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Presence and Functionality of Rangeland Management Institutions: The Case of Insindi Smallholder Resettlement in Gwanda, Zimbabwe

By Onalenna Gwate
Lupane State University, Zimbabwe

Abstract- The Fast Track Land Reform in Zimbabwe adversely affected environmental management. The study sought to establish the presence and functionality of institutions for rangeland management in Zimbabwe in Fast Track Resettlement areas. Data was collected using questionnaires and interviews. A total of 30 questionnaires were administered on each household, randomly selected to get their perspective on rangeland management issues. Key informants were also interviewed to understand the trajectories of rangelands management. Data from questionnaires was analyzed using the Statistical Package for Social Sciences (SPSS). Results revealed that there was a dearth of relevant institutions for the management of rangelands as a common property resource. It was concluded that lack of robust institutions, particularly in Fast Track Resettlement areas was at the core of rangeland deterioration. In order to enjoy the full benefits of the fast track land reform, robust technical support has to be availed to reduce environmental degradation taking place in the area.

Keywords: natural resources, land reform, institutional development, rangelands, common property resource.

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Keywords: natural resources, land reform, institutional development, rangelands, common property resource.

I. Introduction

The history of land reform in Zimbabwe dates back to the coming in of white settlers in 1890s (Marongwe, 2002). However, this study would focus on post independence land reforms particularly the Fast Track Land Reform (FTLR) as critical in explaining the unprecedented rangeland deterioration. From 1980 until 1999 government acquired 3.8 million ha of commercial farmland and resettled 71000 families (Feltoe, 2004). This programme was supported by a robust development package. It is also alleged that during this time government owned 300,000 ha of former commercial farmland which had not been allocated for resettlement. Many of the early resettlement programs were not successful because of inadequate planning, failure to provide appropriate infrastructure and agrarian support systems. In March 2000, it was revealed that 272 state owned farms had been leased to high ranking civil servants and a coterie of ruling party cadres (Feltoe, 2004). Up to 1990, government had failed to come up the requisite pieces of legislation to engender a sustainable land reform. As such commercial farmers used this failure by government to follow the procedure laid out in the acquisition legislation in order to obstruct and delay the acquisition for resettlement.

The year 2000 marked a turning point in Zimbabwe's history of land and agrarian reform. Hitherto, there was talk of the land question, but now talk was on the land as an answer to economic problems. The government acquired about 5 million hectares and resettled about 46111 families on 2.5 million hectares under the fast track land reform programme (FTLRP) (Feltoe, 2004). Land audits indicate, that by February 2006, about 156,000 households were resettled on 6,800,000 hectares. The FTLRP was associated with the modification of existing settlement models in the form of a communal subsistence farming model A1 (either as a villagised or self contained model variant) and commercial farming model A2 (with variants of small, medium, large and peri-urban farm models). The programme occurred under adverse macroeconomic and unstable political conditions (Chigumira, 2010). Unlike previous resettlement programmes, the FTLR was not properly planned. Consequently, people were resettled without first laying out development infrastructure and were not psychologically prepared to live in relatively pristine environments. Environmental issues were relegated to the background during the land reform in Zimbabwe. There is, generally, a dearth of skills and techniques for sustainable rangeland utilization. The result has been intense disturbance leading to environmental degradation through soil erosion, deforestation and overgrazing. Deforestation has been on the increase particularly in the resettlement areas due to clearing of land for expansion of agriculture, collection of firewood for subsistence as a well as for commercial purposes as a response to the demand created by the rise in electricity charges and the shortage of paraffin. Soil erosion is essentially driven by poor farming methods bedeviling smallholder resettlement schemes. The backlash of environmental degradation is more evident

Author: Department of Geography and Population Studies, Lupane State University, Raylton, Bulawayo, Zimbabwe.
e-mail: onalennag37@gmail.com

in rangelands of marginal areas. Given that prime beef in the country come from arid and semi arid regions like Matabeleland, rapid environmental deterioration has serious ramifications on beef production in the country. As such, the problem may not only be felt by farmers, but the entire Zimbabwean population as beef is also a critical foreign currency earner. Therefore, the study sought to establish the presence and functionality of institutions for rangelands management in Insindi smallholder resettlement area.

II. Literature Review

a) Causes of rangelands degradation

Rangeland degradation is influenced by a number of factors. Haji–Rahimi and Ghaderzadeh (2008) identified inappropriate animal husbandry system as one of the major issues promoting rangeland degradation. The transhumance system was noted as a key driving force in rangeland degradation. However, the Africa Centre for Holistic Management in Victoria Falls, Zimbabwe has demonstrated that overgrazing is not in anyway related to an increase in stock numbers. Neely and Butterfields, (2004) argue that overgrazing is a function of time and not stock numbers and occurs when an animal returns to a grass plant before it has had time to fully regenerate. When animals are allowed to roam freely, they will indeed revisit plants before the particular plants recover. However, when animals are herded to ensure that they do not re-graze the plants before they are fully recovered, then overgrazing is no longer an issue. Adverse climate change may reduce the productivity of rangelands so that their grazing capacity may be reduced to the extent of causing desertification (Sharma *et al.,* (2007). Therefore, in Zimbabwe where over 70% of the rural population entirely uses fuel wood as a source of power (Marongwe, 2002) and in the era of acute electricity load shedding in the urban subsystem, bush cutting is critical in rangelands degradation. Investigations by Chigumira, (2010) in three farms in Kadoma district revealed that because of the shrinkages in the economy, hyperinflation and reduced incomes from crop production, most households particularly those that are resource poor, communities resorted to off farm sources of income particularly through intensive utilisation of their natural environment. These included intensive sale of firewood which have consequently contributed to decreases in woodland and bushland and conversions tocultivation/grassland at the three sampled farms. Ambiguity in property also undermines rangelands. Haji –Rahimi and Ghaderzadeh, (2008) notes that after the passage of nationalization laws in 1963, all natural resources including rangelands were vested to government and the zeal for judicious management waned and the backlash was severely felt in the rangelands. For Zimbabwe, Chigumira (2010) and Chigwenya (2010) attribute rangeland degradation to poor environmental governance and institutional decay respectively.

b) Institutional framework for current rangeland management in Zimbabwe

A number of legal and policies pertinent to the environment exist in Zimbabwe. These include Environmental Management Act cap 20: 27, Communal Forest Produce Act cap 19:04, Forest Act cap 19:05, Rural District Councils Act cap 29:13 and the Parks and Wildlife Act cap 20:14. However, it should be observed that there is no legislation or policy that specifically deals with rangelands as a distinct resource. This probably explains the degradation obtaining at rangelands as a neglected resource. At the same time pertinent policies include Wildlife based land reform policy, the Integrated Conservation Plan for the Fast Track land reform program, Millennium Development Goals (MDGs), National Environmental policy, National Action programme on the United Nations Convention to Combat desertification and drought, Water management strategy and the National Action plan to the Johannesburg Plan of Implementation. However, often the letter and spirit of these policies are not followed.

III. Research Methodology

a) Study area

The study area lies about 18 km from Gwanda town along the Gwanda-Bulawayo road. The A1 resettlement area covers about 6000 hectares. The study area is located between 20° 53´S and 20°45´S and between 28 ° 57´E and 29 ° 03´ E. Vegetation physiognomic structure is essentially tree bush/ savanna (TBS) with *Colosphospermum mopane* comprising the canopy cover. Dominant tree species include *Colosphospermum mopane, Dichrostachys cineria* and *Terminalia sirecea*.

b) Methods

Based on the sample size calculator, a total of 30 households were selected and questionnaires were administered on each household, randomly selected to get their perspective on rangeland degradation. Interviews were also conducted with key informants such as traditional leaders and government extension workers from Agricultural technical and extension (Agritex) services, the Environmental Management Agency and Forestry Commission. The interviews sought to extract information related to the role of each institution in rangeland management and also to identify challenges and opportunities for each institution. The Statistical Package for Social Sciences (SPSS) version 17.0 was used to analyze quantitative data generated from questionnaires. Essentially frequencies and descriptive statistics were run.

IV. Results and Discussion

a) Demographics

The respondents comprised people from different age-groups. Sixty percent of people interviewed were at least 41 years of age and 30% were between 30 and 40 years of age while only 10% accounted for the 30 and below age group (Figure 1). Hence, all important age categories were represented. In terms of gender, the majority interviewed were males (63%) and the rest were females (37 %).

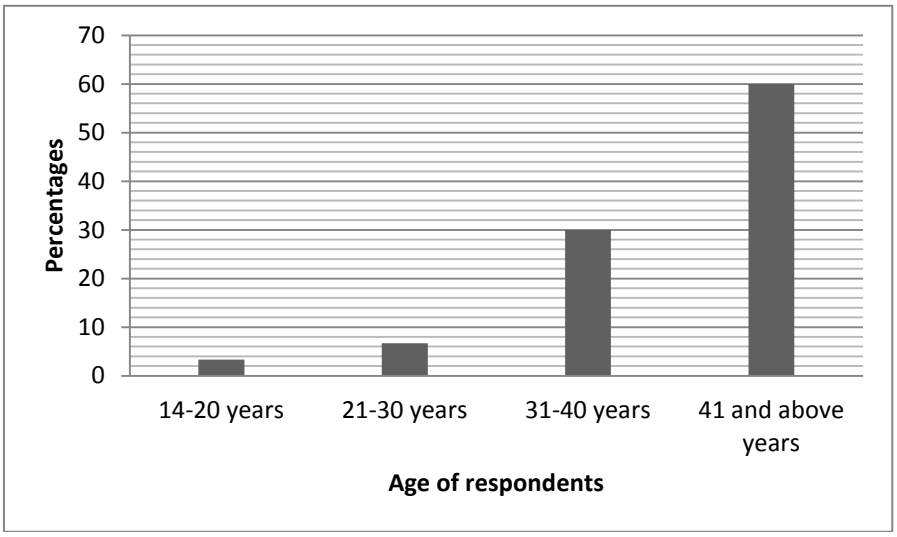

Figure 1 : Age of respondents in the survey

About 67% of people interviewed have been residing in Insindi resettlement for over three years suggesting that land uptake was very high at the time of the land reform. At the same time 30% have been resident in the area for the past 2 years while only 3% had been resident in the area for less than a year.

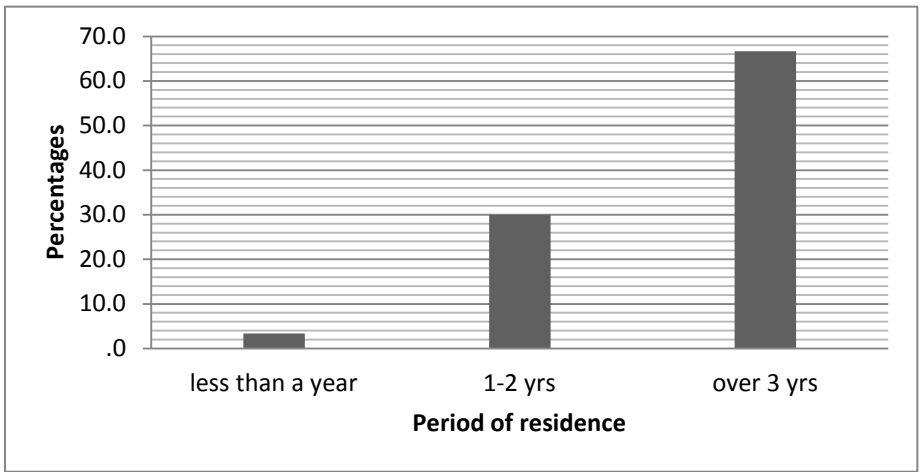

Figure 2 : Period of years resident in Insindi resettlement area

b) Livestock ownership and importance of rangelands

According to respondents, the sampled households owns 29 goats and 30 donkeys and cattle as (Table 1), making a total livestock population of about 89. On average each household owned two goats, one donkey and one cattle.

Table 1 : Livestock ownership in Insindi resettlement area

	Goats	Donkeys	Cattle
Number	29	30	30
Mean	1.55	1.37	1.47

A cross tabulation of the importance of rangelands and the number of livestock owned revealed that regardless of livestock ownership, grazing use was considered an important option as can be seen from figure 3 below. It shows that people appreciate the role of grazing to the local economy. However, it is also clear

that those with a few livestock also give more weight to mining of natural resources as a critical use. For example, for those with less than 10 goats, four people indicated that the rangeland was important for mining of natural resources and so was five people with four and less donkeys. Finally, five people with five and less cattle also recognized natural resource mining as an important rangeland use option. The results suggest that the different social groups of the community appreciated the importance of rangelands in as far as grazing is concerned irregard of livestock ownership. People who had fewer or no livestock also appreciated other roles that rangelands play such as aesthetics and mining of natural resources. The recognition of the invaluable role of rangelands is reflective of the significance of the pastoral economy to the locals. This confirms the long held convention that semi arid areas are the prime beef producing areas in Zimbabwe.

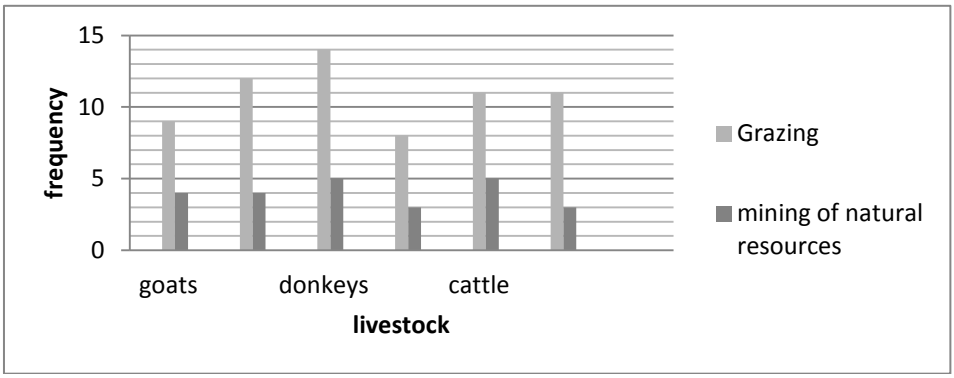

Figure 3 : Cross tabulation of livestock owned and perception of rangeland importance

c) Rangeland condition

The majority of people (43%) interviewed generally felt that their rangelands were in good condition while 33% felt that it was average and 23% felt that it was poor (Table 2). The results imply that rangelands are under threat. In terms of healthy rangeland indicator, an overwhelming 83% indicated that high vegetation cover and absence of gullies were indicators of a health rangeland. At the same time 17% indicated that availability of water and more wildlife were indicators of a healthy rangeland.

d) Causes of rangeland degradation

In terms of causes of rangeland degradation, 73% indicated that drought, tree cutting and overstocking were the key driving forces behind rangeland degradation while 27 % attributed rangeland degradation to lack of institutions Table 3.

Table 3 : Causes of rangeland degradation

Causes of Rangeland degradation	Percentage of respondents
Drought, tree cutting, overstocking	73%
Lack of institutions for management	27%
Total	100%

About 90% of respondents indicated that soil erosion and lack of palatable grasses were key forms of the manifestation of the process of rangeland degradation while 10% also felt that the presence of alien invader plants contributed to rangeland degradation. The results may be indicative of the fact that invader species are not a significant problem in Insindi.

e) Need for rangeland regulation

There was a general consensus that rangelands have to be regulated mainly because the community was not well organized and had no common goals. At the same time about 9 respondents indicated that there was need for rangeland regulation given that degradation was already high and about seven people felt that government has to regulate rangelands owing to its paternalistic role.

i. *Ways of controlling rangeland degradation*

About 43% of respondents indicated that rangeland degradation can be reduced by controlled grazing while 40% argued that the development or strengthening of local institutions could be critical in reducing rangeland degradation. About 17% indicated that degradation can be reduced by destocking, revegetation and reseeding (Figure 4).

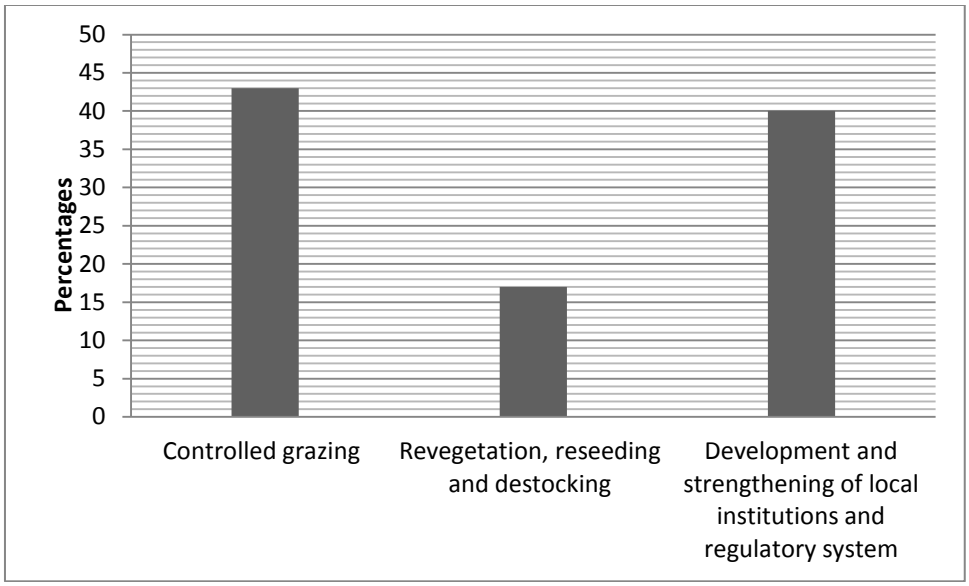

Figure 4 : Ways of reducing rangeland degradation

ii. *Institutions for rangeland management*

About 77 % of respondents indicated that institutions of rangeland management existed while 23% said such institutions were nonexistent in the area.

Existing institutions are predominantly community based (Figure 5). 50% of respondents indicated that community based institutions in the form of the neighbourhood watch committee and the committee of seven were instrumental in rangeland management issues. 30% of respondent were of the opinion that there were no institutions for rangeland management at all and 20% indicated that government agencies were a key institutes in natural resources management. This means that government and Non Governmental Organizations (NGOs) are playing a peripheral role in rangeland management.

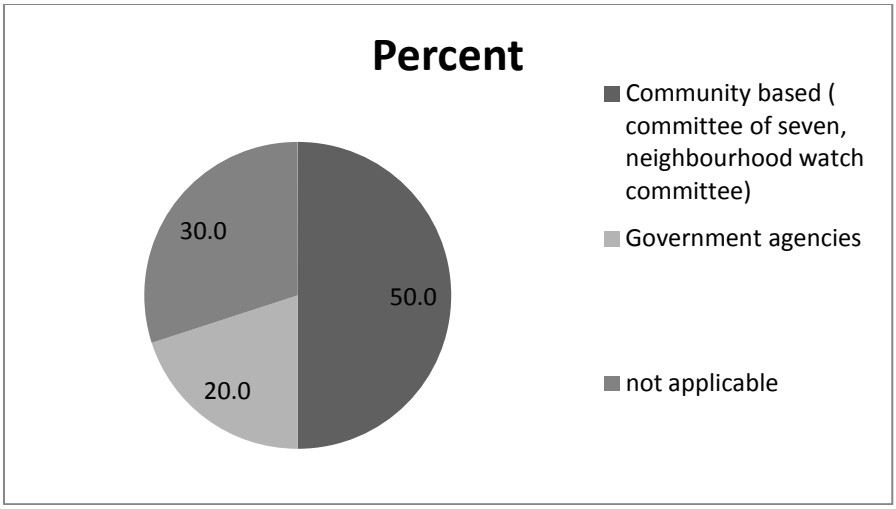

Figure 5 : Institutions for rangeland management in Insindi resettlement area

iii. *Effectiveness of institutions*

About 20% of respondents indicated that community based institutions are more effective while 40% indicated that they were not effective. About 10% of respondents felt that although government agencies were existed, they were not effective. About 30% indicated that institutions were neither there nor effective (figure 6). It is therefore clear that community based institutions play a critical role in rangeland management, albeit ineffective.

The results also suggest that people understand the dynamics of rangeland deterioration and also insights to sustainable utilization. No institutions existed to engender sustainability. Admittedly, legislation such as the Traditional leaders' Act, Communal Lands Forest Produce Act cap 19:04, Environmental Management Act cap 20:27, Forest Act cap 19:05 and Rural District Councils Act cap 29:13 are critical in rangeland management. However, these are peripheral to the issue with a consequent of unsustainable use. At the same time local institutions for natural resources

management that were said to be in existence are either the neighbourhood watch committee or the committee of seven established under the auspices of the Integrated land reform policy. Both institutions lack capacity to deal with rangeland issues. Apparently the core business of the former is to provide security services for the resettlement area and issues of rangelands are just but incidental to their core business. Hence degradation will remain a thorny issue in this area. The latter was established to enhance sustainable management of natural resources in the fast track resettlement areas. However, they were never trained in natural resource management. In addition, they do not wield as much power as they should with respect to environmental governance since there were no intensive environmental awareness campaigns carried out as a prelude to the land reform and also not everyone recognize the environment as a common rallying point. Over and above the results suggest that there are no effective institutions either community based or otherwise for sustainable development of rangelands in fast track areas. This confirms studies by Chigumira, (2010) and Chigwenya, (2010) that environmental governance institutions have broken down in the country due to a decade of political and economic crises with a consequent backlash on the receiving environment. Attached to this, the results suggest that no environmental management programmes are currently going on in the resettlement area since the majority did not meaningfully participate in rangeland management and those who participated were only providing security in the resettlement area. This is undoubtedly a serious gap which needs to be addressed.

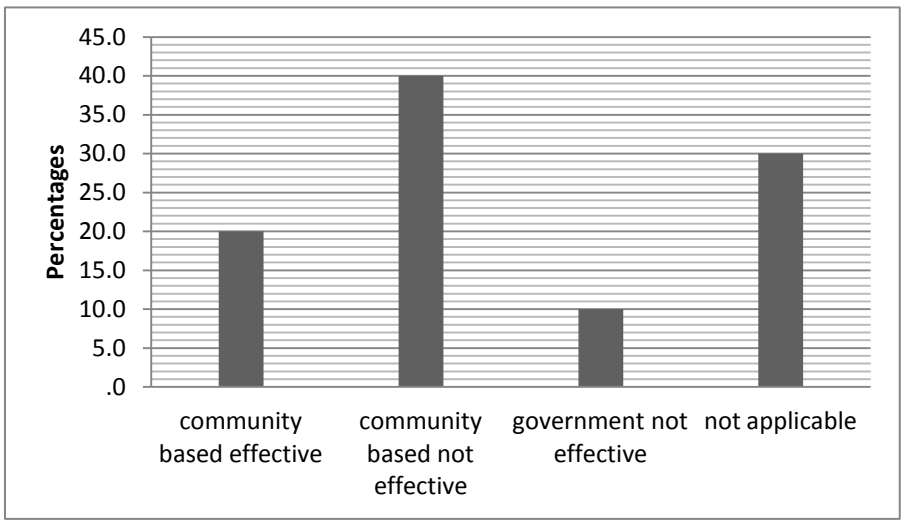

Figure 6 : Effectiveness of institutions in rangeland management

iv. *Participation of resettled farmers on rangeland management*

About 60% indicated that they participated in rangeland rehabilitation while 40% indicated that they are not involved in any rangeland management initiatives. Apparently the 60% that claimed participation in rangeland management were essentially involved in security services for the entire resettlement area, rather than actual rangeland management.

V. Conclusions

Admittedly, the fast track land reform, particularly smallholder schemes has led to community disturbance but rangeland condition is still relatively good to support the farming communities. Therefore, the fast track land reform has not entirely destroyed the agricultural as Campbell, (2008) would want us to believe. It can also be concluded that there is a dearth of requisite institutions and legislation for sustainable management of common property resources such as rangelands in Zimbabwe. There are relevant legislation such as the Environment Management Act, Communal Forest Produce Act and the Forest Act but enforcement is weak resulting in unregulated rangeland use. For example law enforcement agents find it difficult to enforce the Communal Lands Forest Produce Act in resettlement areas because it was not gazetted for such areas. To a greater extent, issues of rangeland management are just but incidental to these pieces of legislation. Hence, the need to develop institutions for sustainable management of rangelands in smallholder resettlement areas cannot be overemphasized. Therefore, disturbances caused by smallholder resettlements in semi arid regions of Zimbabwe if not properly managed could have serious and irreversible environmental effects in the near future. This could also undermine the local beef and wildlife economy which form the backbone of livelihoods in such areas. It is recommended that institutional development for management of rangelands as a common property resource would be critical in enhancing sustainable utilization rangelands. This should be accompanied by

revamped extension packages to promote environmental awareness and the importance of rangelands in the community. Also, strategic environmental impact assessments must be carried out by government in resettlement areas to militate against factors that are likely to cause more adverse rangeland degradation. Strategic environment assessments help inform policy, programmes and projects and could be a useful tool for the sustainable utilization of rangelands of rangelands in the smallholder resettlement areas. There is also a need to resuscitate paddock fences in the resettlement areas. The results of this present study showed that open grazing inadvertently led to overgrazing. Therefore, the resuscitation of the paddock system will go a long way in reducing overgrazing since livestock movement will be controlled with a consequent of reducing rangeland degradation. In order to achieve full benefits of the fast track land reform programme, technical support would be required to reduce rangeland degradation in the smallholder resettlement areas.

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Climate Change is Human Induced?

By Ashutosh Mishra

Abstract- Climate is the most vital element of our planet and its live ability is key concern for every habitat. From Silent Spring till present debate is on about humankind's impact on nature. Since its establishment in 1988, the Intergovernmental Panel on Climate Change (IPCC) has been playing pivotal role in raising public concerns on human-induced climate change through its various assessment reports. These reports follow exhaustive review process, and are widely accepted.

In 2007, IPCC`s 4th assessment report- 'Climate Change 2007 – Impacts, Adaptation and Vulnerability' came in question on Himalayan glacier melt. The Climate gate in 2009 further strengthened the confusion on credibility of IPCC`s projections. Present study analyses district level temperature and rainfall patterns of Uttarakhand- a Himalayan state, and examines the validity of IPCC`s projection.

Uttarakhand is a tourism oriented economy. State is best known for its religious places and natural sites. Rapid urbanisation in mountainous regions is disturbing regional eco-balance, but increasing vehicular pollution in climatesensitive areas seems to have greater impact on temperature and precipitation patterns. Result shows a noticeable shift in the variability of temperature and rainfall, and a significant warming especially in mountainous districts, However human activities does not correlate very well with these changes.

Keywords: climate-sensitive sectors, monsoon, climatic variability, polar caps, vehicular pollution.

GJHSS-B Classification : FOR Code: 040104

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Climate Change is Human Induced?

Ashutosh Mishra

Abstract- Climate is the most vital element of our planet and its live ability is key concern for every habitat. From Silent Spring till present debate is on about humankind's impact on nature. Since its establishment in 1988, the Intergovernmental Panel on Climate Change (IPCC) has been playing pivotal role in raising public concerns on human-induced climate change through its various assessment reports. These reports follow exhaustive review process, and are widely accepted.

In 2007, IPCC`s 4th assessment report- '*Climate Change 2007 – Impacts, Adaptation and Vulnerability'* came in question on Himalayan glacier melt. The Climate gate in 2009 further strengthened the confusion on credibility of IPCC`s projections. Present study analyses district level temperature and rainfall patterns of Uttarakhand- a Himalayan state, and examines the validity of IPCC`s projection.

Uttarakhand is a tourism oriented economy. State is best known for its religious places and natural sites. Rapid urbanisation in mountainous regions is disturbing regional eco-balance, but increasing vehicular pollution in climate-sensitive areas seems to have greater impact on temperature and precipitation patterns. Result shows a noticeable shift in the variability of temperature and rainfall, and a significant warming especially in mountainous districts, However human activities does not correlate very well with these changes.

Keywords: climate-sensitive sectors, monsoon, climatic variability, polar caps, vehicular pollution.

I. Introduction

India is considered highly vulnerable to climate change, not only because of high physical exposure to climate-related disaster, but also because of the dependency of its economy and majority of population on climate-sensitive sectors (e.g. agriculture, forests, tourism, animal husbandry and fisheries). More than 40 million hectares of India (12 per cent of land) is prone to floods and river erosion; of the 7,516 km long coastline, close to 5,700 km is prone to cyclones and tsunamis; 68 per cent of the cultivable area is vulnerable to drought and hilly areas are at risk from landslides and avalanches (NDMA, 2007). The country has a unique climate system dominated by the monsoon, and the major physiographic features that drive this monsoon are its location in the globe, the Himalayas, the Central Plateau, the Western and Eastern Ghats and the oceans surrounding the region.

The Himalayas influence the climate of the Indian subcontinent by sheltering it from the cold air mass of Central Asia. The range also exerts a major influence on monsoon and rainfall patterns. They prevent frigid and dry arctic winds from blowing south into the subcontinent keeping South Asia much warmer when compared to regions located between corresponding latitudes throughout the globe.

Himalayan glaciers cover about three million hectares or 17 per cent of the mountain area. They form the largest body of ice outside the polar caps and are the source of water for the innumerable rivers that flow across the Indo-Gangetic plains. About 15,000 Himalayan glaciers form a unique reservoir which supports perennial rivers such as the Indus, Ganga and Brahmaputra which, in turn, are the lifeline of millions of people in South Asian countries (Pakistan, Nepal, Bhutan, India and Bangladesh). The Gangetic basin alone is home to 500 million people, about 10 per cent of the total human population in the region.

The Himalayan ecosystem is highly vulnerable to the stress caused by increased pressure of population, exploitation of natural resources and other related challenges. Climate change may adversely impact the Himalayan ecosystem through increased temperature, altered precipitation patterns, and episodes of drought. According to IPCC`s 4th assessment report "*glaciers in the Himalaya are receding faster than in any other part of the world and, if the present rate continues, the likelihood of them disappearing by the year 2035 and perhaps sooner is very high if the Earth keeps warming at the current rate. Its total area will likely shrink from the present 500,000 to 100,000 km^2 by the year 2035*" (Cruz et al, 2007).

Syed Iqbal Hasnain, India's well-known Glaciologist, observes that "*The Ganga system is about 60 to 70 per cent snow and ice. There are more than 800 glaciers in the Ganga basin. The Gangotri is the big one. It used to cover more than 250 square kilometers, but now it's breaking up in many places. You will see blocks of dead ice that are no longer connected to the main ice body. I'm afraid that if the current trends continue, within 30 or 40 years most of the glaciers will melt out*" (Black 2009).

Contrary to Hasnain`s view, a white paper on the status of Himalayan glaciers and global warming by V.K. Raina, former Deputy Director General of the Geological Survey of India, suggests that *"in most cases glaciers have stopped retreating. While the Gangotri glacier stopped receding in the 2007-09 period, glaciers like Pindari in Kumaon continue to record a high annual retreat of almost 10 metres annually*". He further states that "*The glaciers are undergoing natural changes, witnessed periodically"* (Raina, 2010:7). According to assessments made during 1935-2006 by the Geological Survey of India, the Gangotri region has not shown any evidence of major retreat (Fig. 1).

Author: e-mail: ashutoshkmisra@gmail.com

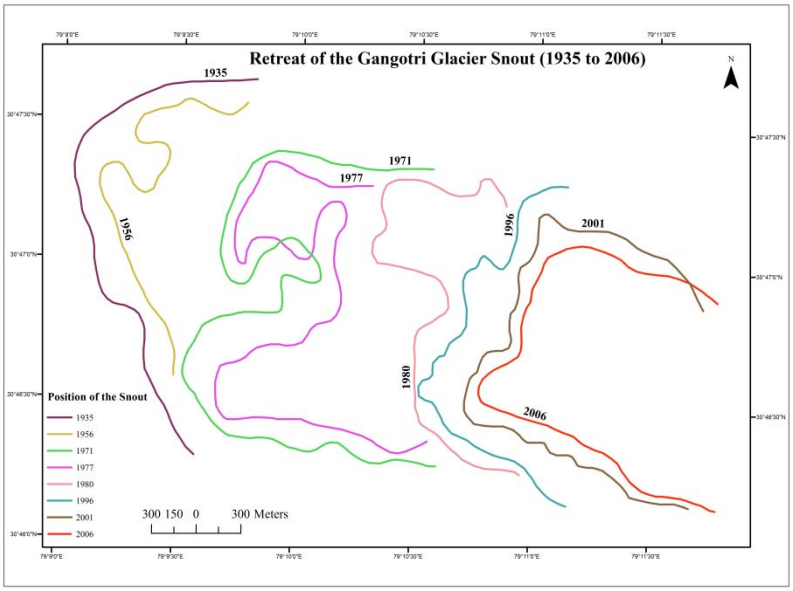

Figure 1 : Retreat of the Gangotri glacier snout. (1935 to 2006 based on maps made by the Geological Survey of India)

A glacier is affected by a range of physical features and a complex interplay of climatic factors. Establishing change in climate of the Himalayan region on the basis of movement of glaciers, and attributing this change to human activities without analysing the local climate variability, departures and level of human interference does not seems reliable.

Present work is an attempt to identify anthropogenic influence over natural climatic variability of the Himalayan region by considering Uttarakhand as the case of study. The data has been collected from Census of India, India Meteorological Department, Survey of India and Geological Survey of India, and simple correlation and regression techniques have been used for analysis of temperature and rainfall patterns.

Uttarakhand is a part of the Indian Himalayan region (Fig. 2). Owing to its immense natural beauty, rich biological succession and India`s great rivers feeding glaciers- Gangotri, Ponting, Milam, Pindari etc., the region is regarded as Devbhumi- abode of Gods, and Tapobhumi- land of asceticism in Indian scriptures.

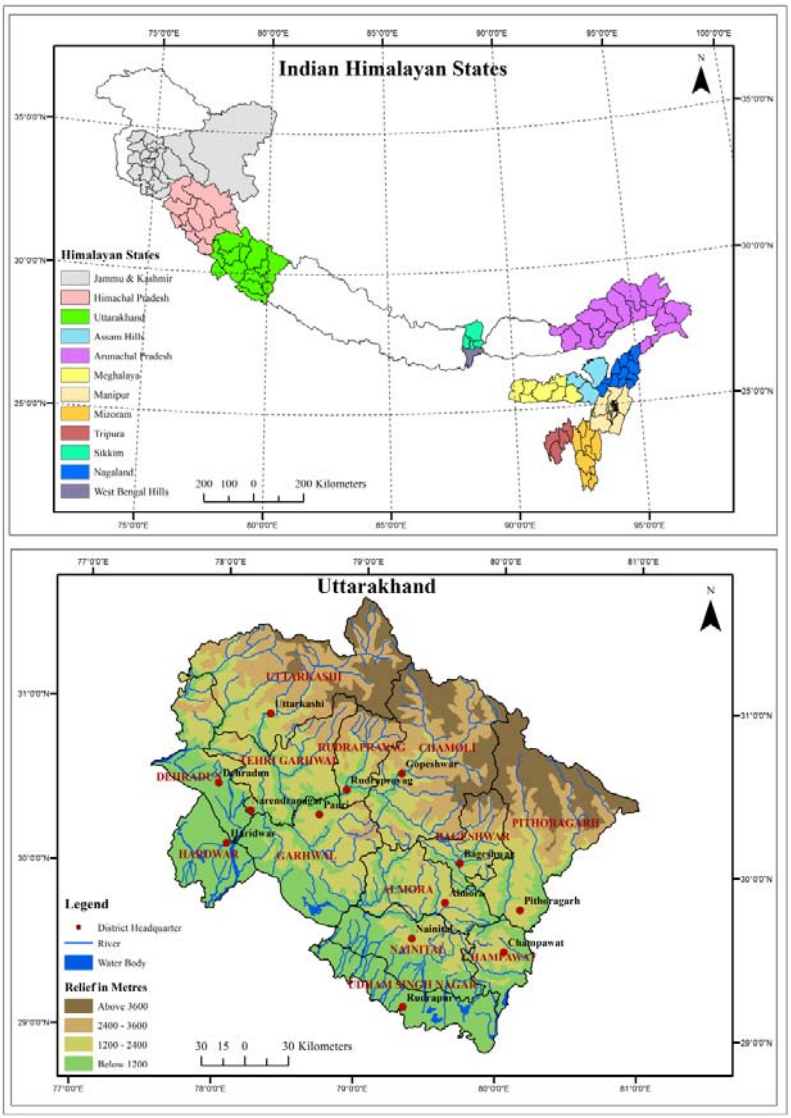

Figure 2 : Location map of Uttarakhand

The northern region of the state is part of the Great Himalayan Range, covered in snow and glaciers. Two of the Indian subcontinent's most important rivers- the Ganga and the Yamuna- also originate from the glaciers of Uttarakhand. The natural resources of the region provide life supporting, provisioning, regulating, and cultural 'eco-system' services to millions of local as well as downstream people. The state lies between the longitudes $77^0 34'$-$81^0 02'$E and latitudes $28^0 43'$-$31^0 27'$N having a maximum dimension of east-west 310 km. and north-south 255 km. It covers an area of 53,484 km^2 with the elevation ranging from 210 to 7817 mt. The state shares border with China (Tibet) in the North and Nepal in the East and inter-state boundaries with Himachal Pradesh in the West, Northwest and Uttar Pradesh in the South. Broadly the region constitutes of 13 districts falling in two major administrative unit viz., Garhwal (northwest portion) and Kumaon (southeast portion).

The climate of Uttarakhand is temperate, marked by seasonal variations in temperature but also affected by tropical monsoons. January is the coldest month, with daily high temperatures averaging below freezing in the north and near 21 °C in the southeast. In the north, July is the hottest month, with temperatures typically rising from 7 °C to about 21 °C daily. In the southeast, May is the warmest month, with daily temperatures normally reaching the high around 38 °C from a low around 27 °C. Most of the state's roughly 1,500 mm of annual precipitation is brought by the southwest monsoon, which blows from July through September.

II. Recent Climate Trend

Although climate represents a set of factors and determinants showing long term averaged state of the atmosphere over a region but temperature and rainfall are the two most prominent elements among them. Present study examines trends of rainfall and temperature at annual and monthly time scales for the

periods of 1911-2012 to understand the climatic variability of the region.

Uttarakhand has two physiographic zones- montane and non-montane. The mountainous regions have recorded more significant warming and declining rainfall trend, while Hardwar, which is almost plain, noticed positive rainfall trend (Table 1).

Table 1 : Regression result for temperature and rainfall patterns

S. No.	District	Correlation between temperature and time series (r)	Regression result for temperature series		Correlation between rainfall and time series (r)	Regression result for rainfall series	
			R^2	F		R^2	F
1	Almora	0.266	0.071	7.598**	-0.209	0.044	4.579*
2	Bageshwar	0.299	0.089	9.826**	-0.221	0.049	5.125*
3	Chamoli	0.315	0.099	10.984**	-0.184	0.034	3.515
4	Champawat	0.291	0.085	9.246**	-0.242	0.058	6.211*
5	Dehradun	0.232	0.054	5.694*	-0.035	0.001	0.125
6	Garhwal	0.247	0.061	6.515*	-0.122	0.015	1.503
7	Haridwar	0.221	0.049	5.124*	0.023	0.001	0.051
8	Nainital	0.260	0.068	7.254**	-0.201	0.041	4.229*
9	Pithoragarh	0.342	0.117	13.250**	-0.236	0.056	5.919*
10	Rudraprayag	0.308	0.095	10.514**	-0.153	0.023	2.404
11	Tehri Garhwal	0.263	0.069	7.435**	-0.114	0.013	1.311
12	UdhamSingh Nagar	0.260	0.068	7.275**	-0.164	0.027	2.769
13	Uttarkashi	0.308	0.095	10.455**	-0.103	0.011	1.075

** *: $p<0.01$, *: $p<0.05$*

It is evident that the temperature and rainfall departures from centennial average are significantly high in higher altitudes (Fig. 3).

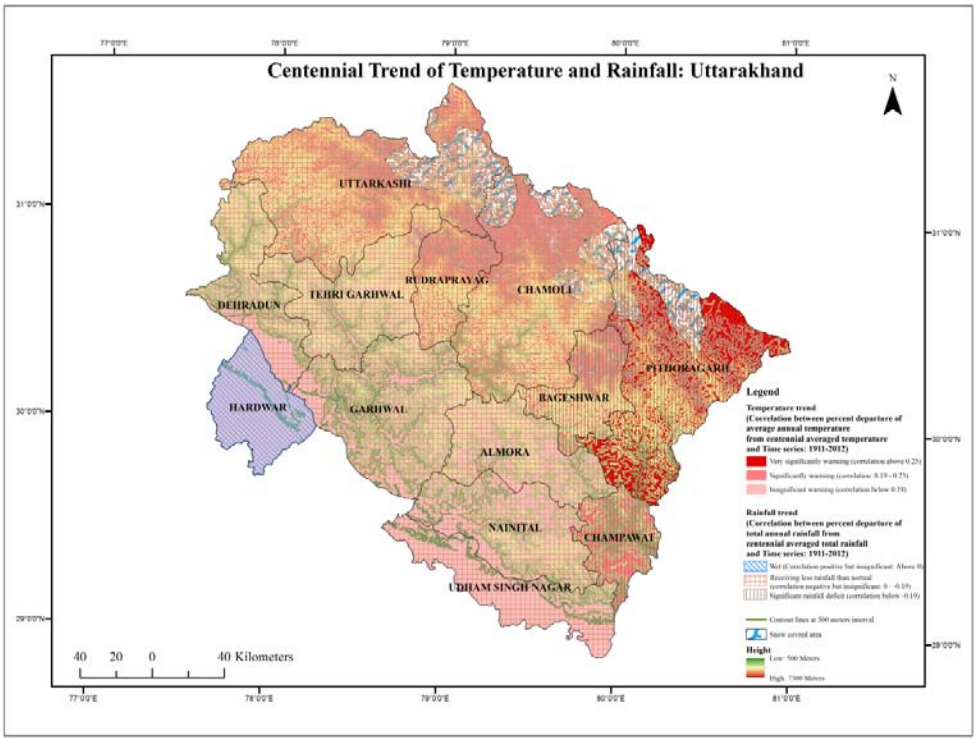

Figure 3 : Temperature and rainfall trend of Uttarakhand

Data shows four distinct phases of temperature patterns during the last century- no warming or cooling up to 1950, warming trend during 1950-1080, cooling trend between 1980-2000 and again warming after 2000. On the other hand the rainfall patterns recorded no significant shift from natural variability at centennial scale (1911-2012) (Fig. 4).

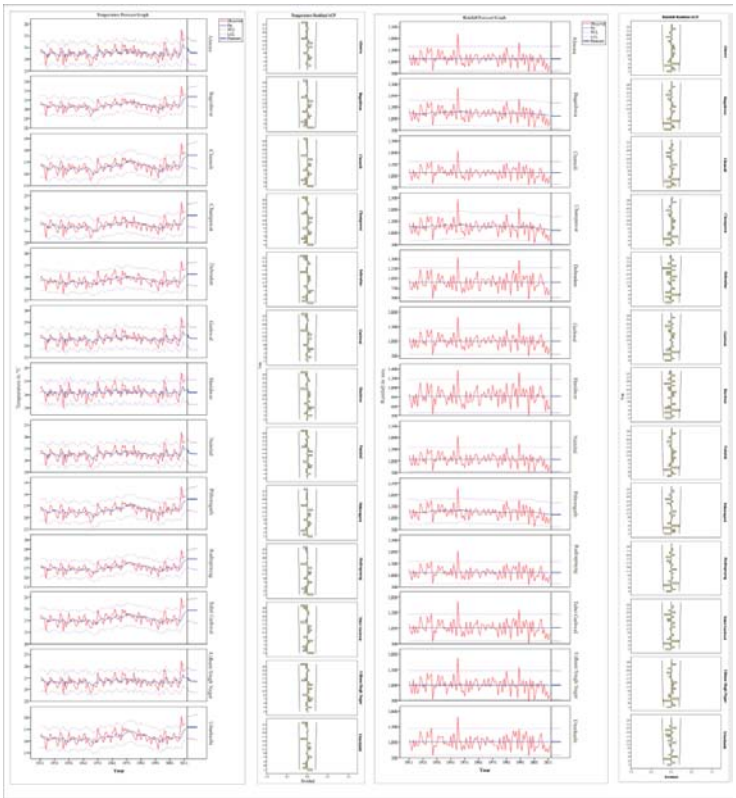

Figure 4 : District level temperature and rainfall forecast graph for Uttarakhand

Analysis of monthly average temperature data shows very striking results. Colder months- January, February, November and December, have recorded significant warming while the hottest months- June, July, August and September, have shown cooling trend. The study area receives most of its rainfall during the months of July and August but during last century (1911-2011), these months have recorded declining precipitation trend. The months of March and May on the other hand have received more rainfall than normal (Fig. 5). Interestingly the districts of non-montane physiographic zone have shown lowest departures.

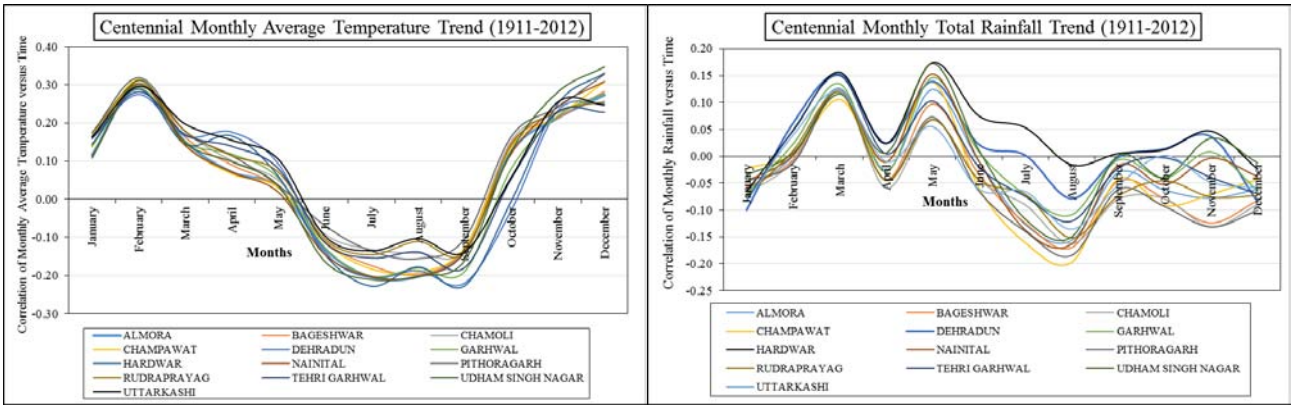

Figure 5 : District level centennial monthly temperature and rainfall trend of Uttarakhand

(Correlation values above 0.19 are significant and above 0.25 are highly significant)

The state has recorded a continuous growth in population during the last century except in 1921-31, however the urban population has grown at faster rate. Most of the population lives in the lower districts where urban share is high (Fig. 6).

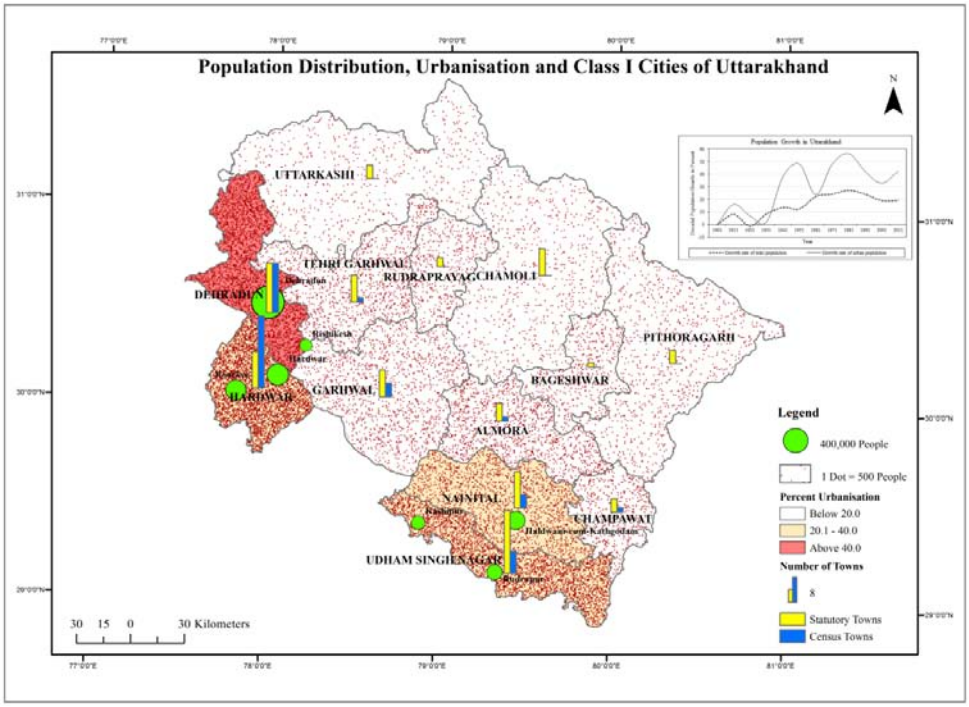

Figure 6 : Population distribution in Uttarakhand

Hardwar and Dehradun districts record the highest population and percent urbanisation, and have the highest number of census towns (Table 2). These two districts have noticed less warming than others. Contrary to other districts, Hardwar has recorded an increasing rainfall trend although this trend is insignificant. Evidently urbanisation holds no significant association with temperature and rainfall trends.

Table 2 : Urbanisation in Uttarakhand

S. No.	District	Total Population	Percent Urbanisation	Statutory Towns	Census Towns	Village
1	Almora	621927	10.02	4	1	2289
2	Bageshwar	259840	3.5	1	0	947
3	Chamoli	391114	15.11	6	0	1246
4	Champawat	259315	14.79	3	1	717
5	Dehradun	1698560	55.9	11	11	748
6	Garhwal	686527	16.41	6	3	3473
7	Hardwar	1927029	37.77	8	16	612
8	Nainital	955128	38.94	8	3	1141
9	Pithoragarh	485993	14.31	3	0	1675
10	Rudraprayag	236857	4.19	2	0	688
11	Tehri Garhwal	616409	11.37	6	1	1862
12	Udham Singh Nagar	1648367	35.58	14	5	688
13	Uttarkashi	329686	7.35	3	0	707

Source: Census, 2011, GOI, and computed

Heavy forest diversion for basic infrastructures is also being accused for deteriorating local climate`s stability. But data suggests that green cover removal is not directly related with the warming. Dehradun and Hardwar which have recorded largest forest diversion are not the warmest districts of the region (Table 3). Forests attract rainfall, but here Hardwar having the noticeable forest diversion, has shown an increasing rainfall trend.

Table 3 : District wise/Sector wise details of forest area diverted from 2000 to 2013

District	Total forest diverted area in hectare	Percent of the total forest diverted area for different purposes						
		Road construction	Managing drinking Water	Irrigation	Electricity transmission Lines	Hydroelectric power plants	Mining	Other uses
Almora	816.29	88.36	1.7	0.61	2.94	0.01	0	6.39
Bageshwar	559.05	67.73	1.57	0.52	0.99	2.88	20.01	6.3
Chamoli	2097.74	44.85	0.46	0.05	37.45	11.54	0.05	5.59
Champawat	738.57	37.76	0.8	0.28	0.49	0	52.09	8.58
Dehradun	19496.09	2.05	0.05	0.01	0.13	0	8.22	89.54
Garhwal	677.4	43.97	2.95	0.18	24.69	0.43	21.48	6.3
Haridwar	5197.71	1.16	0	0.31	0.16	0	55.79	42.57
Nainital	3165.71	13.71	2.24	0.32	0.61	0	77.14	5.98
Pithoragarh	1667.66	66.42	0.58	0.1	29.6	0.75	0.25	2.3
Rudraprayag	389.56	66.19	1.76	2.36	3.99	16.16	0	9.55
Tehri Garhwal	1591.74	30.35	1.16	0.08	9.88	44.46	0.41	13.67
Udham Singh Nagar	156.23	9.15	0	2.3	3.16	0	0	85.39
Uttarkashi	830.95	52.71	1.1	0.95	13.22	27.59	0	4.44

Source: Uttarakhand forest statistics, Forest Department, Government of Uttarakhand, p. 44.

Uttarakhand is famous for religious and adventure tourism. Noticeably the tourist pressure at four major religious centres of the state have been almost doubled during the last twelve years (Table 4).

Table 4 : Tourist inflow at selected location in Uttarakhand

Place	District	Percent increase in tourist Inflow (2001-2012)
Yamunotri	Uttarkashi	240
Gangotri	Uttarkashi	250
Kedarnath	Rudraprayag	378
Badrinath	Chamoli	136

Source: CSE, 2013

The three districts– Uttarkashi, Rudraprayag and Chamoli, where these religious centres are located, have recorded very significant warming during past decade. Increasing vehicular pollution seems fuelling temperature rise in these areas. Although growing industrialisation and vehicular density in Dehradun and Hardwar districts have no significant impression on temperature trend on the other hand. It can be said that vehicular pollution is more significantly correlated with temperature patterns in hilly areas while in the plain region, it has less impact on the atmospheric state. In other words neutralising capacity of plain ecosystem seems greater than mountainous ecosystem.

III. Conclusion

Analysis shows noticeable departures in temperature and rainfall patterns. Months of March and May have recorded more rainfall and significant warming. Temperature of June, July, August and September are at cooler side. Result shows that surface temperatures have risen significantly during the last century, but this may be result of various cooling and warming phases. Besides having significant temperature-time correlations, R^2 values are very weak because of very noisy data. The ARIMA models predicted warming up to 0.3°C till 2035, being maximum for Chamoli district. Results show that this change is almost natural rather than anthropogenic. Warming is unequivocal with decreasing rainfall (except Hardwar), however, temperature and rainfall patterns do not fully support the hypothesis that urbanisation, industrialisation or green cover removal have great bearing on this warming or drying trend. Although increasing vehicular pollution in temperature-sensitive high altitude areas seems to have some impact on these trends. We can say while human interference has fuelled some variations in patterns, natural factors are the major cause behind climatic variability and changes. IPCC`s claim that due to human intervention in the Himalayan ecosystem, up to 2035 we are going to lose large volume of glaciers, thus, does not seem a real claim.

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The Quality of Leadership that we have in Zimbabwe: A Formula for Real Disaster (2013 - 2014)

By Dr. Silas Luthingo Rusvingo
Great Zimbabwe University, Zimbabwe

Abstract- The objective of this Paper is to expose the quality of leadership that we have in Zimbabwe and thereafter to come up with a Summary, Conclusion and Recommendations designed for risk treatment.

Keywords: quality, leadership, zimbabwe, formula, disaster.

GJHSS-B Classification : FOR Code: 049999

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Abstract- The objective of this Paper is to expose the quality of leadership that we have in Zimbabwe and thereafter to come up with a Summary, Conclusion and Recommendations designed for risk treatment.

Keywords: quality, leadership, zimbabwe, formula, disaster.

I. Introduction

A foretaste of the quality of the leadership in Zimbabwe is ably demonstrated by Robert Gumbura. He was leader of RMG independent End Time Message Pentecostal Church. He was a polygamist with six young wives aged between 20 and 25 years of age, despite that he was 57 years of age. The church leader caught the eyes of the Author when he appeared before a High Court Judge facing four counts of rape involving female congregants and one count of possessing pornographic material. He had in February 2014 been found guilty of the five counts as charged and had been jailed for forty years. What had shocked the Author at first was Gumbura's criminal enterprise given he had six young wives against his advanced age of 57 years. Secondly, it was the kind of indoctrination that he gave to his church congregants, both men and women which left the Author gasping for air with shock. From the media shocking reports the Author had read about a woman congregant who had been raped by Robert Gumbura, leader of the said church. The raped woman had a hasty retreat to her husband to appraise of what had happened to her. But to the Author's complete surprise, the suppossedly offended husband had taken it *pore pore* (meaning without much ado) when he stopped the aggrieved wife from making a police report of the alleged rape. The Author wondered what was the excuse that one can let a man who had raped his wife to walk scot free. From the barbaric indoctrination given to his church congregants both men and women Robert Gumbura, the Church leader, is a Jesus Christ incarnate. Anything done by Gumbura, whether its rape, murder etc it is Jesus Christ who has committed the grisly rape and murder and people should not complain about what Jesus Christ incarnate has done to mankind. That rape and murder committed by Robert Gumbura is actually a spiritual blessing from God himself. The third weapon that Robert Gumbura used against his gullible church congregants was the fear factor. Him being Jesus Christ incarnate, he had the power to cause death or ill health to any of his congregants. As a result of this fear factor instilled into the gullible members of his church, the church congregants feared him more than people in Zimbabwe feared His Excellence President Mugabe at 90, president of Zimbabwe for an uninterrupted 34 years and 38 years in 2018 and more than 38 years as he has vowed to stand again in the Presidential election of 2018. The criminally enterprising Robert Gumbura employed what the Author will call baboon and monkey tricks to govern his gullible supporters instead of righteous principles which resonate with not only good corporate governance but biblical teachings (Chidavaenzi 2014).

This is the Author's ignition to the leadership crisis bedevilling Zimbabwe. To do full justice to the topic under discussion in this Paper the Author will have to make an announcement about the relevant literature review which is up next.

II. The Relevant Literature Review: The Quality of Leadership we have in Zimbabwe: A Formula for Disaster

There is no doubt in the Author's mind that the heart wrenching story of Robert Gumbura of the End Time Message Pentecostal Church was a perfect start to the leadership crisis in Zimbabwe. To this topic the Author lined up a number of prominent journalists from the media of pluralism in Zimbabwe with each one of them giving his relevant contribution on the said topic. And without much ado the Author will call upon Chimakure to give the audience his contribution.

a) Elect leaders with a vision (Chimakure 2013)

His Excellence President Mugabe, 89, who was then seeking re-election in the 31 July 2013 harmonized elections had told a Japanese news Agency that he had given thought to quitting but had decided against the idea. Sounding confrontational against the innocent Britain, his Excellence President Mugabe had said:

Author: Great Zimbabwe University. e-mail: srusvingo@yahoo.com

"I have thought about retirement, but not when the British are saying we want regime change".

The then 89 year old His Excellence had told the Kyodo News Agency in an interview in Yokohama in Japan that:

"I won't be changed by the British. My people will change me".

His excellence President Mugabe, in Japan for the three day Tokyo International Conference for African Development said he would not need calls from Britain to step down as he had taught democracy to the British (Kyodo News Staff Reporter 2013).

It was this background that Chimakure (2013) intervened to give his contribution which was quite worthwhile. Chimakure (2013) was referring to a story title Zimbabweans were afraid of elections in which Zimbabwe Electoral Commission Deputy Chairperson Joyce Kazembe openly stated that the electorate is scared at the prospect of elections.

"There is fear out there. People are afraid of elections. That fear is real. There is also fear of the unknown. It will take time to remove that fear," Kazembe said.

While the informed people agree with Kazembe that voter education is crucial to remove this fear from the electorate, people also believe that voter education should teach the people to go beyond merely exercising their right to vote, it should enable them to vote for leaders with a positive vision for national development. In the then forthcoming elections, voters should be made aware that Zimbabwe then required a new generation of leaders and not to re-elect the same leader time in time out. The new generation of leaders would build the country's economy to a competitive level globally for the benefit of citizens. The electorate would be taught that leaders should be voted into power not on strength of their sloganeering and demagoguery, but on the strength of their vision and commitment to nation building (Chimakure 2013).

Zimbabwe's problems since independence emanated from leaders whose focus was narrowly confined to self enrichment, patronage and party politics. Voters should be disabused from voting such people into power. They should elect leaders with a powerful vision for sustainable development etched in strong participatory democracy. People need leaders with a concrete vision for the future. We should have leadership characterized by creativedreamers who can embrace globalization, leaders who do not dwell on past achievements – real and perceived. This is where voter education counts for it is the electorate that can elevate people of such caliber to the corridors of power. The electorate also has the power to kick out leaders who think Zimbabwe belong to them and a few friends and relatives. Such people have no sustainable vision for the growth of this country and they must not be in positions of power at all. Voters should understand that through the ballot they wield more power than politicians who intimidate them through killing, maiming or rape. In fact, their power as voters is permanent unlike that of politicians that is temporary for it depends on the very same voters they intimidate and thrust with contempt (Chimakure 2013).

Museve's contribution was quite remarkable as he quite rightly dwelt at length at Zimbabwe's leadership failure. For this more details coming your way.

b) Zim's leadership failure (Museve 2014)

The graft and corruption that is now being unearthed means that His Excellence President Mugabe had failed to do the job for which he was mandated. The main responsibility of any president must be to effectively preside over the affairs and administration of the country. In order to achieve that His Excellence President Mugabe should appoint ministers who should be appointed on merit. Their responsibility is not only to ensure that not only government policy is effectively implemented but to ensure that it is effectively administered and in line with the Constitution and the laws of the country including adherence to the country's budget. In addition His Excellence President Mugabe is provided with all the resources he needs to ensure he is effective in carrying out his mandate according to the constitution. His Excellence is even provided with high level security and all the necessary comforts to ensure that his decisions are objective and serve the interests of the people first. This is to ensure that he stems corruption, fights graft and is not easily influenced or swayed in making decisions that may prejudice those that seek to disadvantage the interests of the country as a whole. The graft and corruption that is now being unearthed means that His Excellence President Mugabe has failed to do his job. His Excellence should take full responsibility for the failure of public institutions to serve the needs of the country including the management of State Enterprises and our national resources. Of course those he has deployed to manage our economy have failed in their duty but they should be answerable to him and him alone. Unfortunately the unearthing of the monumental deception committed through abuse of public funds is now being framed as a victory for ZANU PF which is most absurd. How can the very people who produced this vomit get the credit for finally cleaning it up? The MDC-T including its president, must also take responsibility for its failure to highlight and expose those fleecing State enterprises and national resources during the Government of National Unity (GNU). This is not the time for excuses. It is just not it, but we could not do anything about it. Of course, ZANU PF prevented the effectiveness of the MDC-T, their rival in the GNU. However, the minister responsible should still have done something about it. The least he could have done is to expose it. But, once more, he has excuses and refuses also to take responsibility. This, again, shows how our

leaders continue to blame circumstances for poor performance and failure to deliver (Museve 2014).

All this and the recent nearly violent abusive reaction of MDC-T youths including some of its leaders to call for Morgan Tsvangirai to retire, was shocking forcing people to realize that our politics was really not about competence or delivery. Rather it is more about popularity and if necessary, threats of violence against those who may see things differently. This has also happened in ZANU PF, mind you. We have seen supposedly intelligent and mature people avoiding the discomfort of the truth and failing to challenge Mugabe's leadership incompetence, despite everything showing that this country is facing catastrophic failure because of mismanagement from the top. Instead they must pretend that all is well, as long as they have their perks and keep their positions. This is the culture that we are faced with; a culture that has nothing to do with performance, but rather a culture of fear and always shifting blame; a culture of avoiding the inconvenient truths. It's comical because if you criticize ZANU PF you are an agent of the West and if you criticize MDC-T you are an agent of ZANU PF. And the circus continues. How ridiculous! Unfortunately the culture has permeated all sectors of our society including the private sector where our executives earn huge packages, avoid tax but cannot meet payroll obligations. At this rate it will surely take eons for us to create a modern state in Zimbabwe. It is time then that the people will always get the leadership that they deserve (Museve 2014).

Museve had a very interesting conversation the other day about the nature of our politics. The poor masses provide the members during voting time, and that is where it ends. This explains why a bag of mealie meal can buy a politician unfettered five years in power. The masses seem easily swayed by foolish things. As a result, the quality and standards of our leadership are not really challenged; the masses will deliver the vote anyway, so why worry? As long as this is the case, we are unlikely to see a vibrant democracy and a modern state where our leaders are accountable and do not always blame someone out there. We must break this pattern. The one solution we have is to establish a new democratic mass movement, but the challenge will remain on how we get the masses especially our exuberant youths and rural folk to understand their responsibility and the need to value leaders not because of their names or history but on their competence and on what they can do for Zimbabwe in the future. It will take educating the masses and forcing them to realize that unless we change the game, they will continue to be taken for a ride as electoral fodder. Zimbabwe needs new vision and a new ethos in politics that puts Zimbabwe first and continually challenges our leaders to behave and be accountable. Without that there is no improvement in our political discourse and democracy. Always remember that the people come first (Museve 2014).

The MDC-T leadership renewal debate was reported to be exposing cultism and cheifism (Makoni 2014). For more on this new way of thinking in our politics let us join Makoni (2014) as she labored to explain to us what is cultism and cheifism in our new political philosophy in Zimbabwe.

c) MDC leadership renewal debate, exposes cultism, chiefism. Whats loyalty got to do with it? (Makoni 2014)

The furore allegedly made by Elton Mangoma, deputy treasurer in the MDC-T raised a lot of issues that are emblematic of the problems that have landed Zimbabwe in the crisis that has been ongoing for a decade. This problem has been a crisis of leadership; a problem of sacred cows in leadership, of personality cults and worship of leaders; chiefism and failure to lead. But mainly it has been the failure by those to speak the truth to power the abject failure to hold leaders to account. We have seen this before, of course on a larger scale. Peoples' patriotism had been called into question when people have sought to hold leaders accountable, for example, His Excellence President Mugabe and Edgar Tekere, the Secretary General of ZANU PF had crossed swords in the 1980s when the two could not agree on a one party state of government then spearheaded by His Excellence President Mugabe. Holding different views has even led to the arrest of some within the MDC-T and their being charged with treason. Surely a party formed as the democratic alternative should be able to tolerate a little criticism and internal dialogue. There should surely be an internal system of checks and balances that seek to rein in excesses whether they be by the dear leader or by the youths who guard the entrance to the party's headquarters Hrvest House. The Mangoma issue where he had called for a party leadership renewal is born of the same mind set, a leadership mindset that does not tolerate dissent. The mindset that creates sacred cows that are above question by the rank and file are being made to make sacrifices for the party. A mindset that given the right tools and power can easily result in the ruthless extermination of perceived opponents eg, Elton Mangoma calling for a leadership renewal in the MDC-T and then getting assaulted by the party's youths at the instigation of Morgan Tsvangirai the MDC-T leader and president of the same party. People have witnessed the same mindset in the ruling ZANU PF before (Makoni 2014).

Having set the context and declared his layout to the party, to the dear Leader and the movement, Mangoma moves on to more substantive issues and in particular the disputed 31 July 2013 harmonized elections. Quite rightly he called out the MDC-T leadership for having allowed the electoral fraud that

resulted in the resounding defeat of the opposition MDC-T party in the 31 July 2013 harmonized elections. Introspection is always good and owning up to failure and taking responsibility allows people to create space for addressing those wrongs. Ok, ZANU PF rigged those elections but the story was getting old and stale. They rigged in 2000, the MDC's first ever election and despite the party's relative youth and inexperience and notwithstanding the brutal violence accompanying that election the MDC acquitted itself well in that election. The next elections were in 2002. Again, they were characterized by brutal violence and rigging. Then in 2005 there was more rigging and violence. Then in 2008; more rigging and even more violence. Come the 31 July 2013harmonized elections. There was still more allegations of poll theft. Now the pertinent question is at what point does the always losing MDC-T start singing a different song? Frankly the rigging song or mantra was always going to get tired. Did the party not think those elections were going to be rigged? If they did why insist on moving ahead with them without insisting on safeguards first? Why evenparticipate in a flawed election process in the first place when all the previous attempts have produced an unsatisfactory result for them? If then someone were to call for introspection and self reflection for the party and its leadership is that person wrong? Is that not the logical thing for the party to do? Did the clueless party ever think they could win the election, the rigging not withstanding? In which event there was either a serious over-estimation of their supporters' enthusiasm (a shocking conclusion in light of the ever diminishing returns at the polls) or a serious under-estimation of their opponents. Either way leadership needs to take responsibility for failures of intelligence, strategy or both (Makoni 2014).

Mangoma went on to mention the confusion and consternation that he said gripped the party following the elections in which they resoundingly lost. Well, that confusion by the party begs the question, had the MDC-T not done any scenario planning? Did the clueless leadership, never think 'what if we lose?' If they did, what then was the confusion and consternation about? Well apprehension certainly gripped even those people outside of the party following the resounding loss in the 31 July 2013 harmonized election as people pondered the implications of the then disastrous result on Zimbabwe's future. The analytical Mangoma noted that it was during this period of internal confusion that the bitterly disappointed Tsvangirai was embroiled in his public, but personal imbroglio with his wife with ZANU PF connections for that matter. (An aside here: Tsvangirai needs to learn the credo 'the personal is political if you are your party's presidential candidate').So far, what analytical Mangoma was saying was common cause. To the outside observer the confused Tsvangirai then appeared to be pre-occupied by these personal affairs at the expense of the democratic project. The highlight for anybody of average intelligence was Tsvangirai visiting the Nigerian popular prophet Temitape Balogun Joshua, better known as TB Joshua. Nothing wrong in seeking and receiving spiritual guidance, but to make that a priority in the face of the massive challenges confronting his party and the country is beyond even the Author himself. To travel all the way to Nigeria for receiving spiritual guidance at a time when your party is on the back foot reeling from defeat is not only even more astounding but resonates with the Author's narrative in his ignition in this Paper that the Zimbabwean quality of leadership is *'a formula for disaster'* it showed Tsvangirai as an erratic and weak person, someone who was at his wits' end and was now seeking divine intervention or inspiration and or answers in the occult. At this material time in the history of not only Tsvangirai, but Zimbabwe, that it did not help. Worse was his spokesperson Luke Tambironyoka who sought to explain this surprise visit to the prophet as occurring in the course of a 'diplomatic' mission to Nigeria (Makoni 2014).

There was a feeling among the people that the MDC-T could have handled the post-election period better. Moreso, Tsvangirai himself had not handled his public but personal affairs any better. Beyond a shadow of doubt. His alliances with multiple women had actually done more harm than good to the MDC-T party then left alone in the political wilderness. Tsvangirai's poor handling of Lorreta Nyati, Lorcadia Karimatsenga, Nosipho Shilubane and Elizabeth Macheka, to name just a few of his dubious women friends made many people question his leadership capabilities. Hell, Yes. Tsvangirai has displayed an amazing lack ofjudgment, a lack of discipline and shocking lack of discretion. Imagine a world of increasing complexity with so many beautiful women outside ZANU PF why did Tsvangirai go for women that had a ZANU PF connection? He himself might have the appropriate answer. But the irreparable damage done to the MDC-T as a party was not only permanent was excessive not only for his liking but for his supporters alike. For your information the post election period was characterized more by Tsvangirai's problems and shenanigans involving women with ZANU PF links and less by the MDC-T's response and reaction to the election. Let it known here and now that Tsvangirai's poor handling of his personal affairs which to the Author was washing dirty linen in public, had actually done a good job of '*assassinating'* his character and he did not need Mangoma's dissent to do that. A matter of fact which was and is undeniable, is that it is naïve and foolhardy of the MDC-T to think that Tsvangirai could go through all these scandals and women shenanigans and emerge with his brand unscathed. *'Mwari rambai!'* (meaning God forbid!). It is appropriate, therefore, for the party to have an internal discussion on the implications for their party and its legitimacy among their constituency and their

stakeholders and yes, these include their funders. As said by the Author before, if you are the party's and presidential candidate the personal is political! (Makoni 2014).

The same Makoni sequed into the critical issue of leadership renewal and its terms. For more on the story let us peruse the next paragraph.

d) Leadership renewal: Terms should be adhered to (Makoni 2014)

Well, leaving aside Tsvangirai's personal shenanigans leadership renewal should be written into the very fabric of the DNA of any democratic party. The relevant terms should be prescribed and the terms so prescribed should be adhered to. People should be made to understand a reason why there are a constitution. But most important it is about constitutionalism; the adherence to the values and principles of constitutions – even when it is personally inconvenient to do so. In the democratic project, it should never be that the only basis for leadership renewal is misbehavior of the leader. Nor should it be that the most popular person can remain party leader for ever as the case in ZANU PF where His Excellence President Mugabe has been the president of ZANU PF since 1977 and continues to be well into 2014 and beyond. In a country of 13 million people there should never be one person who can lay claim to having a right to lead in perpetuity. There is no one person who knows it all and who can do it all. That is why we have different parties and movements. It is always going to be a team effort. Tsvangirai has been a leader who has been leading the MDC-T since 1999. Any new ideas he had have been introduced and innovations have since been implemented and consolidated (or not). It is imperative for the MDC-T to create space for new leadership, new ideas and indeed 'fsh impetus' as Mangoma calls it. Leadership of a country should never be about rewarding a person for the role they played in *'liberating us'.* Look where that has gotten us. Let us consider the questions asked by Mangoma in his famous letter, the subject of his expulsion from MDC-T. Did they fail in their reform agenda? The party's conduct towards the 29 Glen View activists says they did. These people were in prison for almost as long as the MDC-T was in the Government of national Unity, having been arrested in 2011. One such arrest was Cynthia Manjaroarrested by the police as bait to get to her boyfriend. The last 3 were only released in 2014. One Rebecca Mafukeni died in prison. The MDC-T went to the election knowing their supporters were in prisons. They were not convicted criminals. Did someone in MDC-T say something about reforms? (Makoni 2014).

There is a raft of failures to deal with issues outlined in the Global Political Agreement (GPA) which is the agreement which gave birth to the Government of national Unity (GNU) in Zimbabwe from 2009 – 2013. The failed institutional and legislative reforms, the nauseating corruption within the MDC-T led councils, were chief among some of the glaring failures by the MDC-T party. After resoundingly lose the 31 July 2013 harmonized elections Tsvangirai is anxious to engage His Excellence President Mugabe, over the luxury house he had been staying in as Prime Minister, during the GNU (2009-2013). Hardly, the stuff to inspire confidence in the legitimacy of the party or its office bearers. People begin to wonder was he in it for the house? Tsvangirai did not need someone to smear his character. He appeared to be doing a good job all by himself. So, should there be a leadership renewal? In a word, Yes. Every interested person in the MDC-T should throw their name in the hat. They should fight it in the party and may the best person then be presented to Zimbabweans. The requirement has been made that no one person is the MDC-T has the grassroots support that Tsvangirai has. Well, this could be true. But Tsvangirai was not born the MDC president just like His Excellence President Mugabe was not born the ZANU PF president. There is nothing pre-ordained or pre-destined about their party leaderships. Zimbabwe does not owe Tsvangirai or His Excellence President Mugabe a right to president of this country come the next harmonized elections in 2018. If Tsvangirai or His Excellence President Mugabe wants to be president they each have to prove themselves worthy of leading this country. If Tsvangirai or His Excellence are genuinely interested in their legacies let it be that of each mobilizing his party to rally behind whichever person becomes the leader of their respective parties after them. Let it be a legacy of building the democratic institutions of their respective parties. Let it be that of setting the democratic example of how to pass on the baton stick. Newspaper headlines such as 'I won't go', 'my people will change me' in the case of His Excellence President Mugabe or Tsvangirai headlines such as 'Tsvangirai tightens grip on the MDC' sound eerily and frightfully familiar. Let not these be the legacies of holding their respective parties to ransom (Makoni 2014).

Kajau reiterates to echo Mangoma's sentiments, that the people want a new leadership in the MDC. For more on this story let us find out what he has to say in just a moment.

e) We need new leadership in MDC (Kajau 2014)

To resonate with the popular call by the various stakeholders so far Kajau was singing from the same hymn book when he was contacted to give his contribution. He said that Morgan Tsvangirai was not a sacred cow in the MDC-T party and he is not bigger that the MDC-T. The party is an organization which should continue to flourish even after the departure of any given individual. The people are not worried about change of leadership because MDC – T is not Tsvangirai and

Tsvangirai is not MDC-T. The people's aim is that, MDC needs to spruce up its image ahead of 2018 which is fast approaching. Certainly people cannot face the next polls under the presidency of this perennial failure who betrayed us over the years from the year 2 000 to date (2014). Democracy should rule the party not selfish people who want to cover up for their natural weaknesses (Kajau 2014).

Tsvangirai should not be a life president of the MDC-T. People need new leadership now! Shame to your remaining sympathizers who still boot-lick Tsvangirai blindly. Everyone including the Western sponsors and diplomats are equally disappointed by the poor performance by Tsvangirai whom people want as a goner yesterday. All dissenting voices in the MDC-T party should rise now and shine so that everyone in the party may see the light. Spearheads such as Elton Mangoma and Tendai Biti are living heroes if not legends who people should salute for standing firm against oppression (Kajau 2014).

If the Author were allowed to partake in the ongoing public outrage about the leadership crisis in Zimbabwe is never, never ever name a political party after one individual in the same party. The name MDC-T is an acronym for Movement for Democratic Change – Tsvangirai. So in a way Tsvangirai is right by categorically saying 'I won't go anywhere, people will change me or take out my name which is a suffix to the name of the party'. In any case any leader who wants to be a leader of a political party in perpetuity is like a twit if not a twit himself. This world of increasing complexity would be a better world without people like the said twits.

Mukundu, a regular contributor came blazing his attack against what he saw as a leadership crisis in Zimbabwe resulting in a destroyed and damaged Zimbabwe as people know it today. For more on Mukundu's contribution details coming your way in just a moment.

f) Leadership deficit more glaring (Mukundu 2014)

The May 2014 confusion on the government's purported revision of the controversial Indigenization and Economic Empowerment law and the furore that this created, points to a government working in discordance and lacking a coherent leadership.

Information Minister Honourable Jonathan Moyo was the first to let the cat among the pigeons by announcing that government was considering new approaches to indigenization, people hear not so much about abandoning the lackluster concept but adjusting it to suit different sector needs and in that attract foreign direct investment. This created a flurry of debate and support from a cross section of society with as many congratulating ZANU PF for this Damascene moment. Mukundu wrote then that ZANU PF had not necessarily climbed down because the indigenization policy was never up, but in the pit down and anything the government had climbed up to see the light and reality on how an economy is managed and that no one owes us a living and we need better relations with the rest. In that sense the government had accrued positive media coverage for being realistic and for the first time after the 31 July 2013 elections showing some seriousness in trying to arrest the economic decline. If this policy revision was carried through then Zimbabwe will sure start from somewhere, forget the theoretical ideological discussions on what this means on ordinary citizens (Mukundu 2014).

In essence, for us to debate on the ideological underpinnings of an economy, whether it is a societal welfare state or full throttle dog-eat-dog capital driven economy, there should be an economy to talk about in the first place. A primitive and comatose economy like we have now simply needs resuscitation. Like a collapsed athlete the critical thing is to resuscitate and stabilize and develop later. It is this resuscitation that Moyo's statement should have created and at most did, were it not for the ambivalence of Indigenization Minister Honourable Nhema who threw cold water on Moyo saying whatever the information Minister Honourable Jonathan Moyo said was his opinion and that the government was yet to develop anything and on the contrary the indigenization law is okay as it is and it allows the Minister flexibility. Honourable Nhema pronouncements were obviously surprising because normally people expected government ministers to speak with one voice, to sing from the same hymnbook as it were. Honourable Moyo and Nhema ordinarily, unless something has changed, meet at cabinet every week and in any case should have each other's landline and mobile phone numbers and therefore expected to speak in sync and not parallel to each other (Mukundu 2014).

The fact that we have a struggling economy is problematic, but it was having a government without a clue on how to move forward and for worse is having Ministers speaking parallel to each other in the media and almost attacking each other. The expectation is that Honourable Minister Nhema would have sought audience with Honourable Moyo before countering the latter's statements through the same medium, mainstream media. The conclusion is therefore that Zimbabwe is in trouble not so much because we do not have money, but because we have a deficit in leadership. It is different to trace how far the lack of leadership goes but since this is a government constituted by his Excellence President Mugabe we can only point at the Chief Executive Officer for sleeping on the job (Mukundu 2014).

It is His Excellence President Mugabe and his deputy Her Excellence Joyce Mujuru who should oversee co-ordination of government business and we know nothing major happens in ZANU PF and in

government without the President's blessing or consent. The question becomes: why is he allowing this public spat and discordance within his cabinet? Are we to assume that His Excellence President Mugabe is losing control of the levers of government and essentially leaving matters to run their own course and take a direction of their choice. If that is the case then we are probably in far more serious trouble than all the troubles stated above. If the top leadership is failing in ensuring discipline in policy pronouncement and implementation, then Zimbabwe will likely continue suffering as various factions within the ZANU PF government compete for space and compete with each other to control debates. In essence we now have a government at war with itself and in that more concerned about factional and personal survival than addressing critical social and economic issues. If the proposal to change the indigenization law was not discussed and agreed in Cabinet then we again ask: what was Moyo's motivation to speak his opinion and not government policy on such a critical economic policy issue. And if Honourable Minister Moyo is right then we ask why Honourable Minister Nhema denied the stated new policy change and what his intentions were. His Excellence had spoken about changing the indigenization and he needs to stamp his authority and inform citizens which is which. What this whole saga tells us is that ZANU PF is caught up in power games and not focused on the business of serving people (Mukundu 2014).

No matter how the faction-riddled party may deny it, this is probably the time for His Excellence President Mugabe to start the process of handing over some key decision making powers to his juniors, more so decisions to do with economic policy. There is need for clarity on as many issues on the economy and there is no leadership to make pronouncements on such. As ZANU PF prepares for its elective congress in December 2014 the leadership question must feature prominently otherwise any outcome of that congress which does not resolve leadership issues is a betrayal of the people of Zimbabwe. Meanwhile, we hope the presidency puts an end to whether the indigenization law is being changed, if so, when and how? (Mukundu 2014).

On the leadership question to feature prominently as aforementioned that question is now settled and not for further debate. Presidential affairs minister Honourable Didymus Mutasa said that His Excellence President Mugabe is constitutionally free to represent ZANU PF at the 2018 National election because he had only started serving his first term under the new constitution. This is despite the then 89 year old having been in power for 33 years. At the end of his current term, Mugabe will be 94 years old (Staff Reporter 2014).

The evidence on the leadership crisis is coming thick and fast. Wakatama joined the fray to make his valuable contribution and below are the graphic details.

g) Zimbabwe suffers from a leadership crisis (Wakatama 2014)

For any country to prosper in this modern age, it must be ruled by educated, democratic, upright and selfless men and women who venerate justice and human rights and whose sole goal is to attain the highest standards of living for the people. But alas, this is not the case in Zimbabwe. The country is being led by mostly semi-literate, corrupt and incompetent people whose only goal is self-aggrandizement. The result is we are where we are. In most respects Rhodesia was far much better than present day Zimbabwe. To most, the words freedom national integrity and sovereignty are now meaningless slogans shouted by our political leaders at rallies. It is true Zimbabweans are thankful for our hard-won freedom and independence. However, what this really means is that we are free from the colour-bar and that we are now ruling, or rather misruling ourselves. This is the sum total of our liberation. Otherwise, life in Rhodesia, the name for Zimbabwe before Independence from Britain in 1980, was far much better than life in Zimbabwe. One would need to write volumes to describe the difference in detail. We only rid ourselves of a white oppressor, only to replace him with a black one. Justice, human rights and well being of the people are non-existent for most (Wakatama 2014).

At independence our economy inherited from Rhodesia, was strong and resilient despite being under real international sanctions. Rhodesians did not blame all their failures on sanction and go 'cap in hand' to all kinds of even queer foreign 'friends'. They faced the truth, put on their thinking caps, rallied up their sleeves and went to work to build a strong economy. They lived and ate well-all of them. Today that economy is in tatters. It is slowly but surely giving up the ghost and only a few, at the top of the heap, live and eat well. The rest are suffering and living in serious apprehension about their future. Local and international pundits have tried their best to help our leaders with criticism, instruction and advice all to no avail. The unlucky ones are arrested or intimidated to such an extent that they had to flee for dear life and now live in the Diaspora. These include geniuses and real leaders, like the beloved musician Thomas Mapfumo who dared denounce corruption and a host of other patriotic leaders in all spheres of life. Thousands of suffering Zimbabweans had to abandon home to seek a better life in other countries. In a rather rambling disorganized and rather incoherent speech given at a meeting organized by the Zimbabwe Congress Students Union, the Senior Minister of State, Honourable Simon Kaya Moyo urged Zimbabweans in the Diaspora to return

home to participate in rebuilding the country economy. He said:

"You go in the SADC region, its Zimbabweans who are running the economies of those countries and beyond. In Europe its you people who are there and can you imagine if we say come back all of you and let us now address all our challenges. There is going to be something else in this country and we shall be moving also in that direction to make sure that those in the Diaspora come back and make the situation attractive in the sense that they must feel that they have got a duty to contribute to our economic development. So, if you have got any relatives outside, he rambled on, 'please tell them to come back home because we need them so that Zimbabwe can move ahead".

Ambassador Moyo then went on to platitudinise about Pan-Africanism and getting rid of corruption. One wonders whether those were real students with intellect that he was talking to because if they were, they would have all walked out instead of clapping their hands at such unreasonable drivel. Or they would have asked him why those Zimbabweans left for the Diaspora in the first place and who destroyed the economy that he wants them to come home and rebuild. How will they survive when their former colleagues, who are now graduates, have to sell air time and trinkets to survive in Zimbabwe? The Ambassador conveniently fails to acknowledge that it is the party's violence and skewed economic policies, born of greed which drove millions of Zimbabweans into exile (Wakatama 2013).

Our leaders have proven beyond doubt that they are not leadership material. They don't have the qualifications required of true leaders. Most of them are uneducated and semi-literate. Honourable Minister Ignatius Chombo was extremely worried about this. Late last year (2013) he said that the government would soon introduce minimal educational qualifications for Councilors in both urban and rural areas, to enhance their literacy and competency. He said most councilors were failing to appreciate their mandate and authority because of low literacy levels. With this kind of admission from a ZANU PF Minister of government, can we then blame sanctions for our sad predicament? The lack of rudimentary educational qualifications is not a local government problemonly. It also applies to most, if not all government departments. There are two typical examples. One is member of parliament, Honourable Joseph Chinotimba. He is a semi-literate former municipal policeman in the Harare City Council who can hardly speak English. The second one is Member of Parliament (MP) for Hurungwe East Sarah Mahaka. She is an illiterate Grade 2 dropout. She is also the Party's Women's League Chairperson for Mashonaland West Province. Can such leaders meaningfully participate in the governance of a modern day state? No. they can only participate in a primitive and poverty stricken country like Zimbabwe (Wakatama 2014).

There are indeed some well educated government leaders in Zimbabwe. However, they fail the major test of real leadership. They do not value justice. Someone friendly to Wakatama was remonstrating with a minister. He said:

"One day the people are going to take you people to court for your misdeeds…."

The minister actually laughed and said:

"The courts may belong to the people but the judges are ours".

Need one say more? Our current leaders scoff at justice. The concept and meaning of the word does not exist in their minds and consciences. This is why Zimbabwe today is an impoverished pariah state whose children have run away to enrich foreign countries. Among them are real leaders who should be at the helm of this country today. Zimbabwe has the most educated and sophisticated people in Africa (Staff reporter 2014). Why is it then that the country is led by people of such poor quality? The answer is the fear factor. If you as a Zimbabwe citizen aspire to high political office, your very life is at risk. Many have paid the price.

Hebert Wiltshire Tapfumanei Chitepo (15 June 1923 – 18 march 1975) led the Zimbabwe African National Union (ZANU) until he was assassinated on 18 March 1975. Although his murder remains unidentified the Rhodesian Author Peter Stiff said that a former British SAS soldier, Hugh Hind was responsible (Staff Reporter 2014). Zimbabweans must pray to god to rid us of poor leaders and give us true leaders who will lead us to 'Canaan" (Wakatama 2014).

To wrap the discussion in this Paper in came Chichoni with his scintillating contribution on effective leadership and how it elicits best performance. Let's hear him make his contribution as below.

h) Effective leadership elicits best performance (Chichoni 2014)

Being a soccer enthusiast and a supporter of the Liverpool Football club of the English Premier League and also a fanatic of the Dynamos football Club of the Zimbabwe Premier Soccer league; when the Author saw the picture of David Moyes he knew straight away what Chichoni was going to talk about – with Moyes having found the going tough at Manchester United his topic on the subject under discussion in this Paper would be: Effective leadership elicits best performance which David Moyes dismally failed to bring to the Manchester United Football club to result in his sacking with four games to go before the end of the 2013/2014 soccer season only to be replaced initially by Ryan Giggs but later by Louis Van Gaal, the current Manager at Manchester United Football Club (Staff Reporter 2014).

Speaking at a business breakfast meeting at Harare Meikles Hotel, recently renowned international leadership expert Rene Carayal brought out a point that

most of the people running small/medium sized businesses often neglect to consider: the importance of leadership. It is good that leadership can be learned, that means all of us can learn to be effective leaders. Carayal told the audience a story about his friend called Jim. Jim had been running a manufacturing outfit for nearly 10 years then. He employed nearly 50 people and his business had been doing reasonably well except for one thing. Jim had always been complaining about his employees' lack of discipline and laziness. He was forced to fire over a dozen employees in the past five years, including two supervisors. Jim consulted a friend who was running a very successful business. The friend gave him some tips and also advised him to read some books on leadership. After reading several books Jim said he was surprised to discover that he was actually the problem. He came to understand that he lacked effective leadership skills to really manage his people. He gave me the example of David Moyes who failed at Manchester United.

"Well", Jim said, "the level of leadership required at a top club is different from that required at a smaller club. This is because you are dealing with super stars, people who might even be earning more than you. With their big ego, they are harder to control: they can question your decision and that can make you angry" (Chichoni 2014).

Jim went on to explain how he was in a similar position managing people with modern and higher qualifications than him and who were struggling financially in a difficult economic environment. According to experts, leadership is critical in running a business or any organization successfully. This is especially so in our modern day with people who are more knowledgeable and informed. Your workers will not probably know a lot more than you do in certain areas. An effective leader in that situation is one that can energize people towards a vision. According to Brian Tracy a leader must have sense of vision or a mission in order to be effective. This vision uplifts, motivates and inspires people to heights of wanting to achieve. Each person has a desire to achieve something bigger than themselves. Look at the way people follow a national sports team when it is playing an important international match. everyone rallies behind the team supporting in whatever way they can. If you can articulate a vision for your business in a similar way to a national achievement, people will rally behind you. This means you have to have a goal that excites and inspires. People are not inspired by salary increases or profits. Inspiring goals are qualitative. We do get inspired not by money but by bringing a product or service to people who need it, about being the best, about being superb in our field, about winning or achieving success in a competitive field. (Chichoni 2014).

A good goal gives a clear sense of direction a feeling towards achievement which brings the best in people. Ordinary people will perform extra-ordinary acts if they are unified by an inspiring goal. Take the biggest club in Zimbabwe, Dynamos, for instance. It does not necessarily have the best players. Neither does it pay the highest wages. Infact, the players have been seen going on strike over wages numerous times. However, when a player is in the field donning the Dynamos blue jersey, they just perform wonders and the team wins most of the time. It is because of the sense of mission associated with team: the vision to win. Effective leaders are action oriented. They don't waste time contemplating or analyzing but they act and drive others into action. The most successful business are those that try more: launch new products, try new markets offer new services, offer new customer experiences. They are led by action oriented leaders. They may fail in some actions, but because they drill more holes they are more likely to hit the gold seam. Some business owners think being tough with employees makes them more productive. Effective leadership works the other way round. You need to compliment workers for a job well done, encourage them and motivate them and they will be happy to do more. They will not only work when you are watching but they will put in all their effort all the time to see the company's goals achieved, because they love working there. If you feel you would like, start reading and studying leadership now and you will achieve far greater things with your people (Chichoni 2014).

Early in this paragraph, I had promised it was time to wrap up the discourse on leadership but no sooner had the Author done that than a friend phoned him to watch and listen to His Excellence President Mugabe's speech at the General Assembly of the United nations in New York on Thursday 25 September 2014. At first the Author resisted the invitation but as part of the Author's Leadership studies, he was forced to search through the various newspapers that make up the pluralist media only to come across his speech in the Newsday of 27 September 2014. For details on this do not miss even a drop about this fascinating speech which is up next.

i) Mugabe holding Zimback (Madanhire 2014)

As sadly predictable, His Excellence President Mugabe, in his address at the General Assembly of the United Nations in New York on Thursday 25 September 2014, ranted against Western countries to repeat his same speech of last year, for their alleged sins of commission such as maintaining sanctions against his government. While other progressive leaders from across the political spectrum address relevant burning issues in detail such as among others terrorism and growing income inequality globally, calling for the resetting of the global economy. His Excellence

President Mugabe spoke like a cold war warrior from another era. His pre-occupation with the alleged victimization of his government is increasingly having fewer and fewer takers, locally and regionally and globally. The awesome speech sounded oddly out of place. The address sounded discordant. His Excellence President's bloated delegation of over 100 did not help his cause either. Year in year out, he takes a dig at the West, but to what end? No other regional leader has been known to fulminate like that on the international stage. Clearly regional leaders do not go out of their way to pick fights. Moreover, Zimbabwe has not been singled out for victimization as the government has clearly breached universal norms like the upholding of human rights and blazenly defaulted on its financial obligations to international lenders such as the Brentonwood Institutions. So, playing the victim card loudly at such forum is not going to be helpful at all. Whatever the West's sins of commission or omission, both sides must meet somewhere in the middle because His Excellence himself is not stainless (Madanhire 2014).

Back home, he is pushing his wife not only to the political heights but helping her to earn dubious PhD degrees from the University of Zimbabwe in a scandal which had since deepened. He does not tolerate any challenges or resistance to that (Mambo and Gagare 2014). Is that the conduct of a practicing democrat? He cannot masquerade as a change agent. Zimbabweans are not fooled. Neither is the world fooled. All this hypocrisy he does is to embarrass the nation to no end. Again the world cannot help but notice His Excellence President Mugabe's advanced age. At 90 he was clearly the oldest leader to address the UN general Assembly. CNN pointedly mentioned that he was now into the 7th term, a sign that democracy in Zimbabwe is not only dubious but non-existent. His advanced age now detracts him from everything he says. Is His Excellence the right person to call for a new world order while refusing to embrace democratic change at home? It is so glaring for all to see. So His Excellence President Mugabe should be the last person to call for change on the global stage. He does not have the moral authority to do so. But it's sad that he does not see this glaring contradiction. He thinks everything is out of step except himself (Nemadire 2014).

But His Excellence President Mugabe as the always angry, rancorous face of Zimbabwe for the past 34 years is as President holding the country back (Madanhire 2014).

All said and done what remains outstanding in this Paper are the Summary, Conclusion and Recommendations. But coming your way first is the Summary of the Paper.

III. Summary

The ignition to the discourse in this Paper was the astonishing leadership qualities of Robert Gumbura (57) of the RMG End Time Message Pentecostal Church in Harare. The church leader is polygamous and had six young wives averaging 20 to 25 years of age despite his advanced age. In February this year (2014) he was convicted on four counts of rape involving his female congregants plus possession of pornographic material for which he was sentenced to forty years in jail. From impeccable sources within his dubious church all female congregants, married or not are his girlfriends. Any female congregant who resists his sexual advances is threatened with death or some life threatening misfortunes.

Up next is His Excellence President Mugabe (90) vowing that it is not for the British to tell him to go but that only his people will change him to resonate with the narrative in this Paper that the leadership in Zimbabwe is a formula for real disaster.

Another disaster from Zimbabwe's quality of leadership is the failure by his Excellence President Mugabe to appoint his cabinet ministers on nothing else but merit. By way of examples. The foreign Affairs Ministry in Zimbabwe with the taciturn incumbent, Honourable Simbarashe Mumbengegwi is going nowhere and is dead and buried (Madanhire 2014). A country like the impoverished Zimbabwe can ill afford an uncommunicative, unresponsive, tight lipped, abrupt and secretive character as Foreign Affairs Minister particularly in these bad times where Zimbabwe needs to engage from the East to the West, from the North to the South (Madanhire 2014).

Another disaster is reportedly coming from the opposition Movement for Democratic Change resisting not only dissent but leadership renewal. For Zimbabwe, it is *"Mai vatsva kumusana mwana atsva kudumbu"* (meaning a double tragedy where mother and baby strapped on her back are both injured in a fire accident). In the ruling ZANU PF His Excellence President (90) is refusing to go to pave way for new bloody with fresh ideas while Tsvangirai of the opposition is also showing equal intolerance for dissent and leadership renewal. The question to ask is: Whether Zimbabwe with this type of leadership?

Another contribution from Makoni (2014) which was worthwhile was to set constitutional leadership terms in office which must afterwards be seen to be adhered to. A good example that readily comes to mind is His Excellence President Mugabe. When the new constitution that we have right now was being crafted His Excellence had 6 consecutive 5 year terms in office while the new constitution stipulated 2 five year terms for any sitting President. Out of greed because he wanted to be President until 2023, the law had to be changed so that it would not be retrospective on His Excellence

President Mugabe who in 2023 will be 100 years old and still in office. A cursory check on our regional peers exhibits that *"kutonga mazoro"* (meaning you are leader today so that I am leader tomorrow and not one person ruling in perpetuity). In soccer you can see how the Spanish domination was being resisted worldwide only to end in pain in July 2014 in Brazil (Reuters 2014). The question is: do you want that to happen to you?

Given 15 years of failure by Tsvangirai to unseat His Excellence President Mugabe, Kajau (2014) was reportedly agitating for new leadership in the opposition party which Tsvangirai was resisting to breach one of the founding values of the party – which is democracy.

The name of the opposition MDC-T goes on to parrot the name 'Democratic Change'. Why resist it now when it was one of your founding principles? *'Mwari rambidzai!'* (meaning God forbid!)

The dilly dallying shown by the ZANU PF party on the urgent need to repeal the controversial Indigenization law was an appalling show of a leadership deficit in Zimbabwe. Given that it was this law which was making Zimbabwe unattractive for foreign direct investment, the paranoid ZANU PF should not have dithered on the repeal of this dangerous law condemned locally, regionally and globally (Mukundu 2014).

Wakatama (2014) for his own right lamented that for a country to prosper in this modern age, it must be ruled by educated, democratic, upright and selfless men and women who venerate justice and logic, human rights and whose sole goal is to attain the highest standards of living for the people and not self-aggrandizement for the greedy leadership. Zimbabwe, touted as bread basket in Africa at independence from Britain in 1980 is now a hopeless basket case importing food from the lowly Zambia and Malawi, who traditionally used to import food from Zimbabwe during its hey days (Wakatama 2014).

Chichoni (2014) was dead right when he spearheaded his spirited fight against ineffective leadership which kills best performance from subordinates. Imagine Zimbabwe with one man at the helm since 1980 to date. The question is: Can we prosper given lack of new blood with fresh ideas to take the country forward. Look at where Zimbabwe is today compared with its regional peers? (Chichoni 2014).

And finally Madanhire (2014) cannot say it any better when he came out blazing his guns to say one person, His excellence President Mugabe is holding Zimbabwe back. His sanctions mantra at the UN General Assembly in September 2014 is increasingly finding no takers home and away save to hold Zimbabwe back (Madanhire 2014).

With the Summary conveniently out of the way, up next is the Conclusion of the Paper which by the looks of it appears a good prospect for the Reader. Details coming your way sooner than later as below.

IV. Conclusion

According to Kenkel (1994) a conclusion is about choosing either of two conflicting statements which are:

The Null Hypothesis (H_0): The Leadership quality in Zimbabwe is not a formula for real disaster.

The Alternative Hypothesis (H_1): The leadership quality in Zimbabwe is a formula for real disaster.

Given the overwhelming evidence unearthed by the short and relevant literature review carried out as shown elsewhere in this Paper and its Summary above the Conclusion of the Paper is to reject the Null hypothesis (H_0) and accept the Alternative Hypothesis (H_1) which states that:

The leadership quality in Zimbabwe is a formula for real disaster.

With the Conclusion now out of the way, the Recommendations are up next. Details coming your way shortly as below.

V. Recommendations

For treatment of major risks identified in this Paper the under listed Recommendations were found appropriate to reduce or eliminate the risks.

a) Robert Gumbura of End Time Message Church abusing his female congregants

Churches in particular the Pentecostals should be kept under police surveillance plus urging members of the public to come forward and report any suspicious behavior of any church leader so that he is investigated, arrested to face prosecution by the courts. For raping four women and possessing pornographic material, Robert Gumbura of End Time Message Church was jailed for 40 years without the option of a fine.

b) His Excellence President Mugabe resisting leadership renewal in both party and government

Both the constitutions of the party and government should be tightened to plug loop holes like this. Every leader in both party and government should be subjected to the constitution which should limit the number of terms and years a President should have in office before he is forced to resign.

c) Incompetent cabinet ministers should not be allowed to hold office

Honourable Ministers Chombo, of Local Government, Mavhaire of Energy, Mumbengegwi of Foreign Affairs should not be allowed to hold office if they are found to be incompetent as per frequent media reports. His Excellence President Mugabe should give such Ministers contract offers such as, five year contracts renewable on evidence of satisfactory performance.

d) Repeal of the Indigenization law

The evidence against the continued existence of this law on the country's statutes is deplorable. Foreign Direct Investment has stopped coming to Zimbabwe because of this obnoxious law.

e) Set a leadership profile for individuals occupying positions in both party and government

A criterion should be set on education, uprightness and selflessness and also democratic aptitude. Anybody without these credentials should not be appointed to party or government position.

f) People aspiring to take up party and government leadership

For all the people who aspire to take up party or government leadership positions for which they are ineffective should take to reading books on leadership. Look for books on leadership and read them to acquaint yourself with leadership skills.

To end the discourse the Christian way the Author will say a short prayer as follows: *Mwari nevadzimu venyika ino ndinoti tibatsireiwo nevatongi vemazvirokwazvo Amen!* (meaning God and all the country's Ancestral spirits please help us and our country to prosper under a multi-skilled leadership. Amen)

VI. Key Assumption

In presenting this Paper the Author would, right from the outset, wish to reassure the beloved Reader that all the facts and figures contained therein are stated as they are on the ground without fear, favour or prejudice.

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Building Densification as a Strategy for Urban Spatial Sustainability Analysis of Inner City Neighbourhoods of Dar Es Salaam, Tanzania

By John Lupala & Sajjad Ali Bhayo
Ardhi University, Tanzania

Abstract- Building densification in developing countries is shaping the spatial patterns of the inner city neighbourhoods. The densification processes are fuelled by higher land values and real estate market dynamics. Due to increased land values, new building forms, uses and density are emerging. Although densification is considered as a strategy to achieving compact development and city spatial sustainability, the unguided nature of building redevelopment is increasingly posing threats in terms of diminishing spatial and liveability qualities in these neighbourhoods. This paper examines the building densification processes in two neighbourhoods of Dar es Salaam City and the resulting effects in terms of plot coverage, floor area ratio and overall spatial patterns. Observations, measurements, transect walks, interview with officials and map analysis were the key methods employed in gathering data. Results indicate that in one of the neighbourhoods, building densification was taking place without a redevelopment plan to guide the process. In Kariakoo, 89 percent of all buildings had higher plot coverage above the recommended standards. Land coverage at block level was noted to be 78 percent which was above the recommended coverage of 70 percent. In Sinza, 13 percent of all buildings also had plot coverage above the recommended ratio.

Keywords: building densification, plot coverage, floor area ratio, spatial quality, sustainability and dar es salaam.

GJHSS-B Classification : FOR Code: 040699

Strictly as per the compliance and regulations of:

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John Lupala [α] & Sajjad Ali Bhayo [σ]

Abstract- Building densification in developing countries is shaping the spatial patterns of the inner city neighbourhoods. The densification processes are fuelled by higher land values and real estate market dynamics. Due to increased land values, new building forms, uses and density are emerging. Although densification is considered as a strategy to achieving compact development and city spatial sustainability, the unguided nature of building redevelopment is increasingly posing threats in terms of diminishing spatial and liveability qualities in these neighbourhoods. This paper examines the building densification processes in two neighbourhoods of Dar es Salaam City and the resulting effects in terms of plot coverage, floor area ratio and overall spatial patterns. Observations, measurements, transect walks, interview with officials and map analysis were the key methods employed in gathering data. Results indicate that in one of the neighbourhoods, building densification was taking place without a redevelopment plan to guide the process. In Kariakoo, 89 percent of all buildings had higher plot coverage above the recommended standards. Land coverage at block level was noted to be 78 percent which was above the recommended coverage of 70 percent. In Sinza, 13 percent of all buildings also had plot coverage above the recommended ratio. These divergences were compounded by the weak development control mechanism and developers' desire to maximize use of land. This pattern of building densification was culminating into poor spatial and liveability qualities. There is therefore a need for preparing plans that will guide the redevelopment processes, instituting effective development control measures and revisiting the possibility of combining plots to facilitate flexibility in design and move towards urban spatial sustainability.

Keywords: building densification, plot coverage, floor area ratio, spatial quality, sustainability and dar es salaam.

I. Introduction

Although urban sprawl is a characteristic feature in most cities of the developing world, the pressure for increased building density towards compact city development is increasingly becoming imminent. It is common in these countries that the rapid city spatial expansion goes hand in hand with transformation of old low rise residential with high rise residential cum commercial neighbourhoods. Worldwide, densification has been recognized as one of the tools for achieving compact city forms and sustainable urban development. Densification that culminates into compact cities has the advantages of reducing vehicle movement, environmental pollution and energy consumption. Densification creates good premises for provision of public transport, effective usability of infrastructure, open space, public realm and business opportunities (Paez, 2012; Cereda, 2009). Paez (2012) further argues that compact nodes are helpful in controlling unplanned urban spatial growth in the cities. High-density areas promote walkability, discourage vehicular movement and also prevent urban sprawl (Long, McGrath and Kolder; 2011). In addition, urban densification promotes social interaction, social inclusions and cultural enrichment in the cities (Bahadure and Kotharkar, 2012). It sounds that all basic facilities such as schools, shopping, parks and playgrounds can be effectively allocated at walking distance. Therefore, people can get equal benefits from these facilities if optimal densities are achieved (ibid.). Aggregated together, these qualities culminate into liveable cities and sustainable urban development.

Literature indicate that the most compact and vibrant European city is Barcelona, which has an average density of 400 dwellings per hectare (The Urban Task Force, 1999; Lupala and Namangaya, 2010). Although increase in density is consistent with the idea of sustainable neighbourhoods, higher densities also carry the connotations of urban cramming (ibid.). From economic perspective, literature further indicate that land economy gains are being achieved from increasing densities from 20 to 25 dwellings per hectare to 35 to 40 dwellings per hectare (Barton in Breheny, 1992). Despite the fact that land use gains diminish above these levels, research confirms that higher densities allow greater number of public amenities and transport facilities to be provided (ibid.). As density levels increase to 40 to 60 dwellings per hectare, the land take diminishes rapidly. More people are close enough to communal facilities to walk, and efficient bus service can be made viable. Increased densities contribute to energy efficiency. If increased densities contribute to these urban qualities, it can therefore be argued that building densification can be deployed as a strategy towards liveability and sustainability of urban centres.

Author α σ: School of Urban and Regional Planning, Ardhi University, Dar es Salaam, Tanzania. e-mail: lupalajohn@yahoo.com

The approach towards urban densification may include increase in Floor Area Ratio (FAR) and Land Coverage (LC). It implies that appropriate use of FAR by increasing more floors in building increases more space to accommodate more functions in one building. City spatial sustainability has been viewed as a useful economic approach because it can attract more capital investment and job opportunities in compactly built cities (Bhayo, 2014). To be able to analyse city spatial sustainability, land coverage (depicting the horizontal expansion of built environment) and Floor Area Ratio (how vertical development building are) becomes instrumental variables.

II. Density as a Concept

Density as a concept has been in academic currency for many years. Several authors have discussed density from varying perspectives. There has not been a consensus on the actual definition of density apparently because of the varying contexts, perceptions and values attached to this concept. It is from these variations that many authors have shied away from definitively arguing for what is high or low density. However, a number of authors have attempted to define density from physical, social, temporal and perceptual perspectives. Physical density is largely manifest in form of floor area ratio and land coverage and building heights (James, 1967; Rapoport, 1975, Correa, 1985; Newman and Kenworthy, 1989; Barton, 1992; Breheny, 1992; Jelinek, 1992; Alexander, 1993; Acioly and Davidson; 1996; Rådberg, 1996 and Arenas-Gomez, 2002). Physical density (sometimes referred to as objective density) has been examined as land use ratios (Lupala, 2002). In housing and urban design, density has been measured in terms of floor area ratios, plot coverage and dwelling units per specified area (Alexander, 1993; Rådberg, 1996). While Floor Area Ratio (FAR) is a unit of density referring to the floor space in relation to plot or land area, plot coverage refers to the proportion of built up areas to that of plot area expressed in percentage. Floor Area Ratio largely expresses the verticality of buildings while coverage expresses the horizontal coverage of built spaces. In common practice, density has often been referred to as a degree or intensity of development or of occupancy. The social cultural perspective of density focuses on such variable as levels of social interaction and feeling of control (Rapoport, 1975). Density can also be viewed from temporal aspects such as fast tempos and rhythms of activities and associational or symbolic relating to the presence or absence of, tall buildings or apartment buildings, absence of private gardens (ibid.). In this paper, emphasis is being put on physical density because it is more practical to objectively operationalize its variables. Some of the key questions that are worth examining are; what are prevailing plot coverage and floor area ratios in densifying neighbourhoods of Dar es Salaam? Is the type of densification notable contributing towards spatial sustainability of the city? What challenges and opportunities are being posed by the on-going densification processes?

III. Spatial Growth Trends in Dar Es Salaam City

Dar es Salaam city has a jurisdictional area of 147,557 hectares and its built up area is estimated to be 115,372 hectares. The built up area is equivalent to 71 percent of the jurisdictional area (TACINE, 2013). By 1892, the spatial extent of Dar es Salaam was limited to only 2 kilometre radius from the city centre. This coverage increased to 6 kilometres in 1963, 17 kilometres in 2002 and 30 Kilometres in 2012 (Bhayo, 2014). The four major arterial roads radiating from the centre are the key features structuring the spatial pattern of Dar es Salaam city. The city has grown up to 30 kilometres northwards along Bagamoyo Road, 28 kilometres westwards along Morogoro Road, some 32 kilometres southward westwards and south eastwards along Pugu and Somanga Roads (Figure 1). This has resulted into a finger-like city spatial structure and corridor development along these major roads. Density along these corridors is relatively high decreasing as one move away from the major roads. The fact that almost all employment is located at the city centre where major roads converge or radiate, the horizontal growth and mono-centric city spatial structure have resulted into severe traffic jams during peak hours and delays from home to work places. This pattern of growth has culminated into a number of issues that undermine city sustainability. For example, the increase in the number of vehicles has compounded traffic congestion problems in the city. The situation is made worse by the increase of motorcycles and tricycles in Dar es Salaam using the same city roads (Kiunsi, 2013). A study by Japanese International Cooperation Agency (JICA, 2008) indicates that vehicles often spend up to two hours to cover a 16-kilometre trip in the city, a distance which could have been covered in 15 minutes if there were more roads and intersections. From economic point of view, URT and Ukaid, (2011) estimated that traffic jams in Dar es Salaam were costing about 20 per cent of the annual profits of most businesses.

In analyzing jaggedness or degree of compactness of the city of Dar es Salaam, urban gradient density values were established from the built up areas by the Adapting to Climate Change in Coastal Dar es Salaam Project (ACC-Dar) in Bhayo (2014). By the year 2002, compactness of the Dar es Salaam city was limited to 6 kilometres (inner radius) from the city centre. This figure increased to 11 kilometres from the city centre (outer radius) in the year 2012 (Figure 2). The reason for increased distance with compactness is due

to the increase in land coverage especially in the outer radius where many of the vacant plots have been developed (be it low rise or high-rise buildings). In the inner city neighbourhoods, Floor Area Ratio (FAR) is increasing by transforming the old low-rise buildings into high-rise. Detailed results from gradient analysis indicate that land coverage was 45 per cent at 5 kilometre radius in the year 2002. This gradient increased up to 57 per cent within the same distance in 2012. Land coverage was 24, 5, 2, 1, 0.6, 0.4, 0.17 per cent at 10, 15, 20, 25, 30, 35 and 40 km radius respectively, which has reached up 80 to 39, 22, 13, 7, 4, 2, 0.4 per cent, with the same distance intervals in 2012. Therefore, land coverage has significantly increased between 2002 and 2012. In other words it can be argued that although density gradient decreases as one move far away from the city centre, with increase in time, inner city neighbourhoods consolidate in terms of land coverage and floor area ratios registering higher percentage in density gradients.

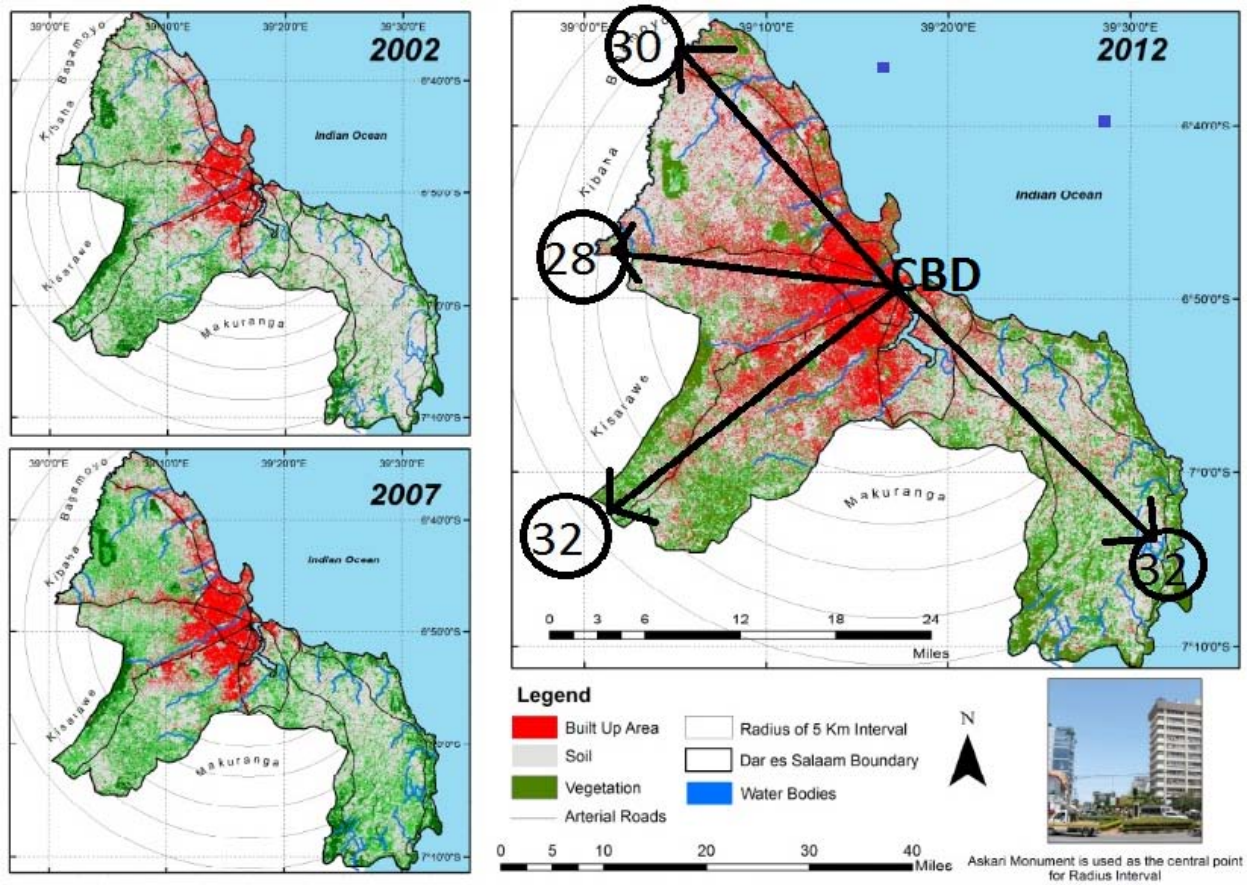

Figure 1 : Spatial growth trends for the city of Dar es Salaam (2002-2012)

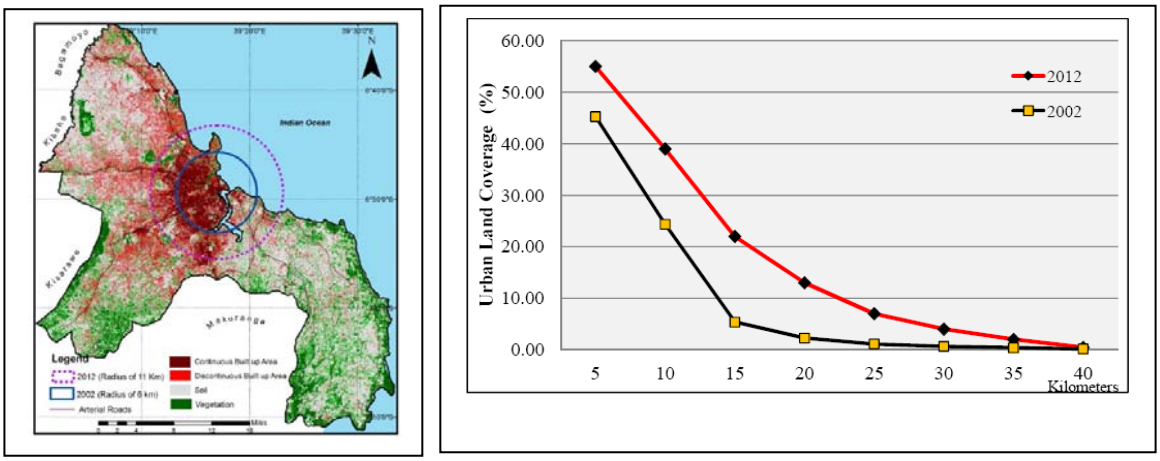

Figure 2 : Jaggedness and density gradient for Dar es Salaam (2002-2012)

IV. Research Methodology

The thrust of this paper was to examine densification processes as a strategy towards compact city development and sustainability. Two neighbourhoods of Kariakoo and Sinza in Dar es Salaam City were selected for data collection and analysis. While Kariakoo has densified to 'saturation stage', similar trends are emerging from Sinza. In these two neighbourhoods, buildings were, and are being transformed in terms of form and uses from residential to commercial, office and other functions. While Kariakoo was part of the Central Business District as recommended by the 1979 Master Plan of Dar es Salaam, Sinza was planned as a "sites and services area" implemented under the World Bank programmes of the 1970s. Therefore dynamics in Kariakoo are more apparent than those in Sinza because of its prime location and relatively higher land values.

In capturing data from the two sites, transect walks, measurement of buildings and observations methods were used. Observation was facilitated by taking photographs and sketching. Observation and measurements were used to capture height and spatial coverage of buildings. These methods helped to capture data on size, spatial form (coverage) and Floor Area Ratios (FARs). Literature review and interviews with officials of Kinondoni Municipality especially on current guidelines used to determine use, height of buildings and plot coverage complemented field studies in the two neighbourhoods. Maps for analyzing jaggedness of Dar es Salaam were obtained ACC-Dar Project (2014). Three blocks were selected from each neighbourhood (Kariakoo and Sinza) for detailed data collection and analysis as shown in Figure 3.

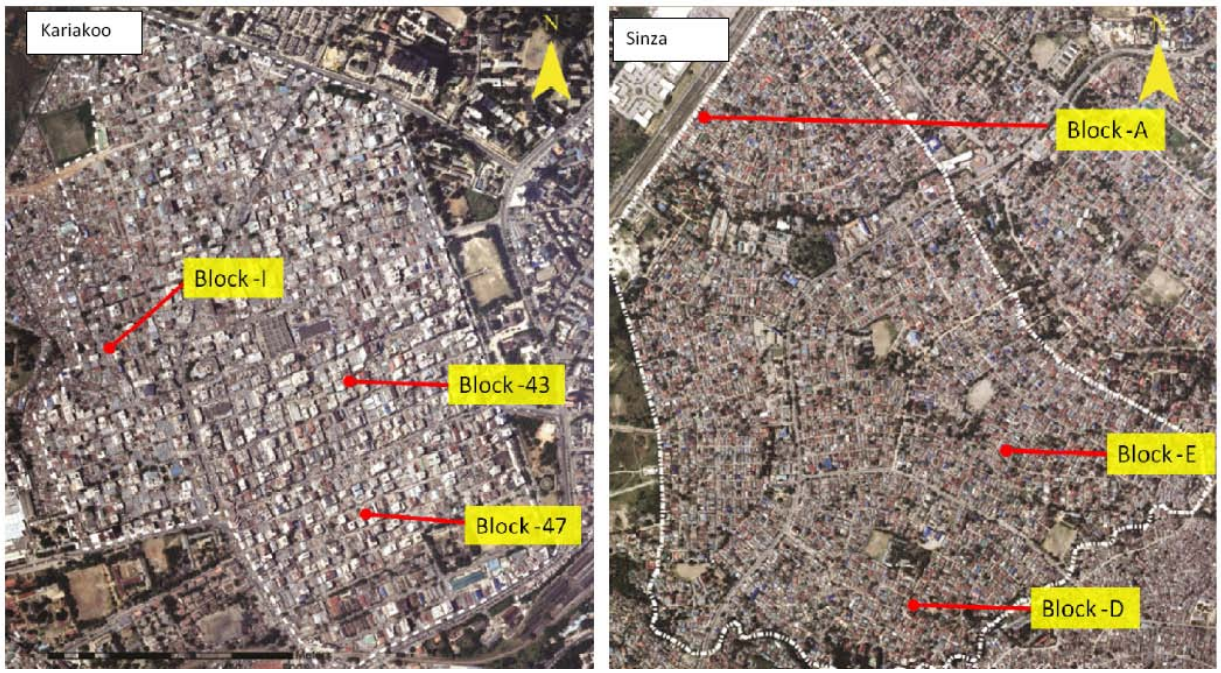

Figure 3 : Location of case study blocks in Kariakoo and Sinza

V. Results from Kariakoo

a) Building densification guidelines for Kariakoo

Owing to the rapid transformation of buildings in Kariakoo, the Ministry of Lands, Housing and Human Settlements Development in collaboration with the Ilala Municipal Council prepared a redevelopment scheme of the area in 2002. Four distinct zones were proposed namely; areas whose development in terms of buildings should not go beyond two storeys, two to four storeys, five to seven and above eight storey (Table 1, Figure 4). Additional guidelines included plot coverage and maximum Floor Area Ratio. While the recommended minimum plot coverage was 30 percent, the maximum coverage was set at 70 percent (Table 1). In terms of building height the recommended minimum was one to two (1-2) a nd eight to ten (8-10) storeys as the maximum.

Table 1 : Redevelopment design guidelines for Kariakoo

Land use	Plot Coverage (%)	Maximum Plot Ratio	Building height (storeys)	Minimum plot size (m^2)
Commercial	66-70	5.3	8-10	900
Commercial residential I	60	3.6	6-8	600
Commercial residential II	60	1.2	3-5	380
Institutional buildings	30-50	1.0	1-2	15000
Other Institutions	50-60	2.5-3.3	5-7	1200

Source: Kariakoo Area Redevelopment Scheme (URT, 2002)

It is important to note that despite the existence of these guidelines, some developers have been violating these rules especially on the aspect of number of storeys. Some buildings were observed to have 10 storeys in an area that was earmarked for 5 to 7 storey buildings (Figure 4). This situation has been caused by partly the weak enforcement of the guidelines and on the other hand, developers' urge to maximize use of plot.

Figure 4 : Building height zones for Kariakoo area and emerging buildings

b) Changing landscape of building heights in Kariakoo

The history of Kariakoo dates back from the 1920s when the first subdivision plan was laid down. Kariakoo draws its name from *"carrier corps",* a settlement that was designed to resettle Tanzanian soldiers who fought in the First World War (1914-1918). Originally, Kariakoo was dominated by single storey houses. Until 1980s, most of the buildings in Kariakoo were still single storey houses. Building transformation in this area was discouraged by the then Building Acquisition Act of 1971 that sought to nationalize all buildings valued at TZS 100,000 (US$ 20,000) during that period. The enforcement of this Act was supported by the country's socialism policy that discouraged private sector investment in real estate development. Rapid building transformation, however, started to emerge in the 1980 following the waiver of this Act (Kironde, 1994, Kombe 1995, Lupala 2002 and Lupala 2007). By 1999, about 87 percent of buildings in Kariakoo constituted single storey houses. Only 12 percent had 2 to 5 storeys. This pattern changed drastically in the decades to follow whereby the proportion of single storey houses diminished to 65 percent and further down to 46 percent in 2006 and 2013 respectively (Figures 5 and 6) (Bhayo, 2014).

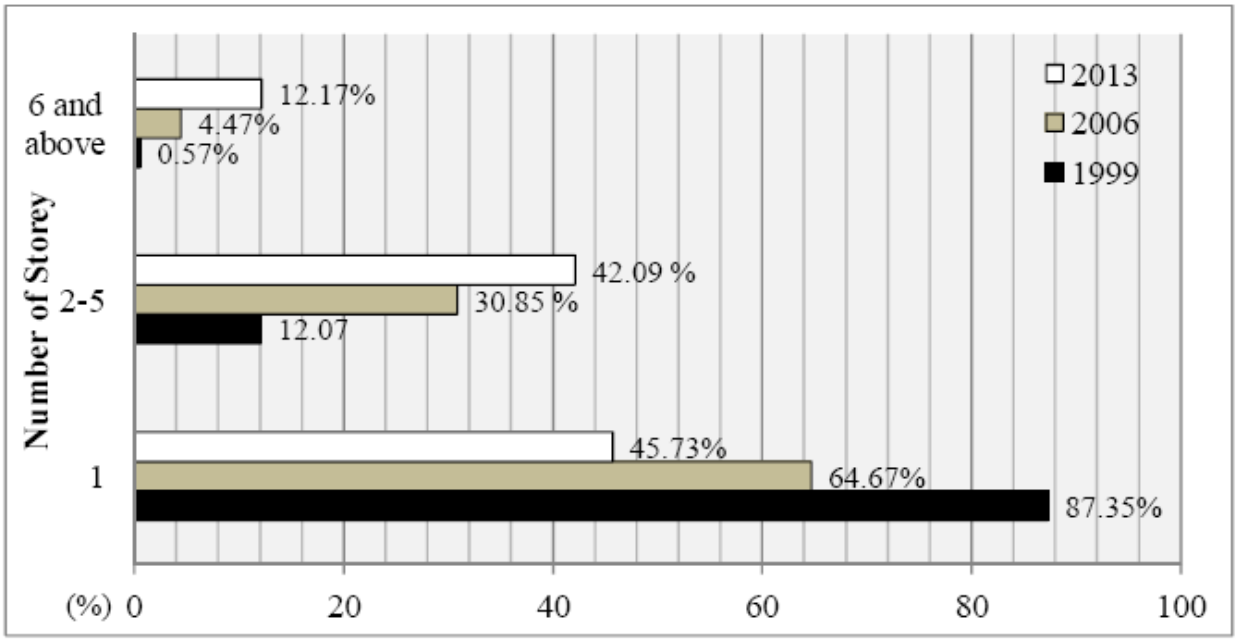

Figure 5 : Trend in changing pattern of buildings forms in Kariakoo (1999-2013)

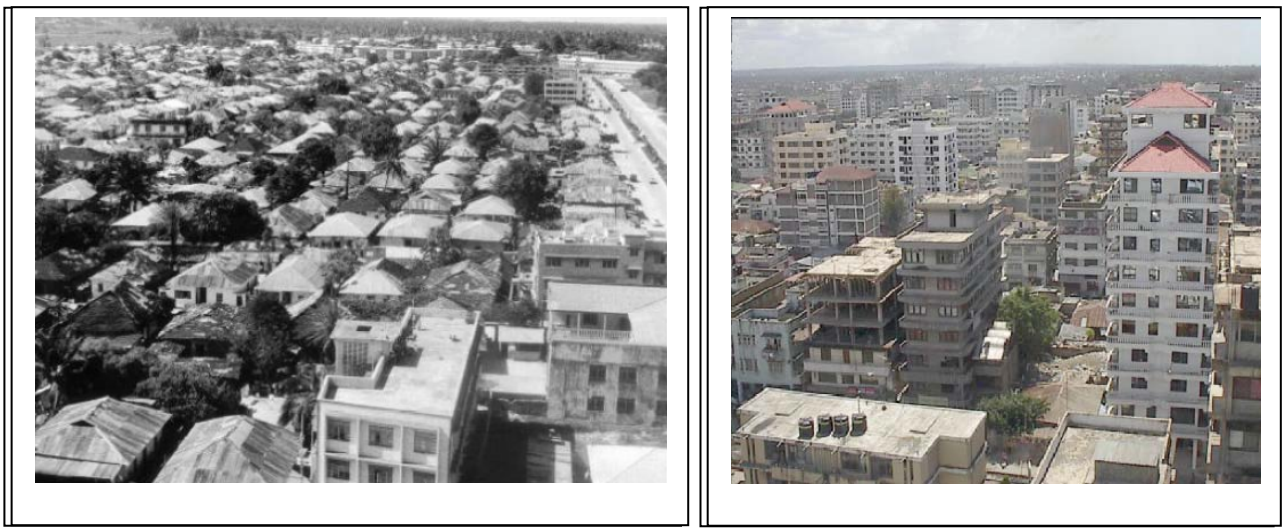

Figure 6 : The changing landscape of Kariakoo in 1960s (left) and 2014 (right)

In the three blocks where detailed studies were conducted, while the number of single storey houses was 9 out of 14 in Block 47 in 2006, all the single storey houses were phased out in 2014. Many building are being transformed from typically single storey residential to multi storey commercial residential and office functions. Redevelopment trends in Block I were relatively slow apparently because of its peripheral location from the commercial centre (Table 2).

c) Floor Area Ratio (FAR)

The minimum Floor Area Ratio (FAR) ranged from 0.1 to 0.5 in block I and 47. The recommended Floor Area Ratio for commercial buildings was 5.3. and 3.6 for residential cum commercial uses. One building on plot 6 Block 43 had a Floor Area Ratio of 8.4. This is a case of violation of the approved ratio of 5.3. Further observations in the areas zoned for residential cum commercial revealed an average Floor Area Ratio that ranged between 4 and 5 as compared to the recommended ratio of 3.6. This pattern of development contributes to informal vertical development in Kariakoo (Table 3).

Table 2 : Trend in building height changes in Kariakoo (2006-2014)

Number of storeys	Block 43			Block 47			Block I		
	2006	2010	2014	2006	2010	2014	2006	2010	2014
1	9	2	-	10	8	3	11	10	9
2	-	-	-	-	-	-	-	1	1
3	1	2	2	-	1	-	-	-	-
4	1	2	4	-	-	1	-	-	-
5	1	2	2	-	1	3	-	-	1
6	1	3	3	1	1	2	-	-	-
7	-	1	1	1	1	1	1	1	1
8	-	1	1	-	-	1	-	-	-
9 and above	1	1	1	-	-	1	-	-	-
Total	14	14	14	12	12	12	12	12	12

Source: Bhayo, May 2014

Table 3 : Floor Area Ratio for Blocks 47, 43 and I in Kariakoo

FAR	Block 47	Block 43	Block I
0.1-0.5		-	-
0.5-1.0	2	-	9
1.0-1.5	-	-	-
1.5-2.0	-	-	1
2.0-2.5	-	2	-
2.5-3.0	-	3	-
3.0-3.5	1	1	1
3.5-4.0	2	-	-
4.0-4.5	2	3	-
4.5-5.0	1	3	-
Above 5.0	3	2	1
Total	**11**	**14**	**12**

Source: Bhayo, May 2014

d) Plot coverage

Fieldwork results from Kariakoo indicate that the majority of the plots had higher plot coverage of over and above those recommended in the guidelines. While the recommended maximum coverage was 70 percent, results from field observations indicate that out of a total of 37 plots, 16 plots had 80 to 90 per cent and 15 plots had 71 to 80 per cent coverage. Two buildings had plot coverage of 90 to 100 percent (Table 4). In general terms, 89 percent of all buildings had plot coverage exceeding ratios recommended in the Redevelopment Scheme of Kariakoo. These findings indicate that building developers are not adhering to guidelines as stipulated in the redevelopment plan. The effect of excessive plot coverage is culminating into problems associated with limited capacity to attend emergency measures such as fire rescue, poor ventilation and poor sunlight in the interior rooms.

Table 4 : Plot coverage in Kariakoo

Plot coverage (%)	Number of plots	Percentage
50 or less	-	-
51-60	-	-
61-70	4	10.8
71-80	15	40.5
81-90	16	43.2
91-100	2	5.4
Total	37	100.0

Source: Bhayo, May 2014

e) Land coverage at block level

In terms of land coverage at block level, Block I had the highest coverage of 83 percent followed by Block 43 with 77 per cent and block 47 that had 73 percent (Table 5). These ratios are again over and above the recommended coverage of 70 percent. Although house form in Block I was still dominated by single storey houses the horizontal extensions has culminated into higher plot coverage. Higher plot coverage is contributing to uncomfortable indoor living especially in hot and humid climatic conditions of Dar es Salaam.

Table 5 : Land coverage at block level in Kariakoo

Block	Total area (m2)	Total built up area	Land coverage per block (%)
43	4207.48	3226.87	77
47	4295.84	3135.65	73
I	3140.86	2615.89	83

Source: Bhayo, May 2014

f) Spatial growth pattern in Kariakoo

The emerging spatial growth pattern in Kariakoo depicts a compact settlement of building with varying heights, size and plot coverage. Although the trend in densification is in line with the view towards optimizing land and infrastructure use in Kariakoo, excessive compactness of buildings closely juxtaposed to each other is resulting into poor spatial qualities of the indoor living environment. Controls on the limitation of building height and coverage seem to have failed. The fact that development is taking place on plot-by-plot basis, the skyline is broken depicting what can be called *"informal vertical landscape"*. View from side balconies is blocked due to narrow building side set-backs and side spaces cannot be used for any meaningful function. Tall buildings are casting shadows on adjacent buildings and streets resulting into dark corridors (Figure 7d). This spatial growth pattern is not sustainable when spatial quality requirements of visual, indoor sun lighting, skyline, space between buildings and cross ventilation are taken into consideration.

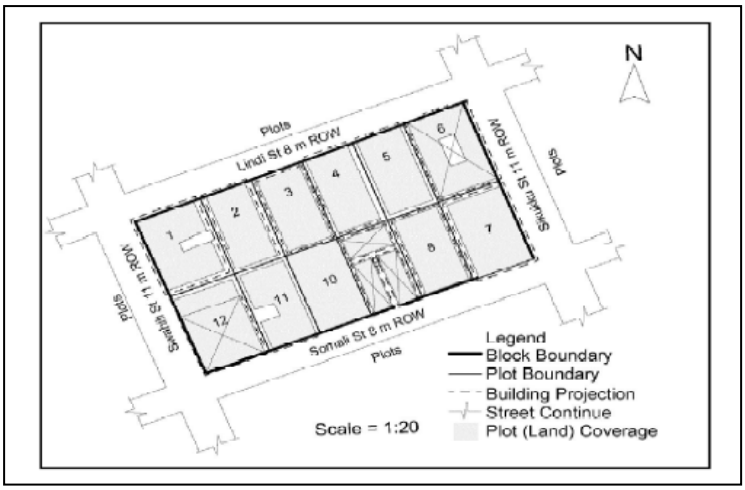

Figure 7a : Plot layout in Block 47 in Kariakoo Area

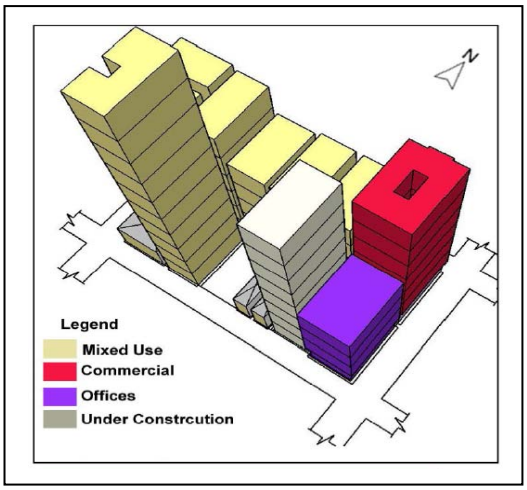

Figure 7b : Block Coverage 73%; Approved height 5-7 storeys

Figure 7c : Small side setbacks cause dark alleys and indoors spaces

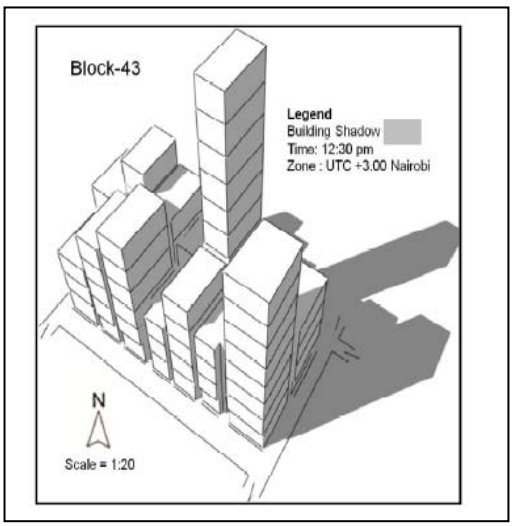

Figure 7d : Shadow effects on adjacent buildings and streets

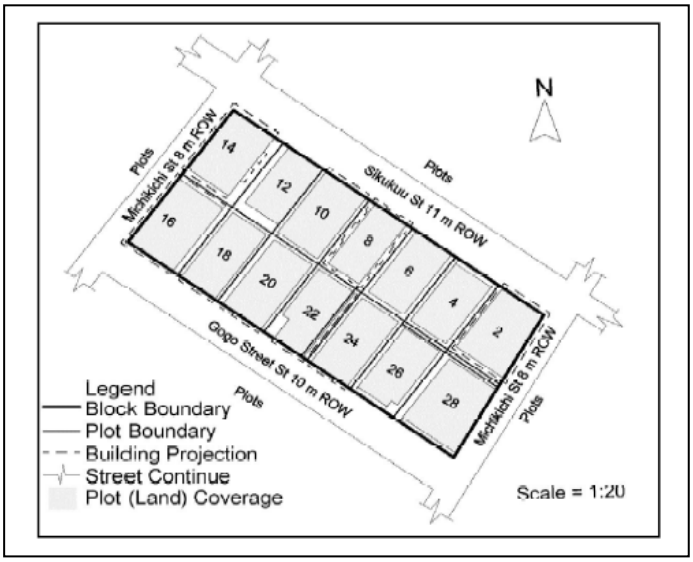

Figure 8a : Plot layout and building coverage in Block 43, Kariakoo Area

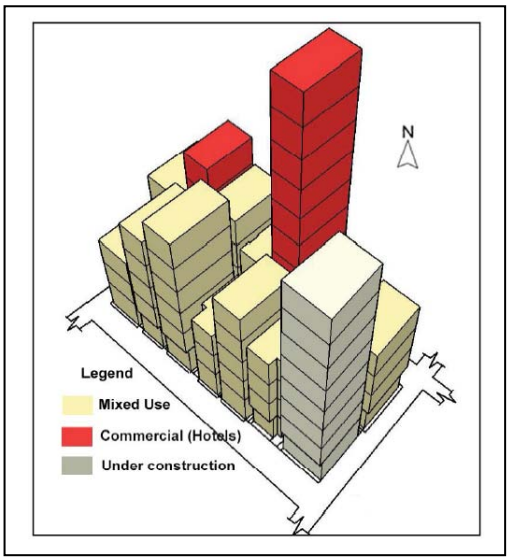

Figure 8b : Plot coverage 77%; approved height 5-7 storeys

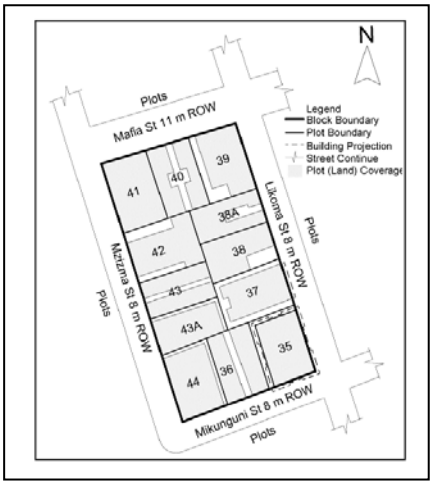

Figure 9a : Plot layout and building coverage in Block I

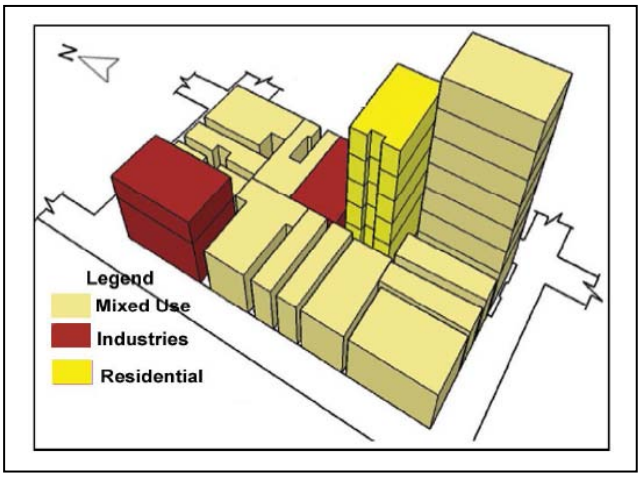

Figure 9b : Plot coverage 83%; approved height 2-4 storeys

VI. Results from Sinza

a) Building redevelopment guidelines for Sinza

Until 2014, the municipality of Kinondoni was yet to develop building densification guidelines for Sinza neighbourhood. Results from interviews with the Kinondoni Town Planner revealed that on average, they were receiving *3 to 10* applications for change of land and building use from residential to commercial from Sinza. In absence of a guiding framework for building redevelopment, plot coverage and floor area ratio were determined by using Government Notices, Orders and Circulars issued by the Ministry of Lands, Housing and Human Settlements Development of 1996. These guidelines are used to make decisions on plot by plot basis and as per specific requirement submitted by the plot developer. The Government Notice Number 157 of 16th May 1996 provides for the following guidelines as summarized in Table 6.

Table 6 : General guidelines for minimum plot size, plot ratio and site accommodation density

	ZONE I RESIDENTIAL							ZONE II SHOPS AND OFFICES		ZONE III SERVICE TRADE		ZONE IV	ZONE V	ZONE VI PUB. BUILD/ PRIVATE OPEN SPACES		
	A	B	C	D	E	F	G									
	Detached houses			Terraced	Multi storey/Block of Flats			Multi storey	One storey	Multi storey	One storey	General indu	Spec indu	Public build.	Schools	Sports grounds
	HD	MD	LD		HD	MD	LD									
Min Plot size	372	930	1395	112	930	930	2790	279	233	233	233	-	-	-	-	-
FAR	0.4	0.25	0.20	0.5	0.7	0.6	0.3	2.5	0.71/ 0.511	-	-	-	-	-	-	
Max coverage (%)	40	25	15	50	40	20	15	70	70	70	70	80	80	50	20	10
Habitab. rooms/ housing area	80	50	40	120	150	120	70	-	-	-	-	-	-	-	-	-

Source: Government Notice No. 157, (URT, 1996). (HD-High Density, MD-Medium Density, LD-Low Density)

Approval of applications for change of use and building permit is usually done by the Building Permit Committee which is a Sub-Committee of the Urban Planning Committee (UPC). Applicants have to lodge an application for change of use first and upon approval, one has to submit detailed drawings that indicate the intended developments.

b) Changing landscape of building heights in Sinza

Sinza was designed as a residential settlement for low-income people under the site and services schemes of the 1970s (Bhayo 2014; Lupala, 2002). The standard plot size was 288 square metres. By that time, this was the smallest plot size which was considered affordable by the low income people. Starting from mid 1980, commercial uses started to emerge in Sinza. These included retail shops, guest houses, hotels, small groceries, restaurants, service industries, social halls and boutiques (Lupala, 2002). In blocks A, D and E, 15 per cent of all buildings had been transformed from residential to residential cum commercial uses. Middle and high income people have been buying off low income people and reconstructing larger high-rise commercial residential buildings. The changing landscape of Sinza is largely attributed to the increase in land value following the establishment of the Mlimani City commercial complex and completion of the Sam Nujoma highway that marks the border with Sinza. As the case was for Kariakoo redevelopment is carried out is piecemeal and on plot-by-plot bases. While the original houses forms in Sinza were predominantly single storey residential buildings, increasingly, commercial and high-rise buildings of 6 to 10 storey buildings are emerging. Although this pattern of settlement development maximizes land uses, it also poses potential challenges to spatial qualities. The fact that plot sizes in Sinza are relatively smaller than those of Kariakoo, unguided building redevelopment is likely to lead into crammed housing with adverse effects on urban spatial qualities.

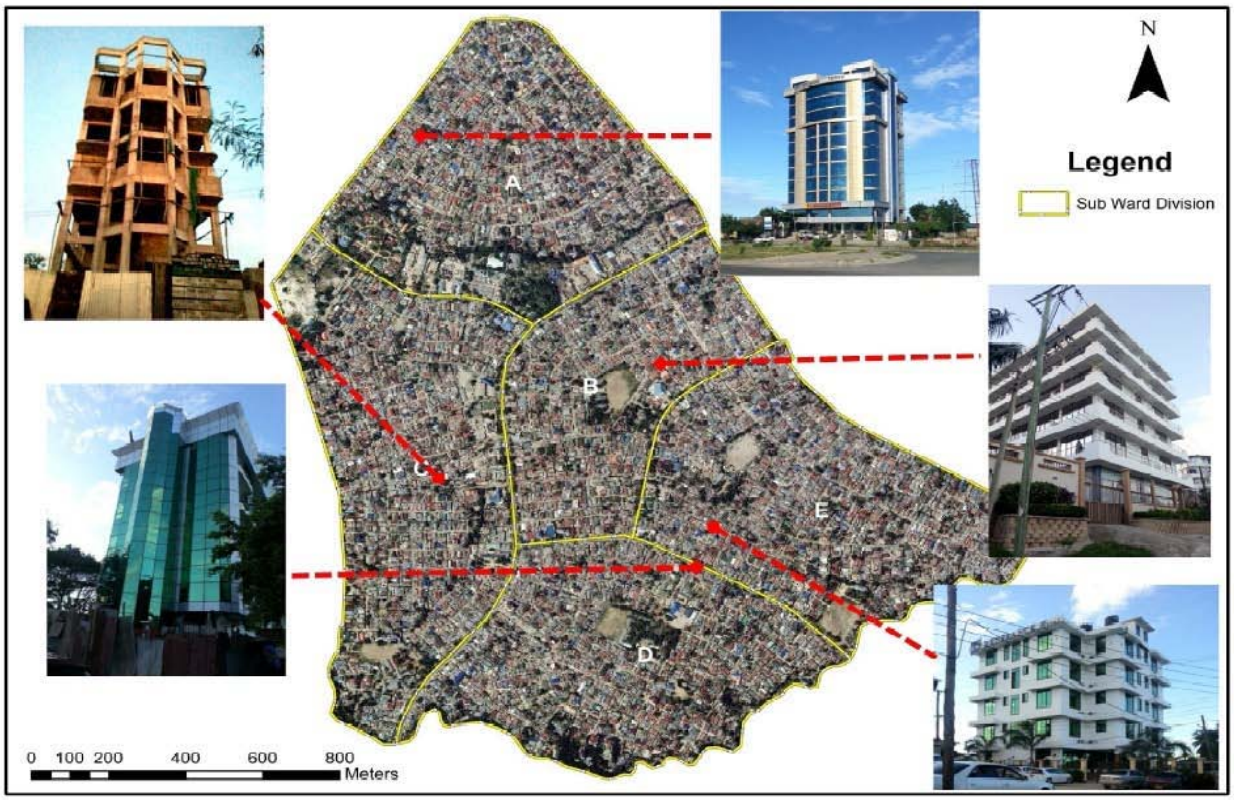

Figure 10 : Sinza settlement and the emerging high rise buildings

c) Building height in Sinza

The newly emerging buildings in Sinza are multi-storey but are still scattered and isolated to form a continuous skyline. The isolated buildings pose a threat of privacy to the surrounding low rise houses because people in the high-rise houses can have a view of indoor and outdoor activities taking place in the low-rise houses. If this trend will continue unchecked, the challenges of loss of privacy, blocked cross ventilation and sun lighting will be more apparent than the case is in Kariakoo.

d) Floor area ratio

The Floor Area Ratio (FAR) for Sinza was revealed to range from 0.1 to 0.5 in block A, D and E. Most of the buildings had FAR of between 0.5 and 1.0 and only two commercial buildings in block A and D had FAR of 3.5 and 5.5 (Table 6). Based on redevelopment guidelines relevant to Sinza, the maximum recommended FAR for residential plots is 0.7. As for commercial developments, the recommended FAR is 2.5. As was the case for Kariakoo, developers in Sinza were also violating the approved guidelines motivated by the urge of maximizing plot use. (Table 7)). Although the extent and number of high-rise buildings in Sinza is still limited, the emerging isolated cases pose a challenge on how new buildings development should be managed to contribute toward compact city without compromising liveability and spatial qualities.

Table 7 : Floor Area Ratio for Sinza

FAR	Block A	Block D	Block E
0.1-0.5	5	5	4
0.5-1.0	4	6	12
1.0-1.5	1	-	-
1.5-2.0	-	-	-
2.0-2.5	-	-	-
2.5-3.0	-	-	-
3.0-3.5	0	1	0
3.5-4.0	-	-	-
4.0-4.5	-	-	-
4.5-5.0	-	-	-
Above 5.0	1	-	-
Total	11	12	16

Source: Bhayo, May 2014

e) Plot coverage in Sinza

Results from field observations and measurement revealed that 15 out of 39 plots had plot coverage ranging between 51 and 60 per cent. The trend diminishes as coverage increase or diminishes around this figure. Only a few plots had higher coverage ranging from 91 to 100 percent. The latter represent newly constructed building (Table 8). The recommended maximum plot coverage for offices, shops and service trade is 70 percent and for residential categories is 50 percent. Again this shows the tendency of having plot coverage exceeding the recommended standards.

Table 8 : Plot coverage in blocks in Sinza

Plot coverage	Number of plots	Percentage of total plots
0-30	1	2.6
31-40	5	12.8
41-50	8	20.5
51-60	15	38.4
61-70	5	12.8
71-80	3	7.7
81-90	1	2.6
91-100	1	2.6
Total	39	100.0

Source: Bhayo, May 2014

f) Land coverage at block level

The established land coverage in blocks A and D was 54 per cent, while in block E was 56 per cent. The small variation in land coverage in Sinza at block level is attributed to the standardized plot and block size with smaller house sizes. In Kariakoo, there was a significant variation in plot sizes from one block to another (Table 9).

Table 9 : Land coverage at block level in Sinza

Block	Total block area (m2)	Total built up area (m2)	Land coverage (%)
A	3504	1906	54
D	3288	1781	54
E	4717	2651	56

Source: Bhayo, May 2014

g) Spatial growth pattern in Sinza

Although the skyline of Sinza is still dominated by single storey houses, isolated cases of high-rise buildings are protruding as monuments breaking the skyline amidst low-rise buildings. In terms of plot and block coverage, the present pattern indicate a modest coverage of about 50 percent. This creates a harmonious living and working environment with visual impressions within human scale. However, one of the potential challenges that is ahead of building redevelopment in Sinza is the small plot sizes which limits flexibility in designing functional multi storey buildings. For example the tall building in Block A (with 10 storeys) could be developed better if more than one plot were combined to provide ample surrounding spaces (Figure 11b). If it happens that adjacent plots will also developed in the same form, then the future spatial pattern will be too compact to provide the requisite qualities of sun lighting, ventilation, view and comfortable indoor living and working environment.

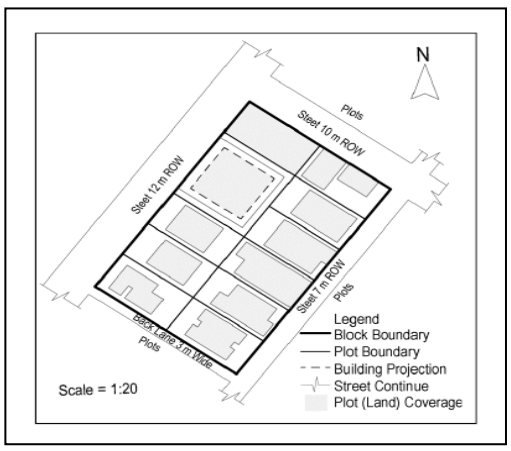

Figure 11a : Plot layout for Block A in Sinza Area

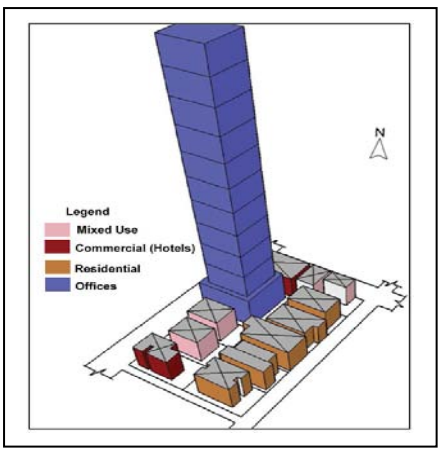

Figure 11b : Block coverage 54%, Approved height: Variable

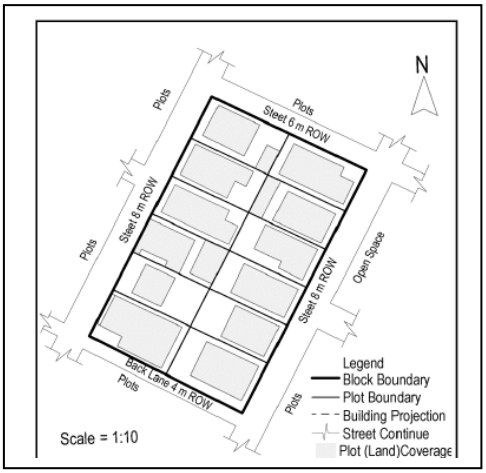

Figure 12a : Plot layout for Block D in Sinza Area

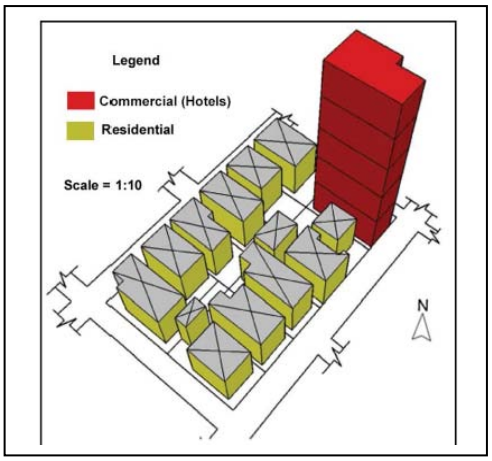

Figure 12b : Block coverage 56%, Approved height: Variable

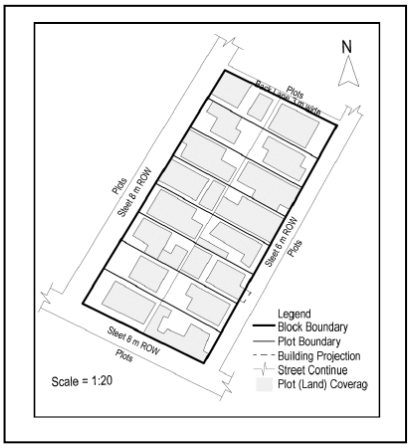

Figure 13a : Plot layout for Block E in Sinza Area

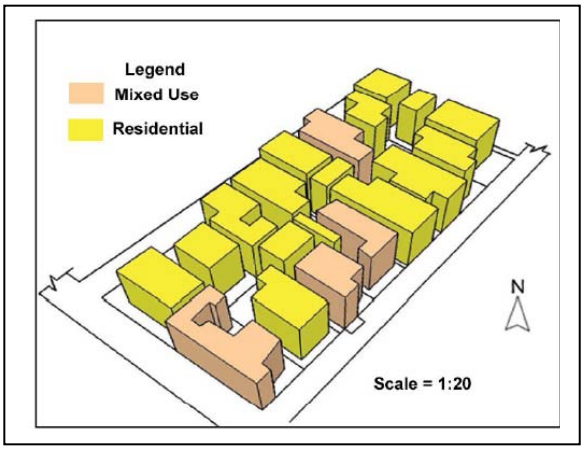

Figure 3b : Block coverage 56%, Approved height: Variable

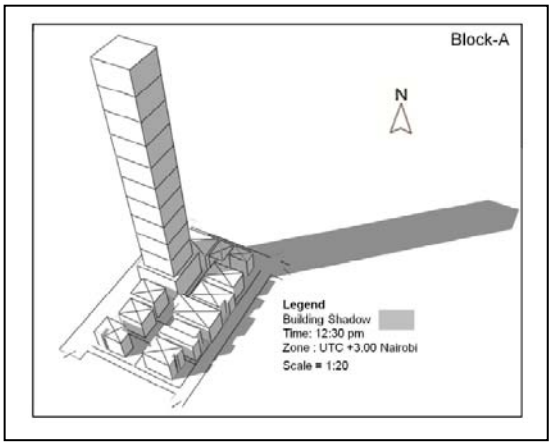

Figure 14a : Shadow effects on adjacent buildings and roads for block A Sinza

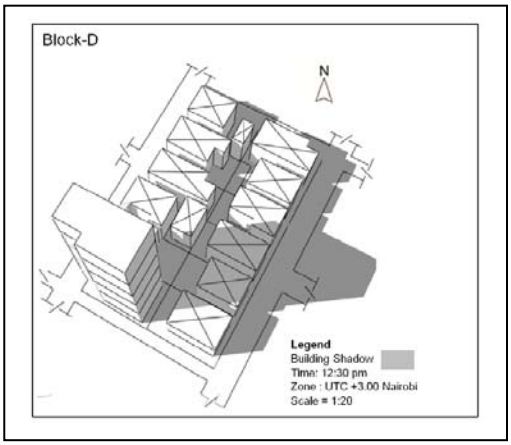

Figure 14b : Shadow effects on adjacent buildings and roads for Block D Sinza

VII. Discussion

Even though the spatial extent of growth of Dar es Salaam has reached as far as 32 kilometres, the revealed density gradients values are still as low as 20 percent at 15 kilometres for the year 2012. Compactness of the city is notable within a distance of less than 10 kilometre distance with density gradient values being more than 40 percent. If the 50 percent compactness is considered as optimal in most of the redevelopment schemes, only settlements developed within a distance of 5 kilometres from the city centre reveal this threshold. Arguing from compact development point of view or jaggedness, the city compactness is still too low to guarantee city spatial sustainability in terms of effective utilization of land and infrastructure. In other words, the city has sprawled horizontally with larger parts beyond the 5 kilometre radius having low land coverage. Based on similar premises for Dar es Salaam City, Lupala (2007) observed as follows; *"if the number of storeys in the low rise house types areas could be doubled, the extent of the built up area for the city could be reduced from 57,211 hectares to only 11,331 hectares. Similarly the horizontal expansion of the city could be reduced from 30 kilometres to 14 kilometres radii".* In other words the study indicated that house forms (low rise or high rise) had a significant contribution in urban sprawl compromising spatial sustainability of Dar es Salaam City.

In both cases, (Kariakoo and Sinza), it has been noted that the guidelines for building redevelopment are inadequate, and where availed, they were being violated with limited or no control from the concerned authorities. This has been revealed in terms of developers constructing buildings with more number of storeys, more plot coverage and floor area ratios than those recommended in the guidelines. Excessive plot coverage especially in hot and humid climatic zones like Dar es Salaam not only undermine spatial quality requirements for sun lighting, cross ventilation and view but also contributes to excessive use of electricity energy (Table 9). Electricity was usually put on during day times because of the shadows and darkness casted by tall buildings in Kariakoo. Reporting findings from Kariakoo, Monterroso (2008) wrote as follows; *"comfort in indoor living environment was largely dependent on orientation of openings. For buildings that had windows on the sides, natural sun lighting was blocked creating dark spaces and compelled residents to use electricity light during day times. This was caused by the compact siting of building closely juxtaposed from one another".*

Table 9 : Cross case analysis

Issue	Kariakoo	Sinza	Emerging issues
Building densification guidelines	• Guidelines were stipulated in the Kariakoo Redevelopment Scheme (2002) • Zoning plan for building height, uses, FAR, coverage provided	• There was no scheme to guide building densification • Government notices, circulars were used as guidelines	• Developers were violating guidelines on coverage AND FAR • There was weak enforcement of guidelines
Changing landscape in building heights	• Rapid transformation started in 1990s • Densification has reached 'saturation stage'	• Still in its infancy stages of transformation • High rise buildings are isolated and scattered	• Although densification leads towards compact development, spatial qualities are largely being compromised.
Floor Area Ratio (FAR)	• Recommended maximum FAR was 5.3 • Observed maximum FAR was 8.4	• Recommended maximum FAR was 2.5 • Observed maximum FAR was 5.5	Developers were violating recommended standard in urge of maximizing plot use.
Plot Coverage	• Recommended maximum plot coverage was 70 percent • Observed maximum coverage was 100 percent	• Recommended maximum plot coverage was 70 percent • Observed max coverage was 100 percent	Developers were violating recommended standard in urge of maximizing plot use.
Land coverage at block level	If recommended guidelines were followed, land coverage at block level was supposed to be 70 percent	If recommended guidelines were followed, land coverage at block level was supposed to be 70 percent	Excessive land coverage leads to excessive compactness, loss of spatial qualities and comfortable indoor living
Spatial growth pattern	Broken skyline due to varying building heights	Isolated cases of tall building with predominant low rise house forms	Broken skyline leads to poor visual impression, unused spaces, informal vertical development and loss of privacy for low rise house forms

VIII. Conclusion and Recommendations

It is apparent from the foregoing discussion that building densification is one of the key parameters for achieving compactness and sustainability. While compactness can be achieved both by increasing coverage and floor area ratios, this approach ought to be careful designed, guided and controlled to avoid the negative externalities emanating from crammed development. The cases of Kariakoo and Sinza serves to illustrate the fact that without proper guidelines for building densification process and effective development control, initiatives for achieving spatial sustainability in cities will not be realised. The potential challenges associated with unguided building densification have been revealed to include; blocked ventilation, loss of view, loss of privacy, broken skyline and creation of unused spaces between buildings. On the basis of these observations and empirical findings from the two cases the following are recommended. Firstly, there is a need of identifying all areas potential for building densification and preparing redevelopment schemes that will guide the densification process. Secondly, there is a need of establishing effective urban development control mechanisms to see to it that the recommended guidelines are followed by developers. Thirdly, in designing and redeveloping areas that command higher land values, the possibility of combining more than one plot should be considered. This will provide flexibility in design and address some of the spatial quality challenges that were identified in Kariakoo and Sinza.

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Zoning Mashhad Watershed for Artificial Recharge of Underground Aquifers using TOPSIS Model and GIS Technique

By Alireza Arabameri
Tarbiat Modares University, Iran

Abstract- In recent years, coincide with population growth and industrial expansion, in many countries in the world,Extract water of underground sources expanded and annual withdrawal of ground water is higher than the annual feeding. This means extracting and using the water in layers that has been saved over thousands of years in the underground. Consequently groundwater levels in the area will be extracted every day and eventually drop where the water will not exist. While proper management and control of these resources will eliminate the problems of drop in water level. One way to managing groundwater resources is artificial recharge of groundwater and determine suitable locations for these purpose. growth and development trend of Mashhad city and excessive Extracting of ground water in recent years, has been essential groundwater resources management strategy in the region more than ever implied. The purpose of this study is Zoning Mashhad watershed for artificial recharge of underground aquifers using TOPSIS Model and GIS technique. TOPSIS algorithm is a Multi Criteria Decision Making, a type of compensatory model and an adaptable subgroup with strong ability to solve multi alternative problems because of having ability to overlap indicators in weak and power points.

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GJHSS-B Classification : FOR Code: 050299

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Keywords: groundwater, aquifer, algorithm TOPSIS, artificial recharge, zoning, Watershed Mashhad.

I. Introduction

Nowadays, shortage and decrease in fresh water is approximately under increased all over the world. Based on the statistics published by FAO (Food and Agriculture organization), need for fresh water has almost become double per 21 years, while useful water resources have been reduced by half in relation to 30 years ago. It seems that useful water resources will become one fourth up to 2025 than useful water resources in 1960. Meanwhile, danger of various pollutions for water resources frequently increased the value and importance of them. Due to mentioned cases, if water resources aren't managed in better way, the life of human being will be threatened by the shortage of water. Thus, it is necessary to acquire the exact and up to date information about the condition of water resources and prediction of their situation in future in order to achieve optimum management for water resources.since, the group decision making, evaluation is resulted from different evaluator's view of linguistic variables, its evaluation must be conducted in an uncertain, fuzzy environment . In recent years, water exploitation has become greater for many reasons such as population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine and assign the suitable position for this case. Due to continuous decline in per capita water and the importance of nutritious preparation for people it is necessary to control the surface water using damp building or artificial recharge methods. Researchers of water sciences have studied the damp building and artificial recharge projects all over the world, drawn logarithm curve for cost against the amount of savable running water and concluded that it is frugal economically to accomplish artificial recharge projects especially flood distribution instead of damp building for the volume less than 30 million cube meter (Bize, et al., 1972). the experiences of under developed countries show that compressing the agriculture caused quick output purposes but they destroy the basic resources for a long term. It can be noticed in pasture destruction, forest resources reduction, deserts increase, reduction and destruction of surface water resources and ground water and exponential compress to the basic resources. In our country, planning in agricultural, rural and natural resources development has always been founded at the

Author: PhD Candidate of Geomorpholog, Faculty of Humanities, Department of Geography, Tarbiat Modares University, Tehran, Iran. e-mail: alireza.ameri91@yahoo.com

level of political development. This traditional attitude toward planning and development caused instability in using basic resources. During 2 previous decades, our country has taken activities to develop agriculture and natural resources comprehensively. Although these activities were slow and sluggish, they can develop a new attitude among experts, connoisseurs and decision makers in agriculture section. Based on this attitude, casual, one-direction and one-dimensional activities can solve part of short term problems and difficulties related to agriculture section and have pathetic effects on this section in long term. Water resources management is a set of various management activities aimed at the optimum utilization of water resources and reduction of economical, social and environmental damages and losses. Decision making issue in water resources management is very complex and complicated because of several decision indicators and criteria. Achieving a determine purpose, there are a lot of solutions with different priorities for various issues such as environmental, social, organizational and political problems. These necessities leads to use of multiple criteria decision making aimed at selection of best solution among different solutions. There are many examples of applications of TOPSIS in literature For instance: Saraf and Choudhury (1998) used remote sensing capabilities in extracting different layers like land usage, geomorphology, vegetation, and their integration in GIS environment to determine the most suitable area for artificial recharge of ground water. Mahdavi (1997, 16) investigated water management and artificial recharge of ground water in Jourm city and indicated that controlling usage and recharge of water tables by the watershed management is the main management technique. Abdi and Ghayoumian (2001, 86) prioritized the suitable areas for storing surface water and reinforcing ground water based on geophysics data, land usage, topography, their integration and analysis in GIS environment.Kia Heyrati (2004) studied the function of flood distribution system in recharge of ground water in Moughar plain in Isfahan. Mahdavi et.al (2005) attempted to find the best position for artificial recharge of ground water by RS and GIS techniques in watershed Shahr Reza in Isfahan and introduced this tool for this case efficiently. Also, Noori et al (2004, 635) tried to find the appropriate areas for artificial recharge of ground water by recharge pools (recharge pools) and GIS technique in watershed Gavbandi and introduced alluvial fans and plain head (Dashtsar) as the best area for artificial recharge. Mousavi et al (2010) found the potential appropriate areas for artificial recharge of ground water in the vicinity of Kamestan anticline by integration of remote sensing and GIS techniques and introduced broken formations, alluviums and river canals as the best position for artificial recharge. Mianabadi and Afshar (2008) investigated and ranked the project of water supply in Zahedan using three methods: Induced Ordered Weighted Averaging (IOWA), Linear Assignment and TOPSIS methods, and then they compared the findings of these methods with the results of adaptable planning method (Mianabadi, 2008: 34-45). Limon and Martinez (2006) used Multi Attribute Utility theory for optimum allocation of agriculture water in north of Spain (Limon, 2006: 313-336). Ahmadi et al (2002) used multiple criteria decision making to rank different projects of refining agriculture water to reuse them (Ahmadi, 2002: 339-352). Also, Anand Raj and Kumar (1996) ranked management options of river basin by ELECTRE method (Anand, 1996: 326-335). The purpose of this study is zoning the best area for artificial recharge of underground basins in Mashhad watershed using effective factors in recharging underground water table by TOPSIS and GIS technique. In another way, this study aimed at the selection of most appropriate area to establish soil damps for the purpose of sustainable development of water resources using TOPSIS Method.

II. Methods and Materials

a) Mathematical situation of studied area:

Being situated in the northeastern part of countery, Mashhad province is bounded by 35°, 43' latitude to 37°, 8' north latitude and 59°, 15' to 60° and 36' longitude. It has access to Semnan Province in the East. Globally, Mashhad Basin is located at 985 meter height above sea level and its extent is 204 square kilometers.

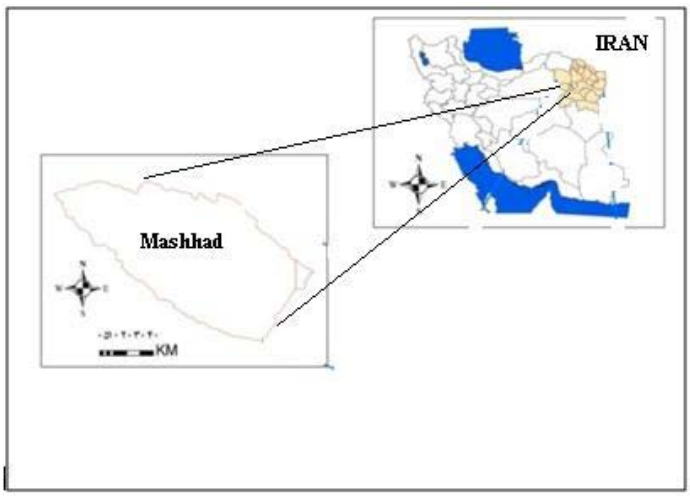

Figure 1 : Geographical position of Mashhad Basin

b) Methodology

Firstly, studied area was investigated by the satellite images of Google Earth and its limitations were determined. Then digital elevation model of area was separated from its digital elevation model in Iran in the environment of soft ware Global Mapper and the output was received. Required data layers for zoning in the environment of software Arc GIS 9.3 was prepared as following: First, digital elevation model classified in to 7 elevation classes based o natural breaks in the heights

of the area. Mentioned classes represent the studied zones in the area and subsequent calculations were done in each of these classes. Slope layer prepared base on digital elevation model o the area by surface analyses tool in 3D analyses. There were different processes to prepare drainage density layer and habitual density such as digitizing main and minor waterways layers on the topographical map1:50000 of the area, digitizing main and minor fault on geological map 1:100000 of area and density tool in Spatial Analyses. Iso-Precipitation layer prepared by interpolating method like cringing technique and linear relationship between rain-height using Interpolate tools in 3D analyses. Second, the investigated criteria for each height zones were calculated (Tables 2 , 10) and their layers prepared separately. After achieving a few numbers in each layer, the numbers were analyzed by TOPSIS method. Then considered watershed was ranked to select the best area for establishing soil damp.

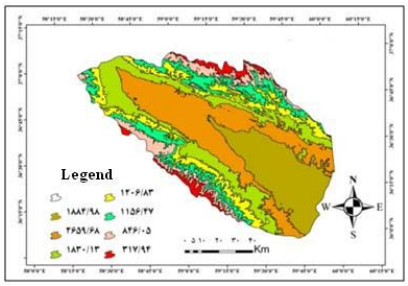

Figure 2 : Rainfall Map

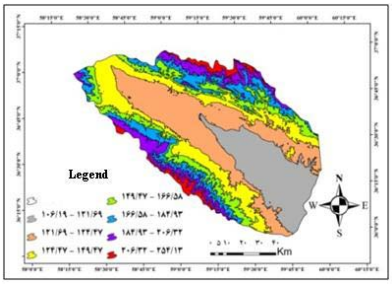

Figure 3 : Area Map

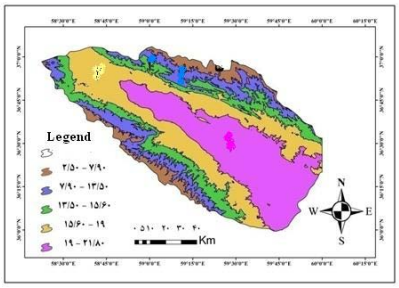

Figure 4 : Temperature Map

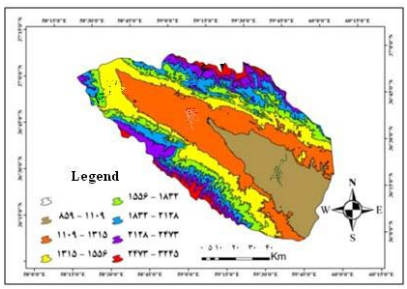

Figure 5 : Elevation Map

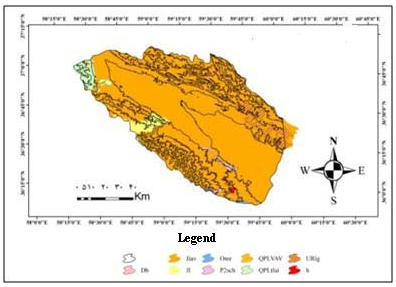

Figure 6 : Lithology Map

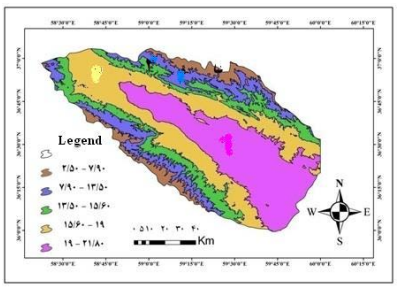

Figure 7 : Habitual Density Map

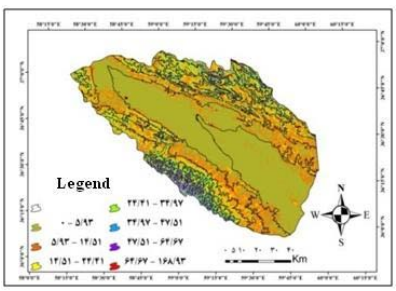

Figure 8 : slope Map

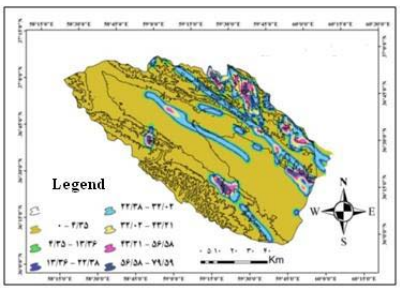

Figure 9 : Fault Density Map

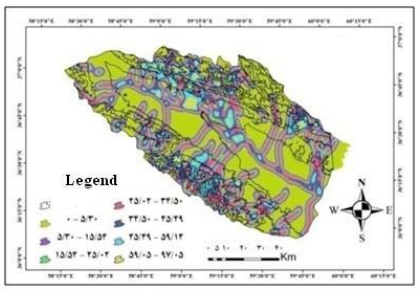

Figure 10 : Stream Density Map

c) Multi Attribute Decision Making (MADM)

The MCDM problems may be divided into two kinds of problem. One is the classical MCDM problems [Hwang &Yoon 1981, Keeney & Raiffa 1976, Feng & Wang 2000] among which the ratings and the weights of criteria are measured in crisp numbers. Another is the fuzzy multi-criteria decision-making (FMCDM) problems [Bellman & Zadeh 1970, Boender et al 1989, Chang & Yeh 2002, Chen 2000, Chen & Hwang 1992, Hsu & Chen 1996, Hsu & Chen 1997, Jain 1978, Kacprzyk et al 1992, Lee 1999, Liang 1999, Nurmi 1981, Raj & Kumar 1999, Tsaur et al 2002, Tanino 1984, Wang et al 2003], among which the ratings and the weights of criteria evaluatedon imprecision, subjective and vagueness are usually expressed by linguistic terms and then set into fuzzy numbers [Zadeh 1965, Zimmermann 1987, Zimmermann 1991]. multiple criteria decision making models are divided into two major categories, including Multi Attribute Decision Making (MADM) and Multi Objective Decision Making (MODM). Multi-criteria decision-making process involves four basic steps, which are 1-Identification and Evaluation, 2- Weighting,

3- Select option using one of the methods of multi-criteria decision making, 4 - Sensitivity analysis and final choices. Multi Attribute Decision Making process in Figure (11) is shown.

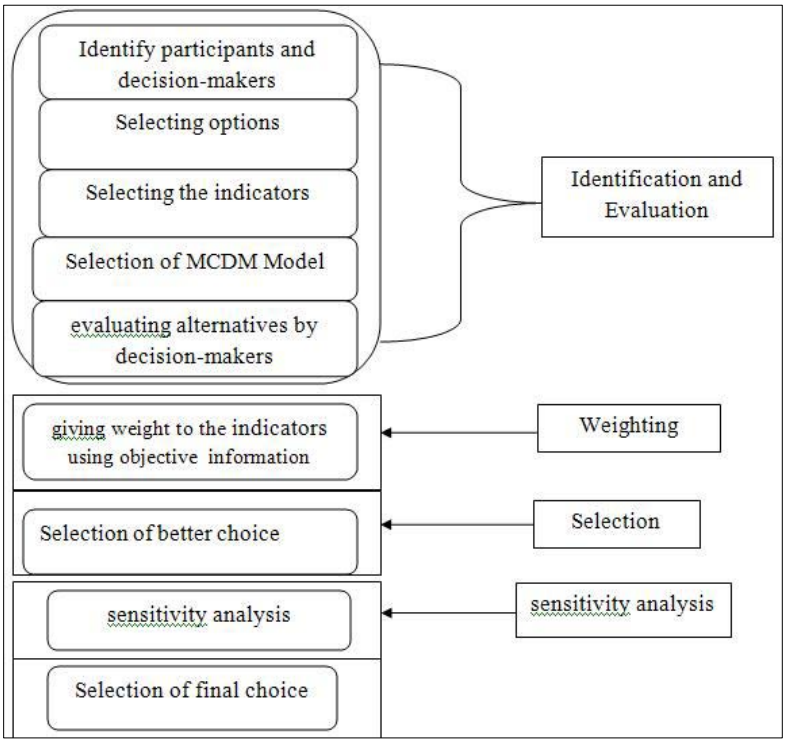

Figure 11 : Multi Attribute Decision Making process

d) TOPSIS

The technique for order preference by similarity to ideal solution (TOPSIS) proposed Hwang and Yoon [Hwang &Yoon 1981] is one of the well-known methods for classical MCDM. The underlying logic of TOPSIS is to define the ideal solution and negative ideal solution. The ideal solution is the solution that maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution is the solution that maximizes the cost criteria and minimizes the benefit criteria. In short, the ideal solution consists of all of best values attainable of criteria, whereas the negative ideal solution is composed of all worst values attainable of criteria. The optimal alternative is the one which has the shortest distance from the ideal solution and the farthest distance from the negative ideal solution. situation of TOPSIS method among the other Multi Criteria Decision Making showed in Figure (12).

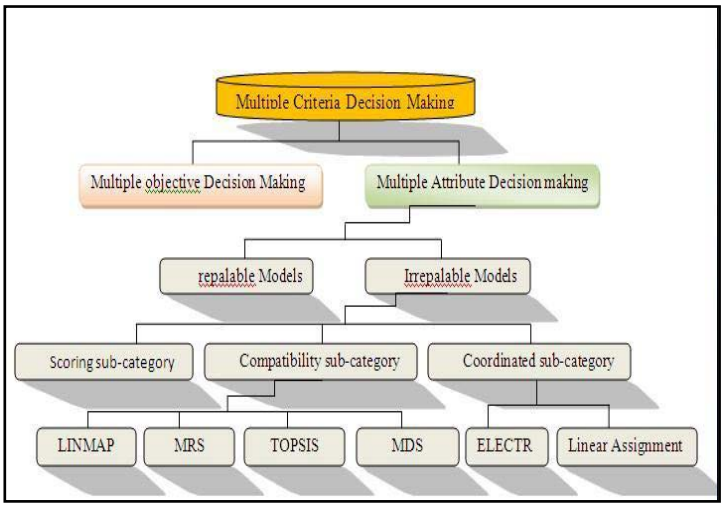

Figure 12 : situation of TOPSIS method among the other Multi Criteria Decision Making

e) Problem solving process using TOPSIS method

TOPSIS model includes 8 processes which are described in the following parts (Olson, 2003-2).

1. Establishing data matrix based on alternative n and indicator k:

Generally, in TOPSIS model, matrix **n×m** with **m** alternative and **n** criteria is evaluated. In this algorithm, it is supposed that each indicator and criterion in Decision

Making matrix has steady increasing and decreasing utility.

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ . & . & & . \\ . & . & & . \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

2. Standardizing data and preparing normalized matrix (matrix R) by Equation (1):

Since it is possible that quantitative amount of criteria and indicators don`t have equal unit , the dimensions of their units should be omitted. Thus, all amounts of entries of Decision Making matrix should be changed into dimensionless amount with following formula:

$$R_{IJ} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} {a_{ij}}^2}} \quad (1)$$

$$\begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ . & . & & . \\ . & . & & . \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

3. Determining weights for whole indicators (w_j) by equation (2) and modifying calculated (w_j) by equation (3):

In this process, the weights of all indicators are calculated by expertise theories and approaches, Linmap method, AHP model, Antropi model and based on the importance of criteria. It is considerable that sum of criteria weights should be equal to 1. In this study, AHP model has been used to calculate the amount of (w_j)

$$\sum_{j=1}^{n} w_j = 1 \quad (2)$$

$$w'_j = \frac{\lambda_j . w_j}{\sum_{j=1}^{n} \lambda_j . w_j} \quad (3)$$

4. Creating dimensionless weighted matrix (V) to implement vector W as an input for algorithm:

In order that the amounts of entries in matrix R gain equal value, , sum of weights of parameter (w_j) are multiplied to the column of this matrix one by one. The acquired matrix is normalized and weighted matrix which is shown by sign (V) (Table 4).

$$V_{ij} = R_{ij} . W_{n \times n} = \begin{bmatrix} v_{11,\dots} & v_{1j,\dots} & v_{1n} \\ . & . & . \\ . & . & . \\ v_{m1,\dots} & v_{mj,\dots} & v_{mn} \end{bmatrix}$$

5. Determining positive ideal (A^+) and negative ideal (A^-) by equations (4) and (5) respectively:

$$d_{i+} = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - {V^+}_j\right)^2} \; ; i = 1,2,\dots,m \quad (4)$$

$$d_{i-} = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - {V^-}_j\right)^2} \; ; i = 1,2,\dots,m \quad (5)$$

6. Calculating distance size of i-alternaive with ideals and using Euclidean method, by equations (6) and (7):

$$d_{i+} = \text{dictance of i} - \text{alternative from positive ideal} = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - {V^+}_j\right)^2} \; ; i = 1,2,\dots,m \quad (6)$$

$$d_{i-} = \text{distance of i} - \text{alternative from negative ideal} = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - {V^-}_j\right)^2} \; ; i = 1,2,\dots,m \quad (7)$$

7. Calculating relative closeness for i-alternative (A_i) i to ideal solution using equation (8):

8.

$$cl_{i+} = \frac{d_{i-}}{d_{i+} + d_{i-}} \; ; 0 \le cl_{i+} \le 1 \; ; i = 1,2,\dots,m \quad (8)$$

As you can see, if $A_i = A^+$, then $d_{i+} = 1$ and $cl_{i+} = 0$, on the contrary if $A_i = A^-$, then $d_{i+} = 1$ and $cl_{i-} = 0$. In sum, the more alternative A_i is closer to ideal solution, the more value of cl_{i+} is closer to unit.

9. Ranking alternatives based on descending order of cl_{i+} :

This amount is fluctuating between 0 and 1. Thus, $cl_{i+} = 1$ represents the highest rank and $cl_{i+} = 0$ the lowest rank.

III. Discussion

In previous decades, decision making in water management problems and selection of better option among suggested options to solve a watershed problems was only done based on economical criteria - profit in relation to cost- and on changing social and environmental criteria in to the economical criterion. However, today using Multi criteria decision making, it is not necessary to use financial equivalent of social and environmental criteria to select the best option. In fact, various qualitative and quantitative criteria can be used to prioritize and select the best options for water resources management.Nowadays, because of uncontrolled exploitation of ground water, water shortage is became doubled. Accurate control and management of these water resources can alleviate the problem of drought approximately. One of the management techniques of ground water resources is artificial recharge of basins and determination of the most appropriate place for it. The ground water resources are the largest and most importance reservoirs of fresh water on the earth for human being

after glaciers and glacial zones (Freeze, 1979). Since these resources are 99% of whole available fresh water, it is necessary to determine and exploit the ground water (Kouthar, 1986- 19).Furthermore,it includes 80% of being used resources in arid and semi-arid areas in most countries (Sedaghat, 1994). Due to Iran`s situation in desert and semi-desert area and its average annual rainfall about 250 mm, so there were many ways to prepare fresh water for agriculture, drinking and industry in different parts of country from a long time ago. Therefore, determination and zoning the most appropriate area for artificial recharge of underground aquifers should be considered in this plain.In recent years, water exploitation has become greater for many reasons such as population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine and assign the suitable position for this case. The Purpose of This Study is Zoning Mashhad watershed for artificial recharge of underground aquifers using TOPSIS Model and GIS technique The results of TOPSIS method to find the most suitable area for artificial recharge of groundwater aquifers of Mashhad Basin showed in tables (1) to (8). Therefore, a matrix is formed with rank (81) for data matrix, with 9 alternatives (height zones) and 9 related indicators (Materials, Precipitation , (mm), Stream density, area(km2), Fault density, Slope, Heat,) (Table 1).

Table 1 : Decision Matrix (X)

Regions	Materials	(mm) Precipitation	Stream density	(2km) area	Fault density	Slope	Heat	height	habitual density
1	3	108.85	48.52	3090	39.84	20.34	20.4	1028	7552.5
2	5	122.1	36.68	2977	38.79	22.59	17.3	1348	3916.14
3	9	146.56	41.73	1629	38.1	27.37	14.55	1675	2504.49
4	7	189.4	41.74	1439	38.26	29.22	10.7	2058	1448.65
5	1	283.59	36.5	764	39.26	26.01	5.2	2755	1590.05

Table 2 : Dimensionless Matrix (Matrix R)

Regions	Materials	(mm) Precipitation	Stream density	(2km) area	Fault density	Slope	Heat	height	habitual density
1	0.2335	0.2684	0.5258	0.6345	0.4585	0.3594	0.6240	0.2457	0.8276
2	0.3892	0.3010	0.3975	0.6112	0.4465	0.3991	0.5292	0.3222	0.4291
3	0.7006	0.3613	0.4522	0.3345	0.4385	0.4836	0.4451	0.4003	0.2744
4	0.5449	0.4669	0.4523	0.2955	0.4404	0.5163	0.3273	0.4919	0.1587
5	0.0778	0.6991	0.3955	0.1570	0.4519	0.4595	0.1591	0.6585	0.1742

Table 3 : Paired Comparison Matrix of different criteria (S)

Parameters	Materials	(mm) Precipitation	Stream density	(km2) area	Fault density	Slope	Heat	height	habitual density	Wij
Materials	1	2	3	4	5	6	7	8	9	0.307
Precipitation (mm)	0.5	1	2	3	4	5	6	7	8	0.2182
Stream density	0.33	0.5	1	2	3	4	5	6	7	0.1543
Area(km2)	0.25	0.33	0.5	1	2	3	4	5	6	0.1089
Fault density	0.2	0.25	0.33	0.5	1	2	3	4	5	0.0764
Slope	0.16	0.2	0.25	0.33	0.5	1	2	3	4	0.0533
Heat	0.14	0.16	0.2	0.25	0.33	0.5	1	2	3	0.037
height	0.12	0.14	0.16	0.2	0.25	0.33	0.5	1	2	0.0259
habitual density	0.11	0.12	0.14	0.16	0.2	0.25	0.33	0.5	1	0.0189
Sum	2.81	4.7	7.58	11.44	16.2	22	28.8	36.5	45	1

Table 4 : Weighted dimensionless Decision Matrix (V)

Regions	Materials	(mm) Precipitation	Stream density	(2km) area	Fault density	Slope	Heat	height	habitual density
1	0.0717	0.0586	0.0811	0.0691	0.0350	0.0192	0.0231	0.0064	0.0156
2	0.1195	0.0657	0.0613	0.0666	0.0341	0.0213	0.0196	0.0083	0.0081
3	0.2151	0.0788	0.0698	0.0364	0.0335	0.0258	0.0165	0.0104	0.0052
4	0.1673	0.1019	0.0698	0.0322	0.0336	0.0275	0.0121	0.0127	0.0030
5	0.0239	0.1526	0.0610	0.0171	0.0345	0.0245	0.0059	0.0171	0.0033

Table 5 : Amounts of positive and negative ideals (highest and lowest function of indicator)

Ideals	habitual density	height	Heat	Slope	Fault density	(2km) area	Stream density	(mm) Precipitation	Materials
A+	0.215	0.152	0.081	0.069	0.035	0.019	0.005	0.017	0.015
A-	0.023	0.058	0.061	0.017	0.032	0.027	0.023	0.006	0.003

Table 6 : Distance o^i-alternative from ideals

regions / Distance	1	2	3	4	5
D_i^+	0.1727	0.1319	0.0833	0.0814	0.1996
D_i^-	0.0750	0.1083	0.1936	0.1513	0.0962

Table 7 : Relative Distance of I-Alternative (A_i) To Ideal Solution

Cl_i	C1	C2	C3	C4	C5
Amount	0.3028	0.4515	0.7003	0.6502	0.3227

Table 8 : Points and Ranks of zones

Region	1	2	3	4	5
Point (Fuzzy Logic)	0.3036	0.4507	0.6691	0.6502	0.3252
Rank	Fifth	Third	First	Second	Fourth

IV. Conclusion

In recent years, water exploitation has become greater for many reasons such as population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine and assign the suitable position for this case. Water resources management is a set of various management activities aimed at the optimum utilization of water resources and reduction of economical, social and environmental damages and losses. Decision making issue in water resources management is very complex and complicated because of several decision indicators and criteria. Achieving a determine purpose, there are a lot of solutions with different priorities for various issues such as environmental, social, organizational and political problems. These necessities leads to use of multiple criteria decision making aimed at selection of best solution among different solutions. The result and findings of different studies show that in TOPSIS method, zone 3 with (0/669) point promotes in first rank among 5 studied zones and thus it is the most appropriate zone to establish the proper area for artificial recharge of underground aquifers , in contrast zone 1 with (0/302) point goes down to the last rank and so it isn`t suitable for establishing damp and zones (4,2,5) with (0/650, 0/450, 0/325) points are located in next ranks.

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Application of AHP Model in Selection of Most Appropriate Area to Establish Soil Damp for Artificial Recharge of Underground Aquifers (Case Study: Tabas Basin)

By Alireza Arabameri
Tarbiat Modares University, Iran

Abstract- In recent years, water exploitation has become greater for many reasons such as population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine the suitable position for Artificial Recharge of ground water. One of the management methods for water resources is Multi Criteria Decision Making. The analytic hierarchy process (AHP) is a structured technique for dealing with complex decisions that was developed by Thomas L. Saaty in the 1980 year. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. The base of this model is comparing variables by pair wise by Matrix relationship.

Keywords: *AHP Model, soil damp, artificial recharge.*

GJHSS-B Classification : *FOR Code: 059999*

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Abatract- In recent years, water exploitation has become greater for many reasons such as population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine the suitable position for Artificial Recharge of ground water. One of the management methods for water resources is Multi Criteria Decision Making. The analytic hierarchy process (AHP) is a structured technique for dealing with complex decisions that was developed by Thomas L. Saaty in the 1980 year. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. The base of this model is comparing variables by pair wise by Matrix relationship. In this way, pair wise of the effective variables on the concrete Pavement were considered and based on relative weights the output was extent. In the present research, combination of Indexing system Method with Analytical Hierarchy Process has been applied to assess the Selection of most appropriate area to establish soil damp for artificial recharge of underground aquifers. The findings of the research show that zone 3 with 0/3606 points promotes in first rank among 5 studied zones and thus it is the most appropriate zone for Artificial Recharge of ground waters, in contrast zone 5 with 0/1731 point goes down to the last rank and so it isn`t suitable for Artificial Recharge and zones (2,4,1) are located in next ranks.

Keywords: AHP Model, soil damp, artificial recharge.

I. Introduction

Iran is one of the arid countries in second world arid continent means Asia The average of world annual rain is almost 860 millimeter. While this numbe in our country is almost 250 millimeter and in Yazd province is almost 61.2 millimeter that means less of ¼ average Iran's rain and less of ¼ average world rain (Ahmadi, 2006) .of course, this amount in consecutive years wouldn't access in steady process and this irregularity in frame work of arid and torrential rains cause wore damage to human and physical environment relative to quantity. Yazd province as a third province content of critic focus for windy erosion after Kerman and Khorasan for reason of region abnormality such as decreasing rainfall and increasing temperature Severely involved with this phenomenon and desert consecutive such as subsidence of underground water sources. Thus it is necessary satiable program which in this way could control one of the biggest obstacles developments (Ali zadeh, 2003). Drought is a generally occurring phenomenon which its effects intensify gradually. In some cases drought continues for longer time and causes destructive damages to human communities. During recent years climate change impacts have been combined with drought effects and caused serious problems in different parts of the World. Characteristics of a drought event are not often easily known until it occurs. During 1967 to 1992, about 50% of the 2.8 billion people who suffered from all natural disasters, have been affected by relatively sever drought. From 3.5 million people who were killed by disasters, about 1.3 million were victims of the drought (Obasi, 1994). About 50% of the World intensive populated regions containing the most agricultural lands are very vulnerable to the drought (USDA, 1994). Since these resources are 99% of whole available fresh water, it is necessary to determine and exploit the ground water (Kouthar, 1986-19). Furthermore, it includes 80% of being used resources in arid and semi-arid areas in most countries (Sedaghat, 1994). Due to Iran`s situation in desert and semi-desert area and its average annual rainfall about 250 mm, so there were many ways to prepare fresh water for agriculture, drinking and industry in different parts of country from a long time ago. Therefore, determination and zoning the most appropriate area for artificial recharge of underground aquifers should be considered in this plain. There are many examples of applications of artificial recharge of ground water in literature For instance: Saraf and Choudhury (1998) used remote sensing capabilities in extracting different layers like land usage, geomorphology, vegetation, and their integration in GIS environment to determine the

Author: PhD Candidate of Geomorpholog, Faculty of Humanities, Department of Geography, Tarbiat Modares University, Tehran, Iran. e-mail: alireza.ameri91@yahoo.com

most suitable area for artificial recharge of ground water. Mahdavi (1997, 16) investigated water management and artificial recharge of ground water in Jourm city and indicated that controlling usage and recharge of water tables by the watershed management is the main management technique. Abdi and Ghayoumian (2001, 86) prioritized the suitable areas for storing surface water and reinforcing ground water based on geophysics data, land usage, topography, their integration and analysis in GIS environment. The purpose of this study is Application of AHP Model in Selection of most appropriate area to establish soil damp for artificial recharge of underground aquifers.

II. Methods and Materials

a) Mathematical situation of studied area

Tabas Basin with 5056/9 KM2 Being situated in the Yazd Province, Tabas Basin is bounded by 33°, 15' latitude to 33°, 57' north latitude and 56°, 25' to 57° and 23' longitude (Figure 1).

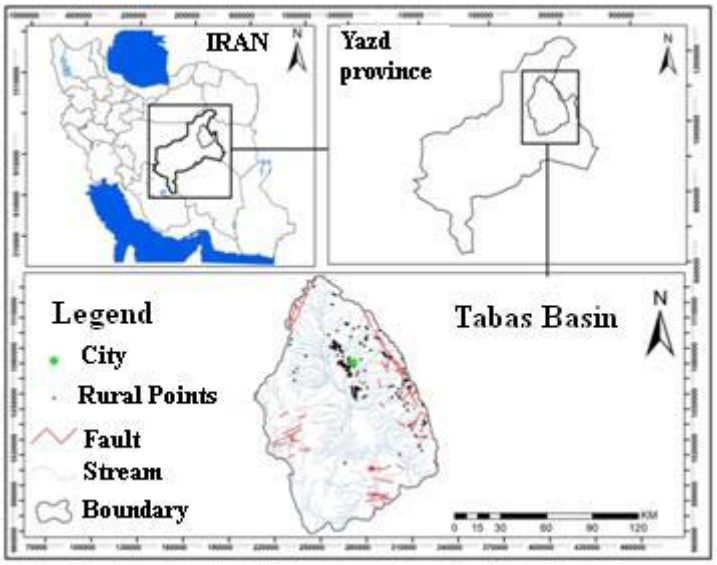

Figure 1 : Mathematical situation of area

b) Methodology

Firstly, studied area was investigated by the satellite images of Google Earth and its limitations were determined. Then digital elevation model of area was separated from its digital elevation model in Iran in the environment of soft ware Global Mapper and the output was received. Required data layers for zoning in the environment of software Arc GIS 9.3 was prepared as following: First, digital elevation model classified in to 5 elevation classes based o natural breaks in the heights of the area. Mentioned classes represent the studied zones in the area and subsequent calculations were done in each of these classes. Slope layer prepared base on digital elevation model on the area by surface analyses tool in 3D analyses. There were different processes to prepare drainage density layer and habitual density such as digitizing main and minor waterways layers on the topographical map1:50000 of the area, digitizing main and minor fault on geological map 1:100000 of area and density tool in Spatial Analyses. Iso-Precipitation layer prepared by interpolating method like cringing technique and linear relationship between rain-height using Interpolate tools in 3D analyses . Second, the investigated criteria for each height zones were calculated and their layers prepared separately. After achieving a few numbers in each layer, the numbers were analyzed by AHP method. Then considered watershed was ranked to select the best area for establishing soil damp.

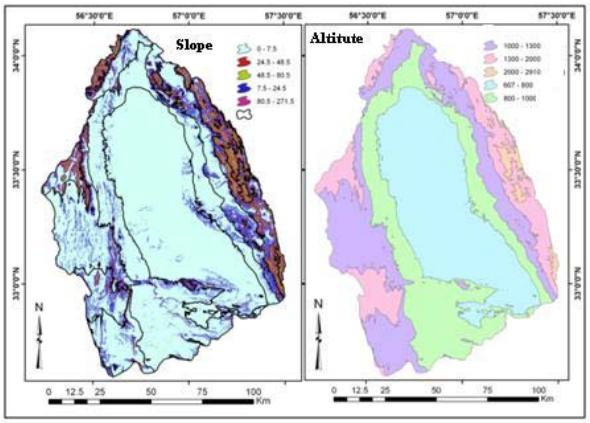

Figure 2 : slope and Altitude Maps

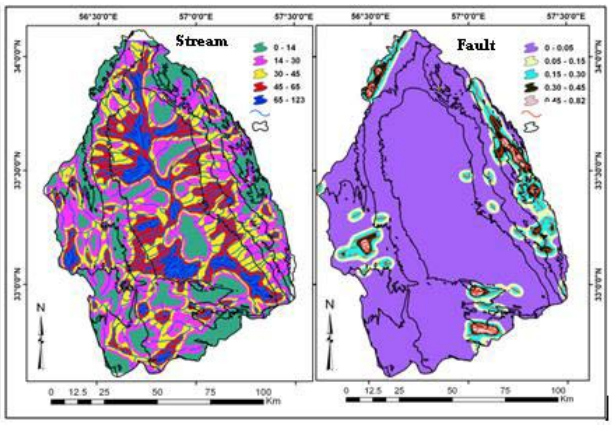

Figure 3 : Stream and Fault Density Maps

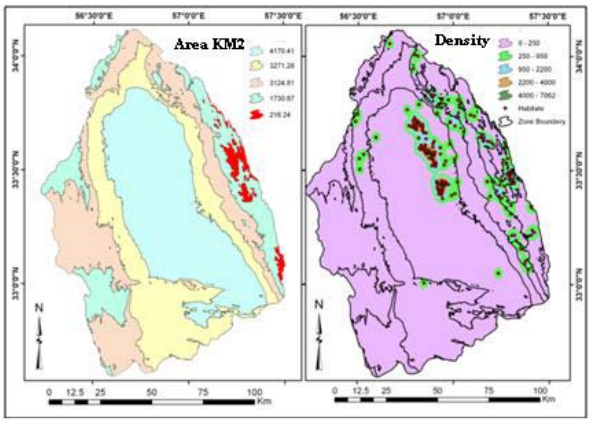

Figure 4 : Area and Habitate Density Maps

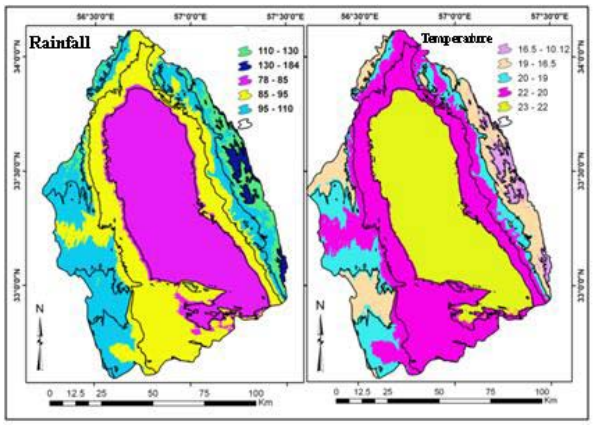

Figure 5 : Rainfall and Temperature Maps

III. Theoretical Basis

Analytic hierarchy process (AHP), as a very popular multiple criteria decision making (MCDM) tool, has been considerably criticized for its possible rank reversal phenomenon, which means changes of the relative rankings of the other alternatives after an alternative is added or deleted. If the weights or the number of criteria are also changed, then rankings might be reversed. Such a phenomenon was first noticed and pointed out by Belton and Gear (Belton & Gear, 1983), which leads to a long-lasting debate about the validity of AHP (Dyer, 1990; Harker & Vargas, 1987; Wang & Liang, 2004; Saaty et al, 1983; Stewart, 1992; Troutt, 1998; Vargas, 1994; Watson & Freeling, 1982; Saaty & Vargas, 1984) especially about the legitimacy of rank reversal (Forman, 1990; Millet & Saaty, 2000; Saaty, 1987; Saaty, 1987;, Saaty & Vargas, 1984, Schoner & Wedley, 1992). In order to avoid the rank reversal, Belton and Gear (Belton & Gear, 1983) suggested normalizing the eigenvector weights of alternatives using their maximum rather than their sum, which was usually called B–G modified AHP. Saaty and Vargas [Saaty & Vargas, 1984] provided a counterexample to show that B– G modified AHP was also subject to rank reversal. Belton and Gear (Belton & Gear, 1985) argued that their procedure was misunderstood and insisted that their approach would not result in any rank reversal if criteria weights were changed accordingly. Schoner and Wedley (Schoner & Wedley, 1989) presented a referenced AHP to avoid rank reversal phenomenon, which requires the modification of criteria weights when an alternative is added or deleted. Schoner et al. (Schoner, B., Wedley, W, 1993) also suggested a method of normalization to the minimum and a linking pin AHP (see also (Schoner & Wedley, 1997)), in which one of the alternatives under each criterion is chosen as the link for criteria comparisons and the values in the linking cells are assigned a value of one, with proportional values in the other cells. Barzilai and Golany (Barzilai et al, 1987) showed that no normalization could prevent rank reversal and suggested a multiplicative aggregation rule, which replaces normalized weight vectors with weight–ratio matrices, to avoid rank reversal. Lootsma (Lootsma, 1993) and Barzilai and Lootsma (Barzilai & Lootsma, 1997) suggested a multiplicative AHP for rank preservation. Vargas (Mianabadi & Afshar, 2007) provided a practical counterexample to show the invalidity of the multiplicative AHP. Triantaphyllou (Triantaphyllou, 2001) offered two new cases to demonstrate that the rank reversals do not occur with

the multiplicative AHP, but do occur with the AHP and some of its additive variants. Leung and Cao (Leung & Cao, 2001) showed that Sinarchy, a particular form of analytic network process (ANP), could prevent rank reversal. As an integrative view, the AHP now supports four modes, called Absolute, Distributive, Ideal and Supermatrix modes, respectively, for scaling weights to rank alternatives (Millet & Saaty, 2000; Saaty, 1986; Saaty, 1994; Saaty & Vargas, 1993). In the absolute mode, alternatives are rated one at a time and there is no rank reversal when new alternatives are added or removed. The distributive mode normalizes alternative weights under each criterion so that they sum to one, which does not preserve rank. The ideal mode preserves rank by dividing the weight of each alternative only by the weight of the best alternative under each criterion. The supermatrix mode allows one to consider dependencies between different levels of a feedback network. More recently, Ramanathan (Ramanathan, 2006) suggested a DEAHP, which is claimed to have no rank reversal phenomenon. But in fact, it still suffers from rank reversal. Wang and Elhag suggested an approach in which the local priorities remained unchanged. So, the ranking among the alternatives would be preserved.

a) Analytical Hierarchy process (AHP)

The Analytic Hierarchy Process (AHP) is an approach that is suitable for dealing with complex systems related to making a choice from among several alternatives and which provides a comparison of the considered options. This method was first presented by Saaty (Saaty, 1980). The AHP is based on the subdivision of the problem in a hierarchical form. The AHP helps the analysts to organize the critical aspects of a problem into a hierarchical structure similar to a family tree. By reducing complex decisions to a series of simple comparisons and rankings, then synthesizing the results, the AHP not only helps the analysts to arrive at the best decision, but also provides a clear rationale for the choices made. The objective of using an analytic hierarchy process (AHP) is to identify the preferred alternative and also determine a ranking of the alternatives when all the decision criteria are considered simultaneously (Saaty, 1980). Process steps are as follows:

Step 1 : building a hierarchy.

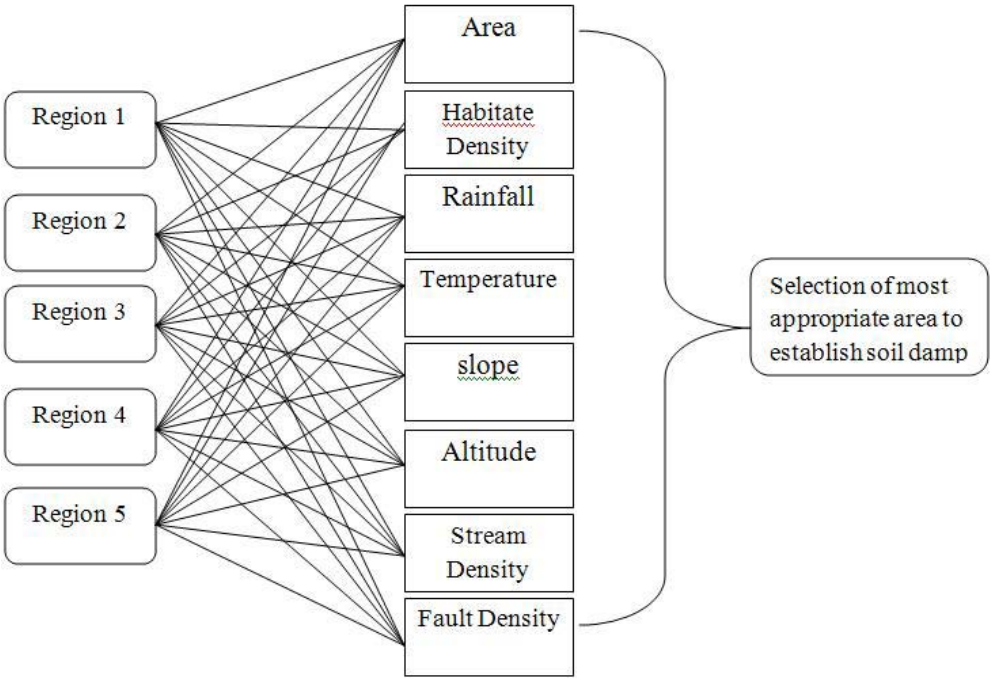

Figure 6 : the process of hierarchical analytic

Step 2: determining the coefficients of the importance standards and sub-criteria: To determine the coefficients (weights) of the criteria and sub-criteria to compare the two to two. Judgment based on the quantitative comparison table below (Table 1).

Table 1 : weighting the factors based on preference in paired comparison (Ghodsipoor, 2009)

Numerical values	Preferences (judging verbal)
9	Extremely preferred
7	Very strongly preferred
5	Strongly preferred

3	Moderately referred
1	Equally preferred
8،6،4،2	Intervals between strong preferences

Step 3: Preparation of paired comparisons matrices and normalization factors: Then the values for each pairwise comparison matrix columns together and each element in matrix paired comparisons were divided into the sum of a column that normalized the paired comparison matrix normalized (Equation 1). Then calculate mean of the elements in each row of the matrix that results in is created normalized weight vector (Equation 2).

$$r_{ij} = \frac{a_{ij}}{\sum_{i=1}^{m} a_{ij}} \quad (1)$$

$$W_i = \frac{\sum_{i=1}^{n} r_{ij}}{n} \quad (2)$$

In these equations m: number of columns, n: number of rows, aij: paired comparison of matrix elements rij: Options for normalization of matrix elements i, j index i, and Wi: weight of i-th item.

Step 4: Determine the final score factors (preferences and priorities): At this stage, the fusion coefficients are determined by the final score of each of the options. For this purpose, can be used the hierarchical composition of the resulting priority vector with respect to all judges at all levels of the hierarchical (Bertolini et al, 2006; Moreno-Jiminez et al, 2005) .

In other words, the final score of each of the routes be determined of the sum of the coefficients of integration options and criterion (Equation 3).

$$V_H = \sum_{k=1}^{n} W_k (g_{ij}) \quad (3)$$

In this respect is: VH: My final choice j, WK: The weight of each criterion and gij: weighing the options regarding the criteria.

Step 5: Calculate the compatibility or incompatibility system: To calculate the rate of adaptability must first paired comparison matrix (A) of the weight vector (W) is multiplied to obtain a good approximation of λ max W λ max W that is A × W = λ max W. Dividing the λ max value of λ max W of W is calculated. Then inconsistency index is calculated of the equation (4) (Ghodsipoor, 2009)

$$I.I. = \frac{\lambda \max - n}{n - 1} \quad (4)$$

Inconsistency rate is calculated via equation (5):

$$I.R. = \frac{I.I.}{I.I.R.} \quad (5)$$

Quantity of I.I.R extracted from this table

Table 2 : quantity of I.I.R

n	1	2	3	4	5	6	7	...
I.I.R	0	0	0/58	0/9	1/12	1/24	1/32	...

If the inconsistency rate less than or equal to 0.1, system consistency is acceptable, If more than 0.1 is better to reconsider its decision on the judgment (Dey & Ramcharan , 2000).

IV. Discussion

The analytical hierarchy procedure (AHP) is proposed by Saaty (Saaty, 1980). AHP was originally applied to uncertain decision problems with multiple criteria, and has been widely used in solving problems of ranking, selection, evaluation, optimization, and prediction decisions. The AHP method is expressed by a unidirectional hierarchical relationship among decision levels. The top element of the hierarchy is the overall goal for the decision model. The hierarchy decomposes to a more specific criterion in which a level of manageable decision criteria is met (Mianabadi & Afshar, 2008]. Under each criteria, sub-criteria elements related to the criterion can be constructed. The AHP separates complex decision problems into elements within a simplified hierarchical system (Limon & Martinez, 2006). The AHP usually consists of three stages of problem solving: decomposition, comparative judgment, and synthesis of priority. The decomposition stage aims at the construction of a hierarchical network to represent a decision problem, with the top level representing overall objectives and the lower levels representing criteria, subcriteria and alternatives. With comparative judgments, expert users are requested to set up a comparison matrix at each hierarchy by comparing pairs of criteria or sub-criteria. Finally, in the synthesis of priority stage, each comparison matrix is then solved by an eigenvector method for determining the criteria importance and alternative performance. The purpose of the AHP Method in this paper is Application of AHP Model in Selection of most appropriate area to establish soil damp for artificial recharge of underground aquifers. The results of AHP method for This Purpose showed in tables (3) to (13) and figures (7,8).

Table 3 : Paired comparison table to the criteria according to the purpose

According to Purpose	slope	Altitude	Stream Density	Fault Density	Area	Habitate Density	Rainfall	Temperature	Wij
slope	1	3	0.20	0.25	5	0.17	0.14	0.20	0.06
Altitude		1	0.25	0.33	2	0.20	0.13	0.33	0.04
Stream Density			1	2	5	3	2	6	0.27
Fault Density				1	3	0.50	0.25	5	0.12
Area					1	0.25	0.17	0.50	0.03
Habitate Density						1	0.33	3.00	0.15
Rainfall							1	4	0.26
Temperature								1	0.07
Sum	27.53	27.50	3.15	10.12	28.00	8.45	4.27	20.03	1

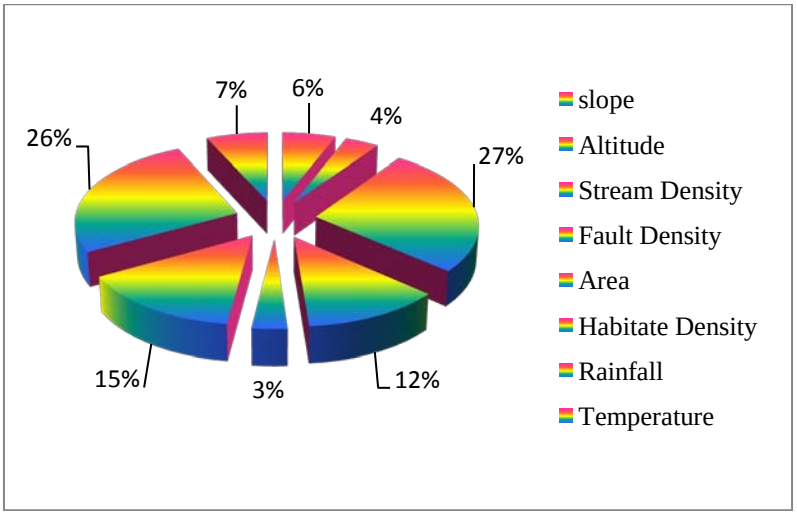

Figure 7 : The weight matrix of criteria according to Purpose

Table 4 : Paired comparison table to the options according to Rainfall

According to Rainfall	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	0.33	0.20	0.14	0.11	0.034137
Region 2		1	0.33	0.20	0.14	0.066919
Region 3			1	0.20	0.33	0.141229
Region 4				1	0.33	0.258897
Region 5					1	0.498817
Sum	25	16.33	9.53	4.54	1.92	1

Table 5 : Paired comparison table to the options according to Stream Density

According to Stream Density	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	0.33	0.20	3	5	0.13435
Region 2		1	0.33	5	7	0.260232
Region 3			1	7	9	0.502819
Region 4				1	3	0.067778
Region 5					1	0.034821
Sum	9.53	4.68	1.79	16.33	25	1

Table 6 : Paired comparison table to the options according to Area

According to Area	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	0.14	0.11	0.20	0.33	0.034821
Region 2		1	0.33	3	5	0.260232
Region 3			1	5	7	0.502819
Region 4				1	3	0.13435
Region 5					1	0.067778
Sum	25	4.68	1.79	9.53	16.33	1

Table 7 : Paired comparison table to the options according to Fault Density

According to Fault Density	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	0.14	0.11	0.20	0.33	0.037844
Region 2		1	0.33	3	5	0.205806
Region 3			1	5	7	0.530032
Region 4				1	3	0.149469
Region 5					1	0.076849
Sum	18.14	4.68	1.79	9.53	16.33	1

Table 8 : Paired comparison table to the options according to Slope

According to Slope	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	0.20	0.14	0.33	3	0.067778
Region 2		1	0.33	3	7	0.260232
Region 3			1	5	9	0.502819
Region 4				1	5	0.13435
Region 5				0	1	0.034821
Sum	16.33	4.68	1.79	9.53	25	1

Table 9 : Paired comparison table to the options according to Temperature

According to Temperature	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	0.33	0.20	0.14	0.11	0.034821
Region 2		1	0.33	0.20	0.14	0.067778
Region 3			1	0.33	0.20	0.13435
Region 4				1	0.33	0.260232
Region 5					1	0.502819
Sum	25	16.33	9.53	4.68	1.79	1

Table 10 : Paired comparison table to the options according to Altitute

According to Altitute	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	0.20	0.14	0.33	3	0.067778
Region 2		1	0.33	3	7	0.260232
Region 3			1	5	9	0.502819
Region 4				1	5	0.13435
Region 5					1	0.034821
Sum	16.33	4.68	1.79	9.53	25	1

Table 11 : Paired comparison table to the options according to Habitate Density

According to Habitate Density	Region 1	Region 2	Region 3	Region 4	Region 5	Wij
Region 1	1	9	7	3	5	0.502819
Region 2		1	0.33	0.14	0.20	0.034821
Region 3			1	0.20	0.33	0.067778
Region 4				1	3	0.260232
Region 5					1	0.13435
Sum	1.79	25	16.33	4.68	9.53	1

Table 12 : The weight matrix of options according to the criteria table

Criteria / Options	Rainfall	Stream Density	Area	Fault Density	Slope	Temperature	Altitute	Habitate Density
Region 1	0.0341	0.1344	0.0348	0.0378	0.067	0.0348	0.0678	0.5028
Region 2	0.0669	0.2602	0.2602	0.2058	0.260	0.0678	0.2602	0.0348
Region 3	0.1412	0.5028	0.5028	0.5300	0.502	0.1344	0.5028	0.0678
Region 4	0.2589	0.0678	0.1344	0.1495	0.134	0.2602	0.1344	0.2602
Region 5	0.4988	0.0348	0.0678	0.0768	0.034	0.5028	0.0348	0.1344

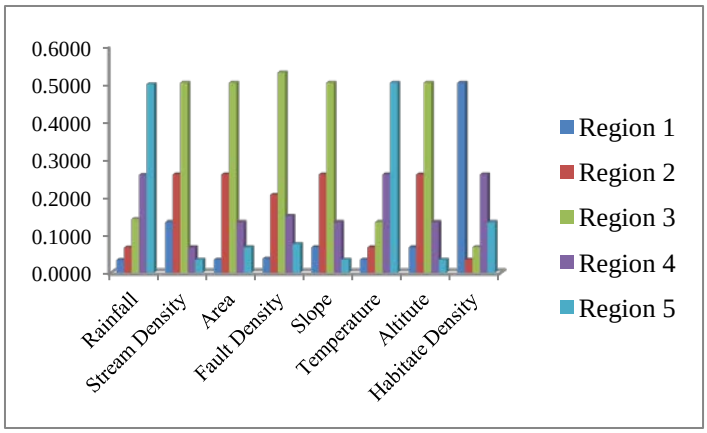

Figure 8 : The weight matrix of option according to criteria

Table 13 : Points and Ranks

Indexes	Region 1	Region 2	Region 3	Region 4	Region 5
point	0/1743	0/1770	0/3606	0/1750	0/1731
Rank	Fourth	Second	First	Third	Fifth

V. Conclusion

Decision making problem is the process of finding the best option from all of the feasible alternatives. In almost all such problems the multiplicity of criteria for judging the alternatives is pervasive. That is, for many such problems, the decision maker wants to solve a multiple criteria decision making (MCDM) problem. A survey of the MCDM methods has been presented by Hwang and Yoon (Hwang, 1981). The analytic hierarchy process (AHP) is one of the extensively used multi-criteria decision-making methods One of the main advantages of this method is the relative ease with which it handles multiple criteria. In addition to this, AHP is easier to understand and it can effectively handle both qualitative and quantitative data. The use of AHP does not involve cumbersome mathematics. AHP involves the principles of decomposition, pairwise comparisons, and priority vector generation and synthesis. Though the purpose of AHP is to capture the expert's knowledge, the conventional AHP still cannot reflect the human thinking style. Therefore, fuzzy AHP, a fuzzy extension of AHP, was developed to solve the hierarchical fuzzy problems. In the fuzzy-AHP procedure, the pairwise comparisons in the judgment matrix are fuzzy numbers that are modified by the designer's emphasis. The findings of the research show that zone 3 with 0/3606 points promotes in first rank among 5 studied zones and thus it is the most appropriate zone for Artificial Recharge of ground waters, in contrast zone 5 with 0/1731 point goes down to the last rank and so it isn`t suitable for Artificial Recharge and zones (2,4,1) are located in next ranks.

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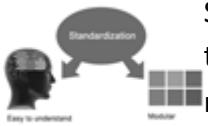

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Results:

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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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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