INT. J. BIOL. BIOTECH., 15 (3): 527-534, 2018.

ASSESSMENT OF TRANSFORMATION OF URBAN GREEN SPACES AND AGRICULTURE LAND IN KARACHI: A CASE STUDY OF GUTTER BAGHEECHA IN AND ITS SURROUNDING AREAS

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ABSTRACT

The sustainability of green spaces in any mega city like Karachi is indispensible for ecological stability. Pace of urban growth in Karachi is very fast and this city is continued to be at the risk of various environmental challenges. The abrupt land use changes and green cover depletion is one of the core issue for urban environment. Cultivated land is an important asset for the urban dwellers but unfortunately it is deteriorating at the pretext of improvement in the infrastructure facilities. The negative anthropogenic and environmental components are big challenge for managing ecological balance of Karachi.

In this study state of art techniques of Geoinformatics utilized to monitor and map periodic changes of land use in SITE Town Karachi from (1992-2015) with special focus on the biomass depletion in *Gutter Bagheecha* during (2001-2015). Field survey was also conducted for ground truthing and collection of primary data. Comparative analysis were based on Satellite imageries of Landsat -7 and 8 TM 30 m and QuickBird 61 cm resolutions. Results revealed gross degradation in biomass in one of the ecologically rich land-used in Karachi during past 15 years. GIS technology proved very promissing for monitoring the variations of land resources such as loss of green cover or biomass due to urban expansion. Therefore, this study should be beneficial for agriculturists, Urban ecologist and town planners.

Keywords: Biomass, Ecology, Environmental challenges, Land use transformation, Urbanization, Geoinformatics.

INTRODUCTION

Gutter Bagheecha is the historically famous largest continuous open green space found in Karachi. It is located in Old *Golimar*, in the South-East of S.I.T.E town UC-4 along the Manghopir Road. Geographically the site lies at 24°.89' 54′ - 26°N and 66°59′ 46′ - 67°.01' 13′ °E having an average elevation of 45 ft. from the sea level. It has been a public amenity space and covered more than 1,017 acres of greenery but now hardly 480 acres of land is left to be called the greener part of *Gutter Bagheecha*. Location map of study area is given in Fig.1. The municipality record of 1892 map of Karachi, shows that this important farming area located at Plot No K-28/108 is approximately 113 years old. Originally it is drained by Shone Drainage System of storm channels of Lyari River. Later, sewerage water was also being treated and used to supply water to grow few cereals, green fodder and vegetables. It later came to be known as the Sewage Farm or (Gutter Bagheecha). At the time of inception of Pakistan, it was known to be the 'largest urban forest and served as lungs of Karachi' with unique ecology of diverse flora and fauna. Similarly, in the year, 1969 this land is shown as a 'Municipal Garden spread over an area of around 1,016.76 acres (The Nation, 2009). Even now this area has been growing vegetables and fruits using fresh as well as treated sewage water, which is legally prohibited in Pakistan. Moreover, being located within urban area it is supplying fresh vegetables to the natives of nearby low housing localities of Karachi at the cheapest rates. Since recent past the growing population and urbanization has resulted in the gross changes in the land cover and land use in this area.

According to the study of Ghazal *et al*. (2013) and published reports of GoP (1972-2010), total cultivated areas of Karachi have shrunk from 90,078 acres in 1972 to 37,887 acres in 2010 while, Urban area has been increased from 286.302 sq.Km to 820.052 sq.Km during 1972-2010, Afsar *et.al*. (2013), which is a clear sign of governmental negligence to avert the prevailing condition of ecological transformation which may led to food security issues. Similarly, findings of Ghazal, *et al.* (2016) revealed that nearly 200 sq. km of built up land has been increased during 1992 – 2011. As documented in a research conducted by Akhtar and Dhanai (2013) and Ghazal *et al*. (2016) that in order to meet the demand of residential areas various new housing schemes have been introduced such as Saadi town and DHA city located at 40 km and 55 km away from the city center for the middle and upper middle class of city dwellers whereas, schemes like *Khuda ki basti* and *Benazirabad* were also established to refuge flood victims and other rural immigrants to the city. Moreover, many fertile pockets of peri-urban arable land have been converted, into residential areas in the recent past.

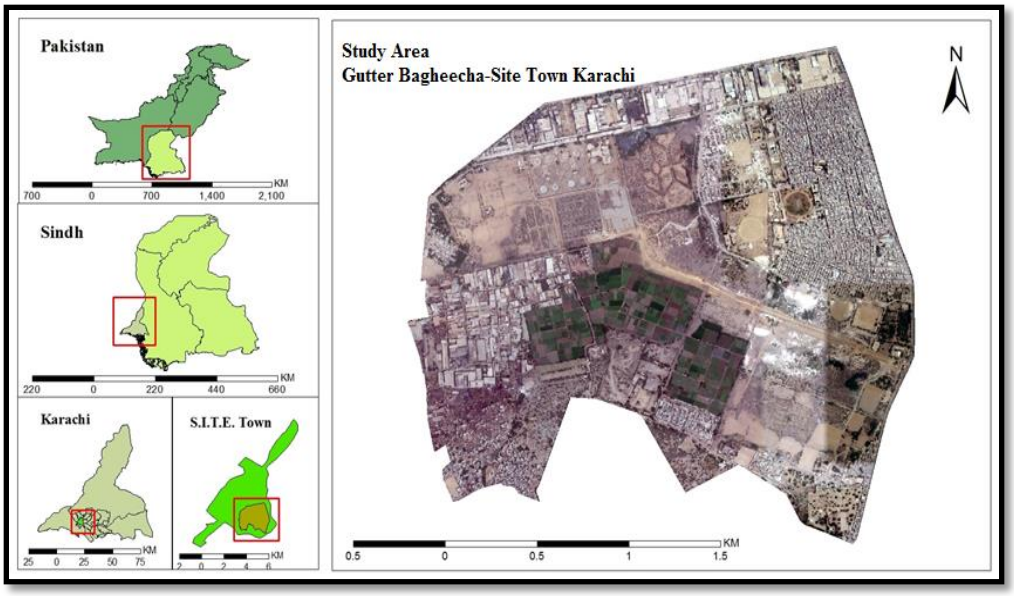

Fig. 1. Location of Study area Image *Source: QuickBird 0.61 m*

Land cover may be observed directly in the field or by satellite image, observations of land use and its dynamics generally require the integration of natural and social scientific methods (Relevant knowledge, interviews with locals and experts) to determine types of human activities– occurring in different parts of the similar landscape. Scientific investigation of the causes and consequences of Land use/Land cover Classification (LULCC) requires an interdisciplinary approach which has now emerged as the new discipline of land-change science as discussed by Ellis (2013).

Land use is rather a more complicated term. It has been defined in terms of human activities such as agriculture, forestry and building construction that alter land surface processes including environment, hydrology and biodiversity. The exponential growth of population increased demand for food, fuel wood and shelter coupled with urbanization have led to drastic changes in landuse/landcover patterns globally. Various research studies have proved that over recent decades, developing countries are characterized by an increase in urban land use through urbanization and a decrease in rural land use (Dewan and Yamaguchi 2009a; Jat *et al.*, 2008; Mundia and Aniya 2006; Yin *et al*., 2011).

According to study conducted in Arumeru, Tanzania by Ngailo *et al.* (2001), there were many factors that were identified to be as major causes of land use and biodiversity changes but the continual increase of human and animal populations was among the major factors. Increase in population pressure led to the decrease in the area needed for, building, grazing animals and more importantly for cultivation of both food and cash crops. In the same manner due to increased population more of the rich biodiversity was exploited for human and animal use. People required trees for building their homes and needed pasture for feeding their animals. As discussed by Sajjad and Iqbal (2012), Land cover refers to the physical and biological cover over the surface of land, including water, vegetation, bare soil, etc. Natural scientists define *land use* in terms of syndromes of human activities such as agriculture, forestry and building construction that alter land surface processes including biodiversity, biogeochemistry and hydrology. Social scientists and land managers define *land use* more broadly to include the social and economic purposes and interaction of human with land resources in order to plan whether land to be managed or left unmanaged.

De Zeeuw *et al*. (2011) considered urban cultivation as a very significant approach to access fresh fruits and vegetables at reasonable costs. World Watch Institute 2011 reported that, globally 800 Million people are engaged in urban agriculture. It was strongly recommended by the UN task force on the prevailing Global Food crises that "A paradigm shift in design and urban planning is needed that aims at reducing the distance for transporting food by encouraging local food production, where feasible, within city boundaries and especially in immediate surroundings" (UN, 2010). Vegetative cover dynamics play an important role in various mechanism of earth surface which are directly linked with hydro-meteorological phenomenon (Tyson et al., 2001). Monitoring the current state of green areas available at any place is somehow important for initiating any plan of plant conservation (Egbert *et al*., 2002).

This current study is also being conducted to prove the potential of Remote Sensing and GIS techniques for delineating various types of land use like built up, open and green areas from landSat-7 TM Satellite data. Reflections from the wavelength of band 3 and 4 (Red and NIR) of LandSat -7 TM Sensor is very supportive for identification and enhancement of pixels containing biomass on satellite image. Similarly this characteristic is ideal for mapping the extent of agricultural and other green bodies. Periodic Monitoring and mapping of natural resources and cultivated land is useful for different administrative units for the sake of comparative study of past and present trend therefore, possible future outcome could have been projected (Ghazal, *et al*., 2015).

MATERIAL AND METHODS

The aim of this study was to assess the impact of land use change on the environment of *Gutter Bagheecha* and its surroundings. Formal interviews of residents and farmers were also carried out to get the first-hand knowledge or personal experience of those who observed the deterioration of historically famous green space. All acquired data was processed to develop Maps, graphs and tables for quick interpretation and understanding of this ecological issue. Following Table-1 gives the brief specifications of satellite images used in this study for the processing of supervised classifications (Site town) and on screen digitization of land use in *Gutter Bagheecha*, respectively.

Table.1. Satellite Images Specifications used for Processing

Name	Resolution	Year	Region of Interest
Landsat 7 TM	30 m	1992	Site Town-Karachi
Landsat 7 TM	30 m	2005	Site Town-Karachi
Landsat 8 TM	30 m	2015	Site Town-Karachi
QuickBird	61 cm	2001	*Gutter Bagheecha*
QuickBird	61 cm	2005	*Gutter Bagheecha*
QuickBird	61 cm	2015	*Gutter Bagheecha*

Use of archive images of remote-sensing technology served an excellent and cost effective solution to observe spatio-temporal behavior of vegetation cover, without being there; thus replaced the need of extensive and time consuming field surveys to the great extent (Langley *et al.*, 2001; Nordberg and Evertson, 2005; Xie *et al*., 2008). Significance of Geoinformatics in Pakistan has now widely accepted and incorporated for monitoring of natural resources since few decades (Kazmi, 2007; Ghazal, 2014). Biomass rich land surface or vegetative bodies can easily be enhanced and separated and using multi-spectral satellite images (Aronoff, 2005). Reflectance of NIR or Red are embedded with certain classification and vegetation Indices enhance biomass concentration by spectral value and obtain single value which enhances the pixel of vegetative matter on the image whose area can be computed.

RESULT AND DISCUSSION

Agricultural production and their surplus availability is considered integral for any place like Karachi whose population has increased many folds in the recent past. Cultivated land of Karachi is an important source of food for the urban dwellers but is deteriorating rapidly without consideration of future challenges of easy access of food. Farmlands located within the city like (*Gutter Bagheecha* and Malir valley) and some Peri-urban areas like Gadap, Konkar etc. are at the risk due to several human and natural induced factors. Following facts have been deduced from the processed maps**.** Land use pattern has changed significantly over the whole period from 1992 to 2015 in Site town generally and in *Gutter Bagheecha* and its surroundings specifically-. To a large extent, land-use change from 1992 to 2015 in SITE Town was characterized by a serious replacement of farmland with urban infrastructure, as depicted in (Fig.2).

For the sake of in-depth assessment of actual change in green cover and other distinct land use changes very clearly, digitization of land use boundaries was performed by using high resolution QuickBird 61 cm images for the years 2001 and 2015 respectively. Polygons geometry was later on calculated that shows apparent variations in different land use, alarming transformation of one of the historically significant urban agricultural land of Karachi (*Gutter Bagheecha* and its surrounding area). In past 15 years there was decline of more than 80 percent in farmland at the cost of urban amelioration which has altered one of the biggest open green land and productive pocket of land

in to built-up and waste land. The case study concludes that during the past decade there has been very extensive change in the land use of SITE Town with special reference to green spaces of *Gutter Bagheecha* and its adjoining areas which fall in UC-4. In the year 1992, there was an extensive area under agricultural land available for cultivation which has reduced to few hectares. In order to study Land cover and land use changes monitoring of spatial extent of vegetation cover is considered as a prime environmental indicator. Construction of Model Park, Dynamic fragmentation is the obvious characteristics of agricultural fields change in the study area, and substantial and significant increase was observed in open land, recreational and residential land, respectively as shown in (Fig. 3 and 4).

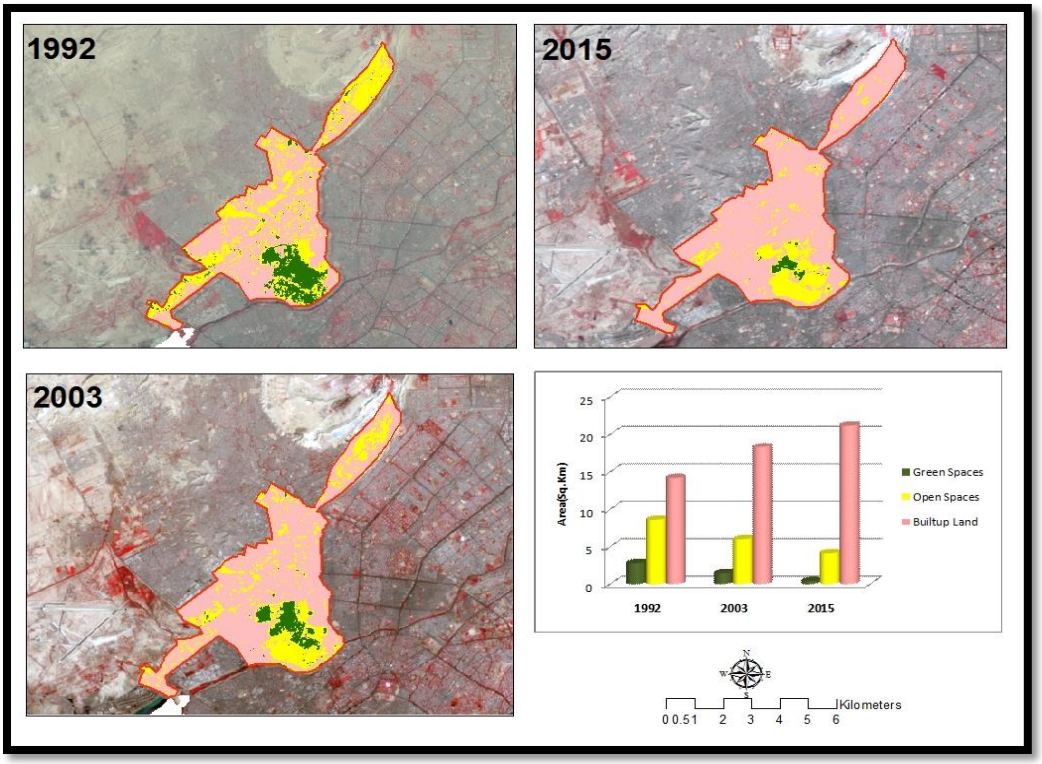

Fig. 2. Temporal Change of Land use in Site Town (1992-2015) using Land sat 7 and 8 Satellite Images

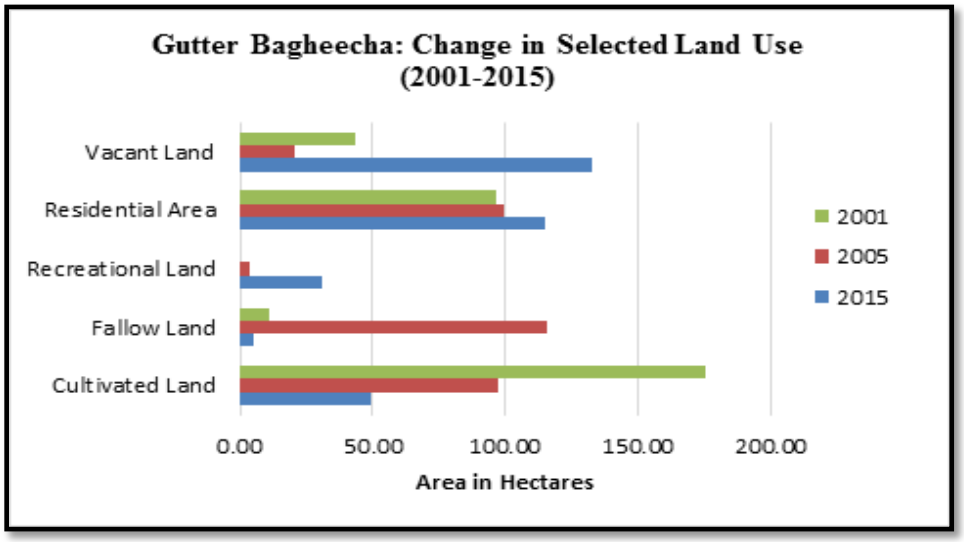

Fig.3. Changes in Land use -of *Gutter Bagheecha* and its surroundings during.2001-2015.

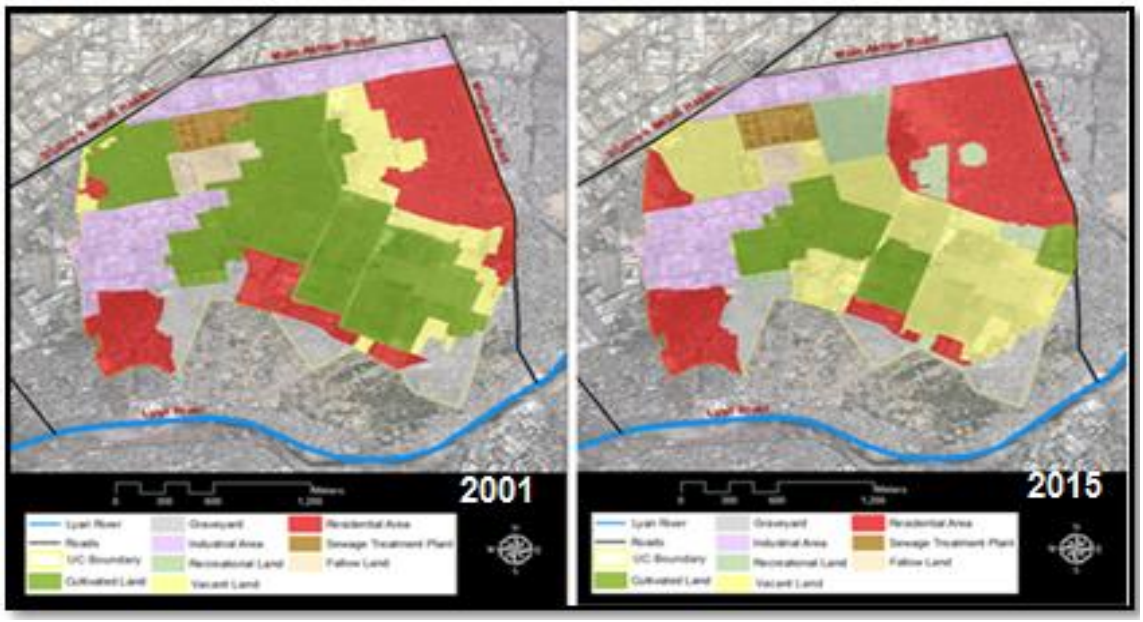

Fig. 4 Temporal Change of Land use in *Gutter Bagheecha* and its surrounding areas

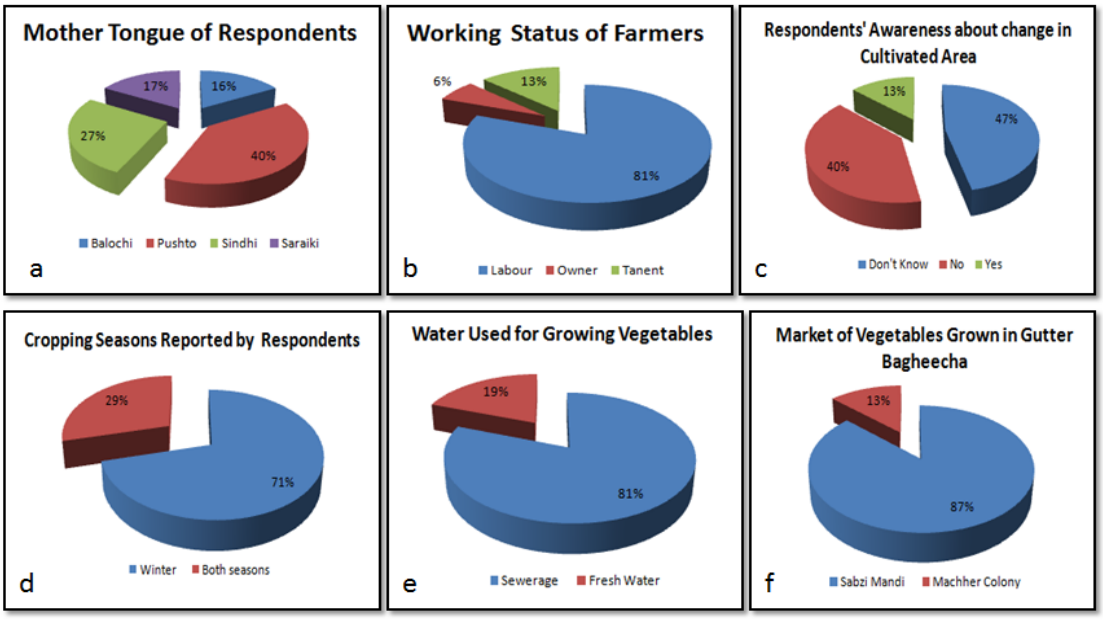

Fig.5. Analysis based upon questionnaire conducted during field survey.

Selected questions from the questionnaire were compiled in the form of pie charts for the purpose of quick evaluation see pie charts in [Fig. 5 (a-f)]. Respondents belonged to different areas of the country and spoke multiple native languages like 40% Pushto, 27% Sindhi, 17% Balochi and 16% Saraiki. Majority of them have been living in Karachi since less than 6 years that's why were not fully aware of any change in land use within and outside *Gutter Bagheecha*. Farmers mainly working as labour on daily wages. Almost 13% were tenants and only 6% of respondents were owners of their farms. As reported by 71% respondents that winter season is the main cropping season when variety of vegetable are grown like (Tomato, Spinach, Coriander, Mint, Bottle gourd, Cholai, Pumpkin and Fodder etc). Variation in the occurrence of rainfall has not become a major problem in the area because the farmers are using untreated sewerage water for crop cultivation which is not at all good for health of the people. It was observed during the survey and around 80% farmers reported to use sewerage water while 20% of fields were

irrigated with fresh water such as mint and coriander. Almost 90 % of vegetable products are sold in whole sale market (Sabzi Mundi at Super highway) while only 10% is sold in the small colonies like Machar and Sheerin Jinnah. Some farmers also reported that whole sellers come themselves directly at *Gutter Bagheecha* to buy vegetables to be sold at their local areas.

Fig. 6 Some vegetables and crops grown in *Gutter Bagheecha* *Source: Authors*

CONCLUSION

It has been revealed from this study that in Karachi Urban up-gradation is taking place at the compromised of historically significant green areas of Karachi. As this area is the meant for Public park or amenity so illegal squatter settlements must not be allowed to spread. Fast rate of transformation of agricultural land is diminishing the traditionally significant green areas and vegetables for urban dwellers. If this practice will be continued without considering the prosperity of urban farming so we might be deprived of these cultivated lands. Another concerning issue is the influence of land mafia and dumping of Industrial waste is responsible for increasing soil contamination and minimizing farmland.

Negligence of City government for not maintaining the water treatment plant for treating sewage water is a matter of great concern. This is an example of resources degradation caused mainly by various human induces factors such as commercialization of land, shortage of clean water, role of land grabber mafia *etc*. It is recommended that areas like *Gutter Bageecha* must be conserved for urban farming, as these areas may provide the ecological refuge to the people and animal species of Karachi City.

ACKNOWLEDGEMENTS

Authors are grateful to dean faculty of sciences for the partial provision of financial assistance used to conduct the field visits of this research. Authors would like to acknowledge NASA and USGS for making the Landsat TM and ETM+ and QuickBird satellite data available on free webs. Profound thank is extended to our students Ms. Rabia Imam for preparing few base maps, Mr. Fahad, Mr. Murad and Mr. Adil for their cooperation during field survey.

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(*Accepted for publication June 2018*)