Effect of Changed family size and composition on determining the optimum size of neighborhoods in Kurdistan Region

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ABSTRACT:

Neighbourhoods form the basic elements in residential areas in settlements, as they are the place where main and most essential services exist to serve the residents settled in form of families or individuals. Theories and housing planning practices based the determination of size of neighbourhoods on many factors; size and composition of population with their proportion to land are the main ones. The basic services are the outcomes of those factors; all services are restricted to the number and type of users with the ability to reach those services by walking within recommended distances.

Primary schools are the most determinant and sensitive one due to user delicate age group. Iraqi optimum size of neighbourhoods in housing standards issued in 1980’s had been derived from specific number of population dependent on family compositions; after more than 30 years of noticeable demographic change, a clear need is emphasized to readjust those figures due to family and population changes that will re-establish the optimum size of our neighbourhood.

The method of current study is based on focusing on current and near future population changes especially for those age groups determining the optimum size of primary schools composing the nuclei of the neighbourhood. This technique will guarantee the best synchronization between resident’s needs linked to proposing optimum neighbourhood sizes dependent on school sizes especially primary level, at the same dwelling re-subdivision worked as a counter force to decreased portion of age groups enrolling schools. The study achieved optimum sizes of neighbourhoods for the next 10 - 25 years determined by primary schools based on new demographic indicators.

KEY WORDS: Neighbourhoods; Schools; Family sizes; Age groups

INTRODUCTION

Neighbourhoods are settlements for human residence, size of neighbourhoods had been subject to many changes regarding size of population leading to optimum size of any settlement. Housing standards and regulations regarding size of communities mostly defined in form of range with a preferred mean. Synchronization between dwellings and needed services are so essential to be maintained.

Neighbourhoods recommended sizes had passed through different stages changed magnitudes were proposed for different countries and communities. Iraqi housing standards also recommended best size of neighbourhoods to be 2400 inhabitants that might reach up to 3600 inhabitants in special cases. These numbers also were dependent on the best fitting with primary schools’ sizes and the corresponding number of people that will provide the number of students in the age group serviced by that function. The family and population change during the 1980’s and 2010’s had been so
wide that it will make those limits obsolete or at least over-standards

2. METHODOLOGY

This study focuses on investigating the change in proportion of age groups within all residents that forms the beneficiaries of mainly of primary school and even secondary ones to guarantee best fit between residents and the educational system to reach at best size of neighbourhoods.

Both international agencies and local surveys for demographic developments had been used as base points to determine realistic population structure and new family sizes that determine exact needs for educational services defining optimum size of settlements, non-demographic but new attitude of local re-subdivision effect had been emphasized with their role in increasing densities that increases demand for educational services.

3. NEIGHBORHOOD PHYSICAL SIZES

The basic principle to determine the size of neighbourhood was established by Clarence Stein 1929 while he was conducting a study of neighbourhood unit (Eisner, S., Gallion, A. and Eisner, S., 1993); he suggested the half mile radius limit for elementary school serviced area, with higher school radius of service of one mile.

Clarence A. Perry in 1929 plan had recommended one quarter mile approximated to 400-meter distance as the optimum radius for elementary school servicing that will not be subject to main traffic interruption. The Iraqi housing standards in General Housing Program for Iraq (G.H.P.I.) had recommended the same 400 m distance to be the maximum distance to the primary school and 800-meter distance for secondary schools from farthest houses (G.H.P.I., 1982).

3.1 Neighbourhoods population

The elementary district schools proposed in USA were serving population sizes between 3000-12000 inhabitants during 1940’s (D.E.S.,2001), while for United Kingdom were about 6000-12000 inhabitants. Lately in 1950’s tendency moved towards smaller sizes elementary schools serving 1000-1500 families having 4000-6000 inhabitants, tendencies were continuous towards decreasing size of schools from what is called district schools especially when walking is taken in as the main mean of movement for attending schools not far from the houses.

3.2 School sizes in neighbourhoods

Engelhardt, N. L. in his proposal 1943, suggested optimum size for elementary schools of 600-800 students with half mile distance; while two elementary schools support the provision of junior high school (Intermediate School) with no more than mile as a limit for walking distance. Four neighbourhoods with elementary schools will need a Senior High School (Engelhardt, N. L. 1943).

The corresponding size of such proposal was 6000 - 12000 – 24000 inhabitants starting with the neighbourhood ending with a new settlement definition named community. These sizes of settlements were subject to continuous changes due to recommendations of minimizing walking distances, increased ratio of enrolment in the learning process with the current regulations of 100% enrolment for lower and higher stages of primary and secondary teaching levels, increased population densities minimized walking distances with more people housed within less distances, in opposite act to minimized percentage of age groups within smaller sized families especially in western countries especially in primary level students (Miller, D.C., et al 2009).

3.3. Iraq’s and Kurdistan’s neighbourhoods’ sizes

During the 1960’s up to 1980’s neighbourhood subdivision designs were proposing 400-500 dwellings as an optimum size of neighbourhoods in Iraq (G.H.P.I., 1982), Erbil City was applying same limits in its main municipality for neighbourhoods’ sizes (GDEI, 2018). According to such trends with the average family sizes changing in 1980’s up to 2007 survey done by Centre of Statistics and Information Technology (COSIT), the available population of neighbourhoods varies between 2480 and 3450 as noticed in Tab.1, these figures are confident with G.H.P.I. recommendations.
3.4 Problems found between current vs. estimated neighbourhoods’ sizes

Doubts came to be felt about the accuracy, categories and conditions of such population estimates serving the goal of average family then household sizes (Al-Quraishi, I. J. 2006). One main issue is the using term of family instead of household, this identification is so essential to have precise number of educational services beneficiaries as additional residents within households rarely might be persons attending elementary or middle schools by living with relatives. The other main issue is the focus on urban family sizes; that is of common sense; families in larger urban areas tend to be in average smaller in size than those in rural ones as was the case in (G.H.P.I., 1982).

3.5. Current vs. estimated household sizes

Two more recent surveys when compared to G.H.P.I. figures showed dramatic change in household sizes, differences in three references for distribution of household sizes clearly can be observed in Fig.1.

Radical shift in Erbil city had occurred in percentage of larger families towards middle sized ones realized clearly in Erbil survey for a sample of 2000 dwellings in 2014 by author that presented an average size of 5.7 persons. The difference is clear from (IHSES, 2007) proposing average family size of 6.8 persons while G.H.P.I. estimated for year 2000 average of 6.0 persons. The most recent survey shows almost diminishing of extremely large households in Erbil (Aziz, M.I. 2014).

3.6. Schools’ attendance age groups

The Iraqi categorization for stages within basic teaching system is a 6-3-3 years stages after kindergarten level; they are age groups 6-11 years for elementary or primary school (PS), 12-14 years for intermediate school (IS) and 15-17 years for high school (HS). Other countries adopt almost similar end of age groups but with different internal divisions like 2-4-3-2 in USA (D.E.S.,2001), with category 2-7-2 in UK with some local differences having different school systems within same country (Miller, D.C. et al., 2009) . The G.H.P.I. had estimated ratio of population in correspondence to those three stages of learning or age groups for year 2000 based on 1980 survey.

As it became evident; clear demographic changes had been identified in averages of household sizes and compositions, these findings surely will raise the question and anticipation of changed family structure and its participation in changed percentage of age groups in the total community presented in shape of changed population pyramid.

3.7. Changes in family composition changing percentages of Schools’ age groups

The projected population pyramid for Iraq for years 2015, 2025 and 2050 obtained from the reliable source of World Life Expectancy online (W.L.E. 2017) had determined percentages of age groups within 5 years age groups. By interpolation on smooth curve, figures organized for all age groups related to different stages of study had been obtained. Findings had been presented with reference to valid proposed year 2000 of G.H.P.I. estimations in Fig.2.

The greatest decline is seen in the youngest age groups corresponding to kindergarten level the decline is decreasing towards oldest age groups this is due to cumulative decline in family size that decreases in child birth as the main contributor to this phenomena. Regarding percentage of age groups at years 2015, 2025 in comparison to authorized 2000 old figures are clearly illustrated in Fig.3 which proves the clear decline in their ratio within families, neighbourhoods and communities, this is so clear for the younger age groups as the estimated ratio will be 69% and 62% for kindergarten and 88% then 66% for elementary schools Gradually smaller decline is observed in intermediate then high schools with ratios of 89% and 78% for intermediate schools and 94% then 82% for high school for the years 2015 and 2025 compared with the current base year of 2000 estimations

The clear decline in need for such essential services in neighbourhoods will;
• Release the current pressure of multiple uses of schools by two shifts or more that enables upgrading the teaching condition adopting one shift per one school.
• Decrease the need for teaching staff, administration etc.
• Enables larger populated neighbourhoods to be served by same schools due to minimized size of age groups than the misleading limits of standards missing demographic changes over more than 35 years.
• This will relax the tendencies for urban densification using higher densities that can be obtained especially in central areas not violating the 400-meter radius that holds enough people and age groups linked to school keeping walking distances to schools within allowable ranges avoiding using two shift schools.
• Make a great decrease in budget needed for new schools with staff and servicing especially when thinking about the number of schools built in Iraqi Kurdistan to serve more than 5 million people with students passing 850 thousand just in elementary stage.

3.8. Misleading of indicators for current needs for larger and more schools

Due to what had been mentioned above the need for determining the validity of The Iraqi standards is been observed to be under question, such standards had proposed neighborhoods based on primary schools of 12 classes (PS-12) and of 18 classes (PS-18), those schools will be serving 2400 and 3600 people as seen in Tab.2. For that reason, the optimum size of neighborhoods had been fixed since 1983 although those standards had not been officially adopted but it had been used as a reference in most of Iraqi municipalities in addition to the criteria of 400-500 dwellings that forms the optimum size of neighborhood.

3.9. Proposed neighborhood population sizes for current and future school students’ capacities

With reference to Tab. 2 the estimated population sizes for different settlements had been determined based on current and future population structure and contribution of study years’ age groups with that population.

It is obvious that for 2015 and on the old estimation became less valid with time progress, the basic PS-12 will be serving an optimum neighborhood population size of 3600 people instead of 2400 currently used which had been estimated by G.H.P.I. At the same time within 33 years from now the PS-6 will do the service for what is PS-12 was built for nowadays depending on the old estimations.

The 18 and 24 classroom primary school sizes PS-18 and PS-24 will be so unnecessary and not welcomed as they will serve 5400 and 7200 people size neighbourhoods in 2025; about 2-3 times the current size of neighbourhoods. So, they will exceed recommended as schools to be within normal walking distances of 400 m from farthest houses. There is a minimal chance to use PS-18 if neighbourhoods’ population of 4800-5400 were necessary for limited or for special conditions, which might accommodate two levels of study the primary and the intermediate in 2050 for designing neighbourhoods of walkable distance to attend schools

3.10. Changed neighborhood densities according to walking distance limits and corresponding school sizes

The nowadays gross population and accommodation densities limits are needed to be modified, the estimated optimum gross density of about 40-60 persons per hectare (G.H.P.I., 1982) that supports using PS-12 and PS-18 will not contain the required students to make the schools economically sound. More densities might be used to make balance between students and school capacities.

The recommended gross densities will be about 60-120 persons per hectare due to recommended increased neighborhood size mentioned in above, these new limits would even propose a change in housing forms that would house the extra population and follow the trend of increased urban population density; i.e. urban densification.

3.11. Changed neighborhood housing typology and plot sizes due to density change

Old proposed densities of 40-60 persons per hectare can be achieved by using 800-600 sq.m. plots as the maximum sizes that can have the optimum sizes of people to get a PS-12 and PS-18
schools respectively for single shift schools and about 400-300 sq.m. plots for double shift schools, however by using smaller plots sizes, the obtained walking distances would be far less.

By new proposed densities the maximum plots will be lowered to about 400-350 sq.m. sizes as maximums if we go with the optimum system of one shift PS-12 schools and 300-250 sq.m. for PS-18, while using 200-150 sq.m. plot will need double shifts PS-12 schools, this will be more synchronized and rational with the available trends of housing re-subdivision of plots serving current and future population.

3.12. Recommended neighborhood population sizes and plot sizes due to family size change

Mostly the last 20 years practices in housing subdivisions layouts had adopted 200-250 sq.m. plots in urban areas for single family housing (Al-Mudaris, S. B. 2003). The produced gross densities due to such conditions were between 120-180 persons per hectare almost triple of school capacities when maximum distances’ neighborhood sizes were planned. This indicates a clear evident of multi shift use of schools in Erbil City, as most of current school buildings are used by two shifts to increase the capacity to be doubled to serve the available students (GDEI, 2018).

One of the direct advantages; is that by the new family structures using the same plot sizes avoiding such non recommended teaching conditions will be achievable. This goal can be obtained if densification would not be applied using PS-18 school sizes for about 4800 people, instead of 2 shifts in PS-12 schools already been used, this can be achieved by an average range of 200-250sq.m plot sizes, that fits 400 meter walking distance. When using PS-12 with one shift the average neighborhood population sizes will be about 3600 and the radius of walking distance will be about 330 m from the farthest house using 300 sq.m. plot sizes.

3.13. The effect of plot owners’ attitudes to re-subdivide

During the last decade Erbil neighborhoods suffered from owner re-subdivision of plots that were of 200 sq.m. size or more into two new plots to provide new opportunities for residence within same areas. This is mainly due to limited capital to build or limited new lands for housing development, in the study carried jointly by Erbil Governorate and UN-HABITAT to strengthen housing sector in 2011-2012 it has been found that real neighborhood housing units were within range of 1.21-1.54 per original plots (UN-HABITAT, 2012). This pressing trend had counterbalanced family shrinkage effect on decreasing demand on schools also led to increased population sizes and housing density as it is estimated by the current study, however the new housing projects were not allowed to carry re-subdivisions.

3.14. Overall or gross impact of analyzed factors on school demand in existing neighborhoods

With regard to previously mentioned conditions and support of Fig.4 the increasing and decreasing factors that determine size of schools locally can be observed, the increasing ones are population net increase which will act on increasing of number of new neighborhoods or push residents to make more re-subdivisions in both old and newer ones, with increasing enrollment in school to reach saturation of 100% , from other side decreasing factors are working in the model including shrinkage of families to smaller sizes in addition to decreased ratio of age groups attending basic teaching within families, (both negative factors were the focus of this study). It is worth to mention that converting of residential plots into commercial ones also will participate in decreasing residents of the existing neighborhoods but these marginal factors had been not discussed to keep the research be more general not specific on specific areas.

3.15. Proposed intermediate and high school sizes that support best neighborhood sizes

As per primary or elementary schools the corresponding intermediate and high schools that will suit the optimum size neighborhoods had been defined. For intermediate level tab.3; shows that for the proposed 3600 optimum population size of neighborhood the best size for intermediate school is IS-15 for the nearby future 2025 that will serve a pair of neighborhoods as the case nowadays but with 7200 population instead of 4800 proposed by the housing standards. For the years after the IS-12 might be the preferable.
however consideration might be taken if population and new family structures does not follow the same trend of decline in size and shape then issue of adoption of IS-15 may continue especially in smaller urban settlements, or where re-subdivision is been applied widely.

Regarding higher schools Tab.4 suggest 12 classroom high school HS-12 then HS-9 as optimum options for our current and future neighborhood sizes of 3600 people, care should be taken if alterations occurred related to portion of students directed to higher technical or vocational studies vs. general study, thereof no more need is expected for HS-15 and HS-18 schools. The old trend in Kurdistan and Iraq showed declined number of enrolment in vocational high school studies for the benefit of general studies, for that reason although decline in population would need higher population size to support same school with higher than expected percentage of enrolment within high level study.

4. CONCLUSIONS

The research pulls clear attract to the great change happened in Iraq’s and Kurdistan’s demographic setting, changed family structure that will lead to changed school enrolments have showed serious discrepancy between reality and almost obsolete standards, this impacts real need to amendments and alterations in neighbourhood sizes in Iraq, the shape of changes is bounded mainly within the following items

- No more validity is seen for adopting 2400 people as the best size for neighbourhoods in Iraqi housing skeleton, the proposed optimum has been identified to be 3600 instead by this study depending on real surveys and global indicators of demographic changes in Iraq and Kurdistan region. For even longer period planning the size might be shifted to 4200 even to 4800 for next 40 years if family structure trends went on same trend of last 25 years.

- The corresponding maximum size of residential plots might be shifted from about 800-600 sq.m for one shift elementary schools and about 400-300 sq.m for double shift schools previously, as the reality in most of Iraqi schools supports 400-300 sq.m. plot sizes for single shift schools and almost 250-150 sq.m. plots for double shift schools which is more realistic to nowadays conditions, although the double shift use is not the preferable case for better education system.

- Avoiding the illegal re-subdivision returning to legal planned neighborhoods supports the need for legal smaller plots sizes been proposed in above avoiding the two shift schools but maintaining average plot sizes not to be below 200 sq.m. leaving internal differences of sizes within reasonable range for different income groups.

- The same trend will be applied for multi-family housing raising the ceiling of maximum net densities by the new factors of 1.2 -1.5 to get same population size that contain age groups supporting optimum educational facilities, however with old densities most schools of single shifts supported smaller walking distances approaching 280-300 meter radius, double shifts were following the boundary of 400 meter.

- For school sizes; proposed optimum elementary level requires adoption of PS-12 as the current and nearby future needs of population for single shift schools, and PS-9 for double shift ones instead of available PS-18 for single with the PS-12 for double shifts previously built or current violated walking distances reaching 500 meters distances. For intermediate and high school levels the use of IS-15 and

| Year | Average household size | Neighborhoods population with 400 dwellings | Neighborhoods population with 500 dwellings |
|------|------------------------|---------------------------------------------|---------------------------------------------|
| 1947 | 9.8                    | 3920                                        | 4500                                        |
| 1957 | 8.0                    | 3200                                        | 4000                                        |
| 1965 | 8.2                    | 3280                                        | 4100                                        |
| 1977 | 6.9                    | 2760                                        | 3450                                        |
| 1987 | 6.2                    | 2480                                        | 3100                                        |
| 2007 | 6.3                    | 2520                                        | 3150                                        |
Table (2). Updated neighbourhood population sizes supporting standard sizes of schools

| School type | Number of Elementary Students | Neighbourhood population having age group with 100% enrolment |
|-------------|-------------------------------|----------------------------------------------------------|
|             | G.H.P.I. | 2015 Needs | 2025 Needs | 2050 Needs |
| PS-6        | 210      | 1200       | 1370       | 1800       | 2300       |
| PS-12       | 420      | 2400       | 2730       | 3600       | 4600       |
| PS-18       | 630      | 3600       | 4100       | 5400       | 6900       |
| PS-24       | 840      | 4800       | 5460       | 7200       | 9200       |

Note: The thick boundary row is the optimum case with second option title in thick border

Table (3). Optimum neighbourhood population sizes supporting intermediate schools (Author).

| School type | Number of Intermediate Students | Neighbourhood population having age group with 100% enrolment |
|-------------|---------------------------------|-------------------------------------------------------------|
|             | G.H.P.I. | 2015 Needs | 2025 Needs | 2050 Needs |
| IS-6        | 180      | 2400       | 2700       | 3100       | 3900       |
| IS-9        | 270      | 3600       | 4050       | 4600       | 5800       |
| IS-12       | 360      | 4800       | 5400       | 6200       | 7800       |
| IS-15       | 450      | 6000       | 6750       | 7700       | 9700       |
| IS-18       | 540      | 7200       | 8100       | 9200       | 11600      |

Note: The thick boundary row is the optimum case with second option title in thick border

Table (4). Optimum neighbourhood population sizes supporting high schools

| School type | Number of High Students | Neighbourhoods population having age group with 100% enrolment |
|-------------|-------------------------|-------------------------------------------------------------|
|             | G.H.P.I. | 2015 Needs | 2025 Needs | 2050 Needs |
| HS-6        | 180      | 3600*       | 3200       | 3600       | 4500       |

Notes (*): 66% enrolment and (+) 80% enrolment

The second higher enrolment is evident in Iraq due to lower ratio attending technical study

Figure 1. Recent Distribution of households in Erbil compared to other sources.

Figure 2. Percentage of age groups related to corresponding stage of learning
Figure 3 Decline in percentage of age groups related to G.H.P.I. estimations for year 2000

Figure 4. Model of Positive and negative factors determining change in number of school age groups

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