ruminant species that depend on natural rangeland for grazing resources. Today, in spite of the advent of monetized economy, pastoralism has remained a veritable source of livelihood and food security as cattle, goats and sheep perform economic, as well as traditional, social and exchange functions. However, the dwindling pastoral resources such as open rangelands, wetlands (Fadama land), watercourses and rivers present new challenges to pastoralism (Adamu, 2008).

The bulk of locally produced meat and milk in Nigeria are through the transhumance pastoralists. However, the productivity of their cattle over the years was low partly because of inadequate supply of pasture and water. The situation is aggravated as a result of climate change which exposed the pastoralists and their herds to tougher weather situation especially drought, poor quality pasture, inadequate water supply , risk of contacting disease, pests, conflict between the pastoralists and crop producers over land use. Furthermore, climate change reduced available land for livestock production purposes because of desert encroachment currently moving at 600 metres/annum (or 350,000 hectares per annum (IPCC, 2007). Consequently, pastoralists migrated to the southern part of the country where pasture could be found. In 2008 alone, a total of ₦78.026 billion was expended on milk importation in Nigeria (National Bureau of Statistics, 2009). The reliance on food importation is described as dangerous for the nation's economy (Olayemi, 2005).

Cattle, sheep and goat performed better (in terms of calving, growth, milk production, etc) within a temperature range of between 10^0C and 20^0C called Comfort Zone". The average temperature range recorded in the study area was throughout the year above the comfort zone (Figure 1) under which these animals can thrive and is capable of predisposing the animals to thermal stress (McDowell, 1980). Further-more, low and irregular rainfall pattern (Fig, 2). It was only in year 2002 and 2007 that the rainfall recorded was above 1500mm which is just barely adequate to support the growth of tree crops. For most part of the period under review (1990-2010), the rainfall was generally low (below 1000mm). This situation may affect the availability of water and pasture to livestock. Similarly combinations of temperature (Fig.1) and high humidity (Fig. 3) are particularly detrimental to milk production (Smith, 1980).Conducive weather conditions, water and food are important in the physiological processes of these animals.



Source: Ogun Osun River Basin Development Authority, Alabata Road Abeokuta

Figure 1 : Average Annual Temperature for Ogun State, Nigeria (1990-2010)

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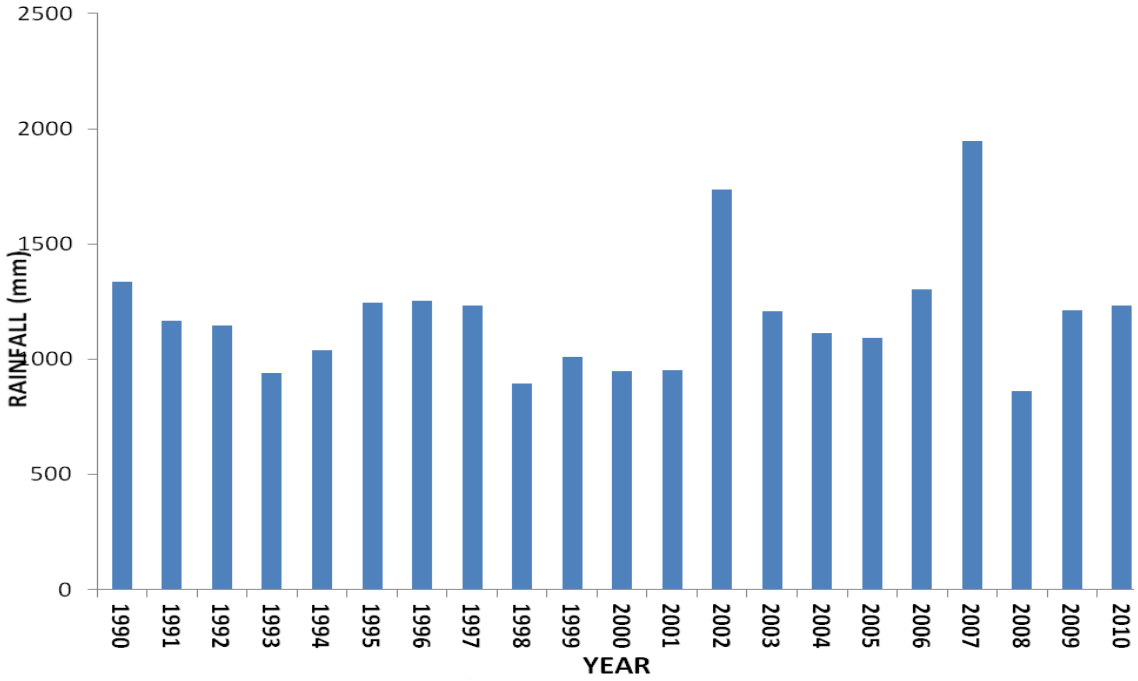
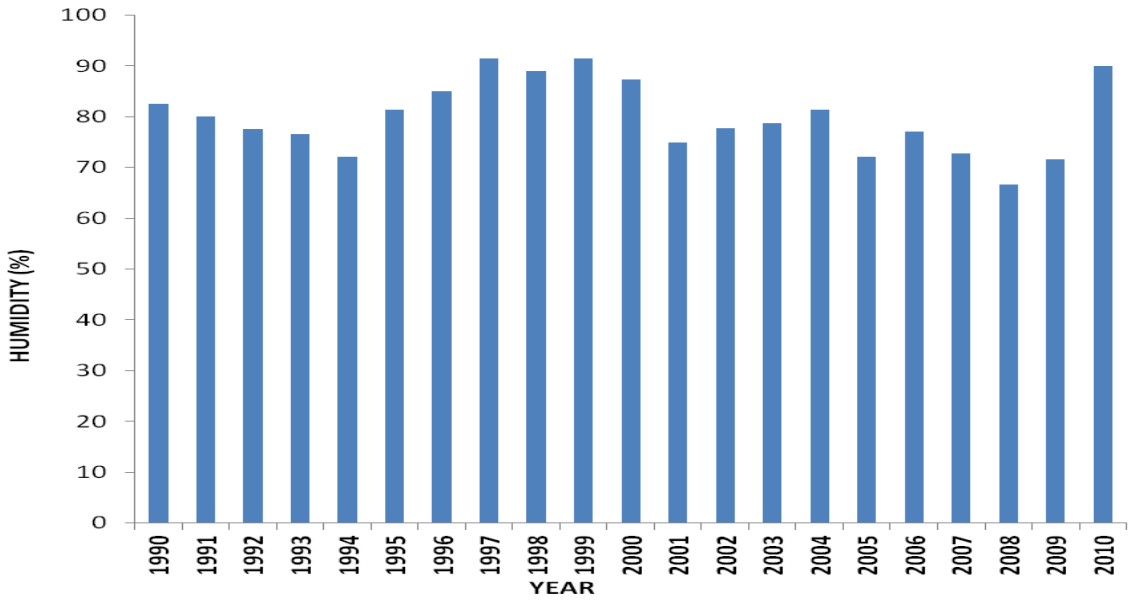


Source: Ogun Osun River Basin Development Authority, Alabata Road Abeokuta

Figure 2 : Average Annual Rainfall for Ogun State, Nigeria (1990-2010)



Source: Ogun Osun River Basin Development Authority, Alabata Road Abeokuta

Figure 3 : Average Annual Relative Humidity for Ogun State, Nigeria (1990-2010)

Thus, the objectives of the study were to:

(a) examine the socio-economic characteristics of the pastoralists
(b) determine perceived effects of climate change on grazing land,
(c) investigate herds' performance due to climate and
(d) investigate the coping strategies of the pastoralist to climate change.

Hypotheses Testing: The following hypotheses were tested:

(1) There is no significant relationship between socio-economic characteristics and coping strategies of pastoralists to climate change.
(2) There is no significant relationship between adverse changes in climatic factors and milk production of the herds.

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III. Methodology

Study Area : Ogun state was created in Nigeria in the year 1976 alongside with six (6) other states with Abeokuta as its capital. Ogun state lies between longitude 2° 45' and 3° 55'East of Greenwich Meridian and latitude 7° 01' and 7° North of the Equator. It covers a land area of approximately 16,406.226 square kilometers. The State is bounded in the West by the Benin Republic, in the South by Lagos State and the Atlantic Ocean, in the East by Ondo State and in the North by Oyo and Osun States. The population of the state is 3,728,098 comprising 1,847,243 males and 1,880,855 females (NPC, 2006). The state has twenty Local Government Areas LGAs. These include Abeokuta North, Abeokuta South, Ado-Odo/Ota, Egbado North, Egbado South, Ewekoro, Ifo, Ijebu East, Ijebu North, Ijebu North East, Ijebu Ode, Ikenne, Imeko-Afon, Ipokia, Obafemi-Owode, Ogun Waterside, Odeda, Odogbolu, Remo North, Shagamu The State is naturally endowed for food and cash crop production Agricultural production is the major means of livelihood of the people of the state. However there are influx of pastoral Fulanis from the northern part of the country into the state probably due to climate change.

Sampling Procedure and Sample Size: The target population for the study was the pastoral Fulanis in the study area. The study used a multi stage sampling technique to select the respondents. Stage one involved a purposive selection of five LGAs where the pastoralists are mostly located. These include Odeda, Egbado South, Egbado North, Ipokia and Obafemi Owode. The second stage involved the random selection of four Fulanis settlements in each LGAs. The final stage was the random selection of seven Fulanis per settlement to make up a sample size of 140. However, only 120 questionnaires were returned and analyzed.

Data were analyzed using percentages, frequencies and Chi-square statistics.

IV. Results and Discussion

a) Socio-economic characteristics of the pastoralists

Table 1 indicated that 37.50% of the respondents were between the ages of 51-60 years with an average age of 49.8 years. At this age, Ismaila (2010) reported that pastoralists are incapable of handling tedious farming activities such as covering long distances to graze the animals. However it was observed that most respondents looked mal-nourished and older than their age. A possible explanation of their physical appearance might be the long distance covered on daily basis to feed their animals. Majority (90%) of the pastoralists were male with an average of 29.5 years in transhumance pastoralism. The tending of cattle requires long distance travelling on daily basis. This is probably beyond the scope of the female. The result revealed that 58.8% of the respondents were married while 15% of them were widow. This indicates that there is a high mortality rate among the male pastoralists suggesting that pastoralism entails a lot of job hazards. Furthermore, 50.8%, 10.8% and 5% of the respondents had quranic, primary and secondary education respectively. This implies that the Fulanis are mostly adherent of Islamic faith. The average herd size was 21. The frequent search for pasture and water might be the basis for keeping small herd size.

Table 1 : Socio-Economic Characteristics of the Pastoral Fulanis

Characteristics	Frequency	Percentage
Age (Years)		
21-30	11	9.1
31-40	14	11.7
41-50	23	19.2
51-60	45	37.5
61-70	27	22.5
Average	49.8	
Gender		
Male	108	90.0
Female	12	10.0
Marital Status		
Single	19	16.2
Married	71	58.8
Widowed	18	15.0
Divorced	12	10.0
Household Size		
1- 05	87	72.5
6- 10	30	25.0
11-15	3	2.5
Average	6	
Educational Level		
No Formal Education	35	28.4
Adult Education	6	10.0
Quranic Education	61	50.8
Primary Education	13	10.8
Secondary Education	16	5.0
Herding Experience		
1-10	7	5.8
11-20	11	9.2
21-30	38	31.7
31-40	39	32.5
41-50	25	20.8
Average	29.9	
Size of Herds		
1-10	24	20
11-20	37	30.8
21-30	43	35.8
31-40	16	13.4
Average	21	

Source : Field Survey (2011)

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b) The Effects of Climate Change on Grazing Land

Table 2 below summarized the effects of climate change on pasture availability, rainfall pattern, drought and water availability. The results revealed that many (67.5%) of the pastoralists strongly agreed that the pattern of rainfall in recent time affects pasture availability. This implies that the pastoralists would wander a long distance in search of pasture and water. However, 50% of the pastoralists reported that flood occurrence is not a hindering factor or constituting any threat to pasture availability. Also, about 40% of the pastoralists strongly disagreed that drought is not a common occurrence in the state while more than half of the pastoralists (52.5%) strongly disagreed that pasture and water is readily available throughout the year in their domain. This agreed with findings of BNRCC (2008) that the impact of climate change can be vast in Nigeria. This means that some stable ecosystems such as the Sahel Savanna may become vulnerable because warming will reinforce existing patterns of water scarcity and increasing the risk of drought in Nigeria and indeed most countries in West Africa. Consequently, more half (56.2%) of the pastoralists cover a far distance to graze their animals.

Table 2 : Perceived Effects of Climate Change on Grazing Land

Perceived effects of climate change	SA	A	U	D	SD	N=120
Pattern of rainfall in recent time affected pasture availability	81 (67.5)*	29 (24.2)	3 (2.5)	4 (3.3)	3 (2.5)	
Prevailing temperature has no effect on the pasture	47 (38.8)	25 (21.2)	0 (0)	45 (37.5)	3 (2.5)	
Flood occurrence hinder pasture growth	30 (25.0)	24 (20.0)	1 (1.2)	60 (50.0)	3 (2.5)	
Drought is not a common occurrence in your location	15 (12.5)	21 (17.5)	6 (5.0)	30 (25.0)	48 (40)	
Pasture is readily available throughout the yea	18 (15.0)	13 (11.2)	3 (2.5)	63 (52.5)	23 (18.80)	
Water is readily available throughout the year	13 (11.2)	10 (8.8)	5 (3.8)	26 (21.2)	66 (55.0)	
You cover long distance to grace your animals	27 (22.5)	67 (56.2)	3 (2.5)	17 (13.8)	6 (5.0)	
Perceived effects of climate change	SA	A	U	D	SD	N=120
Pattern of rainfall in recent time affected pasture availability	81 (67.5)*	29 (24.2)	3 (2.5)	4 (3.3)	3 (2.5)	
Prevailing temperature has no effect on the pasture	47 (38.8)	25 (21.2)	0 (0)	45 (37.5)	3 (2.5)	
Flood occurrence hinder pasture growth	30 (25.0)	24 (20.0)	1 (1.2)	60 (50.0)	3 (2.5)	
Drought is not a common occurrence in your location	15 (12.5)	21 (17.5)	6 (5.0)	30 (25.0)	48 (40)	
Pasture is readily available throughout the yea	18 (15.0)	13 (11.2)	3 (2.5)	63 (52.5)	23 (18.80)	
Water is readily available throughout the year	13 (11.2)	10 (8.8)	5 (3.8)	26 (21.2)	66 (55.0)	
You cover long distance to grace your animals	27 (22.5)	67 (56.2)	3 (2.5)	17 (13.8)	6 (5.0)	

Source : Field Survey (2011)

*Figures in parenthesis represent percentages.

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c) The Effects of Climate Change on Performances of Herds

The perceived effects of climate change on performance of the herds are shown in Table 3.

Thirty-eight percent of the respondents strongly agreed that the herd's milk production has reduced due to climate change. Also, more than half (52.5%) of the respondents strongly agreed that herd mortality is on the increase while (56.2%) reported the emergence of new types of diseases. Furthermore, 60% of the respondents agreed that abortion in cattle has also increased. In addition 40.8% of the respondents reported incidence of pre and post calving mortalities in their herds. This might not be unconnected with the quality of existing pasture and the need to cover long distances under harsh weather conditions. This finding agreed with NRC (2002) that climate change could impact the economic viability of livestock production systems worldwide. Surrounding environmental conditions directly affect mechanisms and rates of heat gain or loss by all animals.

Table 3 : Perceived Effect of Climate Change on Performance of Herds

Perceived effects of climate change	SA	A	U	D	SD	N=120
Milk production has reduced	57 (47.5)	51 (42.5)*	- -	9 (7.5)	3 (2.5)	
Herd mortality is on the increase	63 (52.5)	44 (36.7)	- -	13 (10.8)	- -	
New types of diseases are noticed	67 (56.2)	24 (20.0)	3 (2.5)	21 (7.5)	5 (3.8)	
Pre calving and post calving mortality increases in your location	43 (36.2)	41 (33.8)	- -	27 (22.5)	9 (7.5)	
Abortion in cattle increases	33 (27.5)	39 (32.5)	- -	48 (40)	- -	
Abortion in cattle decreases	78 (65.0)	29 (23.7)	- -	10 (8.8)	3 (2.5)	

Source : Field Survey (2011)

*Figures in parenthesis represent percentages

d) Coping Strategies of the Pastoralists to Climate Change

Coping strategy is an adjustment or self insurance pursued by the pastoralists to ensure future income generation from cattle production and minimize the adverse effects of climate change on cattle productivity. Most pastoralists (65%) engaged in sinking of open wells for the watering of their cattle In addition 57.4% of the respondents reported the use of crop residue. It is important that pastoralists are exposed to technology of hay and silage making and methods of storing crop residue in order to maintain the nutritional value of these feeding stuffs. More than half (58.5%) of the pastoralists' respondents disagreed with the migration option as a way of mitigating the adverse effects of climate change while 52.5% of them resulted to herd size reduction. More than half (57%) of the respondents preferred the cultivation of pasture and legumes for their animal.

Table 4 : Coping Strategies of Pastoralists to Mitigate the Effects of Climate Change

Variable	SA	A	U	D	SD	N=120
Sinking of well	78 (65)*	29 (24.2)	-	10 (8.3)	3 (2.5)	
Production of hay	25 (21.2)	83 (68.8)	- -	9 (7.5)	3 (2.5)	
Storage of crop residue	34 (28.8)	69 (57.4)	- -	17 (13.8)	- -	

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Production of silage	14 (11.7)	18 (14.6)	- -	13 (11.2)	75 (62.5)
Growing of pasture	24 (20)	45 (37.5)	- -	45 (37.5)	6 (5.0)
Sinking of boreholes	37 (31.2)	13 (11.2)	1 (1.2)	48 (40)	18 (15.0)
Migration to conducive locations	39 (32.5)	10 (8.8)	1 (2.2)	48 (40)	22 (18.5)
Reduction of herd size by selling	39 (32.5)	15 (12.5)	3 (2.5)	48 (40)	15 (12.5)

Source : Field Survey (2011)
*Figures in parentheses represent percentages

e) Relationship between the adverse changes in climatic factors and performances of the herds

The result of Chi square analyses established a significant relationship between adverse changes in climatic factors and milk production (x^2=52.00, p≤0.05), herd mortality with (x^2=20.725, p≤0.05), new types of diseases are noticed (x^2=53.500, p≤0.05)) and pre-calving mortality increases (x^2=15.500, P≤0.05) (Table 5). The result confirms the findings of NRC (2002) that lack of prior conditioning of livestock to weather events often results to catastrophic losses in the domestic livestock industry. According to him, combining an adverse environment with high performance pushes the levels of vulnerability and consequent risk to even higher levels. Inherent genetic characteristics or management scenarios that limit the animals ability to adapt to or cope with environmental factors also puts the animal at risk. Ambient temperature has the greatest influence on voluntary feed intake. Most of the local breeds of cattle have reached their peak of production by virtue of their poor genetic make-up and unfavorable environmental situations (Amogun, 2009).

Table 5 : Relationship between Adverse Changes in Climatic Factors and Performances of the Herds

Variables	Degree of freedom	x^2 calculated	x^2 tabulated	Probability	Comments
	3	52.000	7.815	0.000	Significant
Herd mortality on the increase	2	20.725	5.991	0.000	Significant
New type of diseases are noticed	3	53.500	7.815	0.000	Significant
Pre and post-calving mortality increases	3	15.500	7.815	0.000	Significant
Abortion in cattle incre ases	2	1.900	5.991	0.387	Not Sig
Abortion in cattle decreases	3	2.100	7.815	0.552	Not Sig

Source: Field Survey, 2011

In addition, a significant relationship was also estab- lished between selected socio-economic characte- ristics and coping strategies of the pastoralists to climate change (Table 6) Age (x^2=25.375, P≤0.05), marital status (x^2=49.30, P≤0.05) and educational level (x^2=51.200, P≤0.05). This finding confirms the report of Sharada et. al. (2000) that both age and educational attainment are some of the important contributory factors to exposure and adoption of innovations. The youth are highly travelled, venturesome and can take risk, while educational attainment will enable them to access information on animal husbandry practices through the print or electronic media that can assist them to mitigate adverse effects of climate change. The wives can assist the husband in the marketing of animal products while the children can assist in grazing of the animals. The larger the size of the household the ease with which these tasks can be accomplished and innovations are adopted (Rogers, 2003).

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Table 6 : Relationships between the Socio-economic Characteristics of the Pastoralists and Coping Strategies of Climate Change

Variable	Degree of freedom	x^2 calculated	x^2 tabulated	Probability	Comments
Age	4	25.375	9.487	0.000	Significant
Marital Status	3	49.300	7.815	0.000	Significant
Educational Level	5	43.025	12.519	0.000	Significant

Source : Field survey, 2011

V. Conclusion and Recommendations

The study revealed that climate change is not only limited to the northern parts of the country but its adverse effects are noticed on the performance of herds of pastoralists (especially on milk production, herd mortality and incidence of unidentified new diseases) in Ogun State, Nigeria. The coping strategies to mitigate the adverse effects of climate change were inadequate to support better performance of the herd. The willingness of the pastoralists to accept a sedentary way of life through the rejection of transhumance (migration) is a welcome development. This will fast tract their access to extension services and improve on their coping approaches to mitigate the adverse effects of climate change. Therefore, the extension workers should expose the pastoralists to better approaches and coping strategies such as hay and silage making. The pastoralists should cooperate on joint use of resources for production of pasture to meet the food as well as water requirements of their herds. The grazing reserves in the state should be properly developed to encourage the pastoralists to adopt a sedentary way of life. This will enable their children to access education, urban values and mitigate the adverse effects of climate change on their herds.

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The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

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Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. **Pick a good study spot:** To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. **Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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INDEX

A

Accomplished · 67
Accurate · 1, 5, 10, 12, 31
Acquired · 7, 28, 30, 31, 32
Adequately · 32, 47
Adjacent · 34
Algorithm · 13, 25, 28, 42
Altered · 43
Aspects · 22

C

Canopy · 6, 13, 17, 18, 32, 34, 35, 40, 41, 43
Catastrophic · 61, 67
Climatology · 16, 41
Coastal · 25, 45, 49, 52, 53, 54
Concrete · 51, 52
Constituting · 65
Correlates · 25
Cultivated · 1, 6, 7, 10, 11, 12

D

Deciduous · 45
Degradation · 1, 2, 3, 6, 10, 13, 15, 16, 18, 19, 20, 24, 25, 26, 37
Density · 3, 35, 41, 61
Derived · 2, 3, 6, 16, 20, 21, 22, 28, 40, 42
Desertification · 1, 6, 18, 21, 24, 25
Detect · 15, 17, 28

E

Electromagnetic · 5, 31
Eminent · 55
Emphasizes · 11
Encroachment · 62
Equivalent · 34
Evapotranspiration · 5
Exceeded · 13

F

Fraction · 30, 35, 37

H

Humankind · 12
Hyperspectral · 32, 40, 41, 43

I

Illumination · 20
Imageries · 25
Implemented · 1, 47, 51
Implication · 53
Indices · 13, 15, 16, 17, 18, 20, 21, 22, 24, 26, 30, 31, 32, 34, 35, 39, 40, 41, 42, 43
Industrialization · 51
Intensification · 61
Inevitable · 30, 68
Interpretability · 28
Interpreting · 18

L

Latitudes · 21

M

Mitigating · 66
Monitoring · 1, 3, 5, 6, 7, 9, 14, 18, 20, 22, 24, 26, 28, 31, 32, 35, 37, 39, 43, 45
Mortality · 61, 64, 66, 67, 68
Multispectral · 3, 7, 26, 41
Multitemporal · 11, 14, 24, 40

O

Obstructing · 53
Occupying · 49
Orthogonal · 42

P

Paradigm · 47, 49, 54
Pedestrian · 52
Phenomena · 1, 5, 7, 37
Photosynthesis · 5, 35
Pleasantness · 49, 50, 51
Pointable · 39
Prairie · 18, 30, 41
Precise · 6, 32, 54
Prediction · 22, 28, 41
Probably · 53, 55, 64

Q

Quantifying · 32, 39, 43
Questionnaires · 64

R

Rectified · 7
Rehabilitation · 1, 47
Reinforce · 61, 65
Resilience · 62
Robust · 39

S

Saturate · 35
Sedentary · 61, 68
Semi-arid · 1, 3, 15, 21, 25, 32, 41
Spatial · 5, 7, 10, 11, 24, 31, 39, 40, 43, 55
Spectral · 1, 5, 7, 10, 21, 25, 26, 28, 29, 30, 32, 37, 39, 40, 41, 42, 43, 45
Spectrum · 31, 32
Successional · 43
Suppresses · 13
Surface · 3, 5, 7, 9, 16, 20, 21, 22, 28, 29, 30, 32, 40, 41, 42,
Surrogate · 6
Surveillance · 30
Survey · 13, 15, 24, 26, 45, 64, 65, 66, 67
Sustainable · 14

T

Terrestrial · 15, 18, 22, 42

V

Variants · 13, 17, 42
Viewpoints · 9

W

Wageningen · 15
Witnessing · 61

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