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ӨМНӨХ ҮГ

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Улс орны хөгжил дэвшил шинжлэх ухаанд суурилсан бодлого, үйл ажиллагаанаас хамаарч буй өнөө үед шинжлэх ухааны шинэлэг судалгаа шинжилгээний үр дүнг олон улсын түвшинд танилцуулах, сурталчлах, хамтран ажиллахад “СИТИ Science” сэтгүүл маань олон улсын бүртгэлийн системд бүртгэгдэж байгаа нь өндөр ач холбогдолтой бөгөөд СИТИ Их сургуулийн эрхэм зорилгод бүрнээ нийцэж байна.

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FOREWORD

CITI University and the editors of the CITI Science journal would like to wish our dear readers a happy New Year 2024 and great success in their research work.

We are pleased to present to you the 4th volume of CITI Science journal with DOI numbers, which aims to be a free forum with academic freedom for scientists, teachers and students to demonstrate scientific achievements, successes, problems and trends. By having a DOI number, the articles published in the journal can be registered in a various an internationally recognized scientific publication databases.

Today, when the development of the country depends on science-based policies and measures, it is very important to be registered in the international registration system for the presentation, promotion and cooperation of innovative scientific research results at the international level.

In this issue, 6 articles from the authors of the USA, Japan, New Zealand, Malaysia and Mongolia are published after being reviewed by expert reviewers, and we believe that the articles will satisfy you. You are also invited to send your academic articles. More information about the journal can be found at <https://citi.edu.mn/citi-science/>

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REVIEW

CHEMICAL BONDS IN MOLECULAR AGGREGATION – FROM DRINKING WATER TO NANOCOMPOSITES

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Abstract: Atoms in a small molecule are assembled by covalent bonds. Small molecules or ionic species tend to aggregate to larger units like macromolecules or crystals *via* various attractive forces categorized as noncovalent bonds (nonCBs). No living creatures can exist without water, whose molecules are aggregated *via* hydrogen bonds, one of the most important nonCBs. Interfacial phenomena are associated with adsorption, mostly mediated by nonCBs at the boundaries between dissimilar counterparts. Aggregation of biomolecules is the origin of living organisms. Unfavorable aggregation states of biomolecules lead to diseases. Functions of nanocomposite materials depend on the states of molecular and/or ionic aggregation with nonCBs. Crystal engineering aims at controlling aggregation of organic and inorganic components to enable innovative nanostructured materials. This tutorial review focuses on some typical aspects of crossdisciplinary features of nonCBs in an attempt to trigger new insights in materials-oriented chemical science and engineering.

Keywords: Molecular aggregation; Noncovalent bonds; Hydrogen bonds; Crystal engineering; Nanocomposites

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1. Introduction
2. Noncovalent bonds
3. Adsorption and interfacial phenomena
4. Crosslinking in colloidal dispersion and polymers
5. Protein and biomaterials
6. Crystal engineering and nanocomposites materials
7. Concluding remarks



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1. Introduction

All matters comprise atoms. An interatomic interaction within a simple molecule is explained by sharing one or more electrons in the outermost or valence orbitals surrounding participating nuclei. The atomic interaction in such a small molecule is defined as covalent bonding [1, 2]. All other atomic interactions belong to noncovalent interactions or noncovalent bonds (nonCBs). Among many nonCBs, van der Waals interaction and hydrogen bonds (HBs) are strictly defined by IUPAC [3, 4]. However, categorization of nonCBs are so broad and diverse that not all of them are defined unequivocally [5-7]. Strength of a chemical bond, regardless of covalency or noncovalency, is conventionally ranked by the enthalpy of atomization of associated aggregates [8, 9]. Actually, the physicochemical content of bond strength is much more complicated than those definable by thermodynamic terminology [10] as extensively discussed [11-15]. Basics of chemical bonds are not fixed at the textbook level when we strictly account the roles of electronegativity and atomic size [16]. The concept of chemical bonds is based on quantum mechanics and discussed in terms of the bonding and antibonding electrons [17, 18]. By the same token, there is an exact definition of bridge bonds in terms of the electron distribution function [19]. Detailed discussion of the theoretical aspects of nonCBs based on quantum physics will not be covered in the present text.

Aggregation of small molecules into larger units occurs in many different ways, e.g., clusters, supra- or macromolecules, biological cells, colloidal dispersing units or crystals. Interactions necessary for any molecular aggregation are dominated by nonCBs [20, 21]. Concepts of molecular aggregates discussed in this text play a crucial role on our daily life, including cooking (generally in food preparation), medical care, or materials technology for high-tech products such as microelectronic devices. Associative processes of small chemical construction units frequently proceed *via* a self-assembly along with the principles of thermodynamic stabilization [22-25]. The concept of nonCBs is also significantly associated with coordination chemistry, centered by the concept of ligands [26-28]. Simplest inorganic ligands are oxide (O^{2-}) or hydroxide (OH^-) ions, when we observe conventional oxide crystals as the aggregates of inorganic coordination units, e.g., SiO_4 in SiO_2 solids, or TiO_6 in TiO_2 crystals. Ionic bonds dominating many popular crystals like NaCl are also categorized to nonCBs [15, 29].

The specific topics with nonCBs will be displayed in the next chapter. Introduction to many other working nonCBs are discussed by referring to interfacial phenomena, colloids and polymers as well as heterogeneous catalysis in chapters 3 and 4. Biomolecular aggregates like proteins are discussed in chapter 5. Chapter 6 exhibits crystal engineering and nanocomposite materials with extended discussion on the roles of nonCBs. In this last chapter, emphasis is laid on the interaction among inorganic and organic components, which may lead to more sustainable materials and their processing.

2. Noncovalent bonds

Noncovalent interactions are described in terms of electrostatics and polarization, in conjunction with Coulombic interaction of molecules [5, 6, 30]. Whether or not all the noncovalent interactions are defined as chemical bonds is controversial, particularly for van der Waals interaction. Microscopically, nonCBs are also understood as an interaction between energetics of σ - and π -hole and the “surface” of molecules [31]. Hydrogen bonds are compared

with other similar nonCBs like chalcogen-, halogen-, or tetrel bonds in terms of electron donor and acceptor in a periodical table [5, 6, 20, 30]. Tetrel bonds, centered by Group 14 atoms like C, Si, Ge [20] are similar to HBs and can be distinguished from genuine HBs only by detailed spectroscopic studies [32].

Occurrence of HBs is basically associated with charge transfer between dipoles [33-35]. There are wide variety of bond strength among HBs, as Deji Raju pointed their borderless nature under the concept of hydrogen bridge [36]. As guided in Fig. 1, a balance of electrostatics, van der Waals nature, and covalency determines the character of HBs. Hydrogen bonds are expressed more generally as hydrogen bridges, X-H-A, where the hydrogen atom (H) abridges two neighboring atomic species, X, and A. The X-H-A bridging bond is explained by introducing three limits of HBs, i.e., covalent limit (40 kcal/mol), electrostatic limit (15 kcal/mol) and van der Waals limit (0.5 kcal/mol) [36]. Corpinot later introduced this concept in a wider framework in his tutorial review [37].

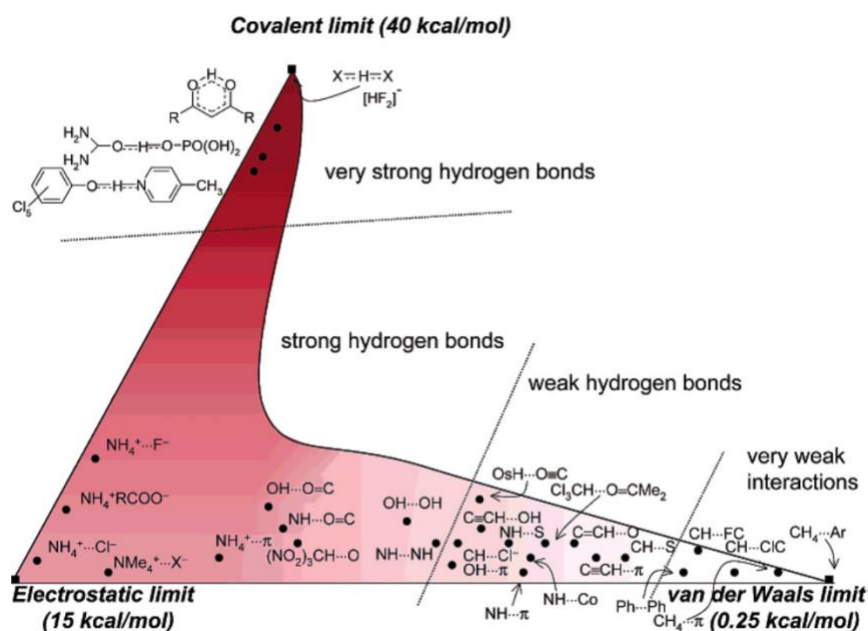


Fig. 1. Categorization of hydrogen bonds [29] (see text for details)

Figures 2a and 2b also demonstrates that HBs are not only simple bonds between two small molecules by s-electrons [38] but also p-electrons can participate. Hydrogen bonding form networks as well, which play an important role on the natural polymers like starch or cellulose [39, 40]. Multiple HBs bring about supramolecular complexes as shown in Fig. 2c [41]. In an aqueous solution containing ionic species, HBs play a particularly important role [42]. Excellent reviews by Scheiner [43] and Pairas et al. [38] exhibit physicochemical details of HBs. The unusually high boiling point of water, 373.2 K, with its atomic mass unit (amu) as small as 18.0 Da, compared with those of organic molecules at around similar molecular size, e.g., 111.6 K with 16.0 Da. The difference symbolizes the role of HBs in our daily life due to the high density of HBs in condensed phases (liquids and solids). The role of HBs

in our daily life is diverse, for instance, gelation of the colloids [44]. A non-flowable gel is formed even with a water content more than 97% in the case of edible jellies (dessert). Their smooth texture would be impossible without HBs.

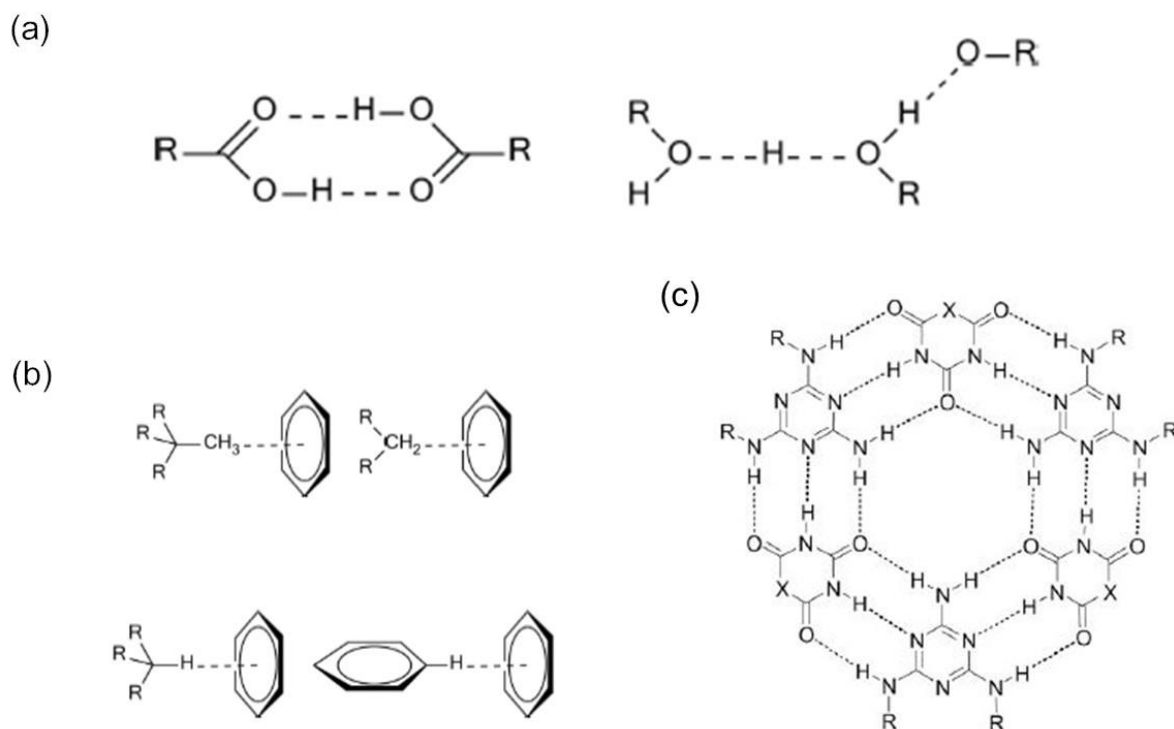


Fig. 2. Representative features of HBs. (a) HBs between same or different molecules [38]; (b) CH-p HBs [38]; (c) Multiple HBs to supramolecular structure [41]

What we observe in kitchen during cooking and baking is predominated by structural change of starch and denaturation of proteins. For both processes, reconstruction of the HBs plays a chief role. The subunits of starch, i.e., amylose and amylopectin [45] are rearranged during cooking to make row grains edible. Associative forces within and between these subunits are based on HBs [46, 47]. Most of the meat is heated in the kitchen to denature proteins with widely varying amount of liquids in the pot or pans. What is happening there is the changes in the three-dimensional structure of the polypeptide chains. This is usually coined as denaturation of proteins [48, 49]. Basics of HBs with their related materials are discussed in tutorial reviews [50-52]. Molecular crystals and their design are closely related to HBs [37]. Related issues will be discussed in depth in Chapter 6.

Hydrogen bonds are most important in biosciences [38, 53]. No living creatures can exist without water and associated HBs [54]. Indeed, water molecules with their intrinsic attractive interaction by HBs are active constituents of biological cells [53]. Their roles include those of solvent, hydration and “joints” in many biomolecular units. It is important to note that similar chemical issues need consideration in medicine or pathology [55, 56]. Related topics will further be referred to Chapter 5. Basics of functional materials are intensively associated with HBs with various interaction of other chemical bonds. Mechanically interlocked molecular frameworks and larger structural units, called metal organic frameworks (MOFs), are the

concepts related to functional materials associated with HBs [57, 58]. These topics will be discussed in more detail in Chap. 6 with the interests in the functional materials processing.

3. Adsorption and interfacial phenomena

Adsorption is one of the fundamental phenomena in surface and interface chemistry. It plays a crucial role in diverse categories from environmental issues to chemical industry. The interaction between the adsorbate, the chemical guest species which are going to the host substrate species, i.e., adsorbent is generalized as adsorption. It is divided into two categories. One is physical adsorption (physisorption) driven by van der Waals force, and the other is chemical adsorption (chemisorption), where chemical bonds are formed between adsorbate and adsorbent [59, 60]. While van der Waals interaction is occasionally categorized as a weak bonding, the role of the electrons is only a very weak interaction due to their synchronized movement belonging to corresponding atomic parties. The interaction is either due to weak London dispersion forces or a bit stronger dipole-dipole forces [61] without participation of chemical bonds in a conventional context. Therefore, only chemisorption is considered further in this chapter.

Basics of chemisorption have been intensively studied particularly for neutral gas molecules on metal single crystals [60]. The intensity of the host – guest interaction is evaluated by the adsorption energy, i.e., the energy needed to separate the adsorbate from the adsorbent. It can be quantified as the heat released during adsorption and measured by calorimetry [62] from the combination of atoms on single crystal with defined surface described by Miller indices. Such a basic study is important for the application to much more complicated organic molecules on the “dirty” substrates, e.g., defective powder surfaces [63]. The interaction or bonding between adsorbents and adsorbates varies from covalent to a variety of nonCBs [60]. One of the representative mechanisms, the Langmuir-Hinshelwood type, is based on the energetically equilibrated states between the guest and host species by forming a kind of nonCBs. As a consequence, adsorbed species may be deformed or dissociate due to mismatches of molecular bond length and the interatomic spacing on the substrate. This frustrated state of the adsorbed species is less stable and more active, so that it triggers heterogeneous catalytic reactions [64].

Surface active agents or surfactants are associating two nonfriendly materials species, i.e., water affinitive (hydrophilic) and water repelling (hydrophobic) ones [65]. The latter property, coined as hydrophobicity, means that the molecule or its local does not strongly interact with water, but only exhibiting van der Waals interactions. Surfactants play an important role in many fields in our daily life, including foods, clothes or paints. Surfactant molecules form micelles (micellization) when their concentration exceed a critical value, called critical micelle concentration, abbreviated as ccc [66]. Micellization results from hydrophobic interaction when participating molecules possess hydrophilic and hydrophobic elements (amphiphilic molecules) simultaneously [63, 67]. Micellization generally occur in many other amphiphilic molecules like peptide, and lead to various functionalization [68]. Associated aspects will further be discussed in Chap. 5 in conjunction with biomaterials. One of the main mechanisms of the surfactant is the removal of oily dirt from textiles by virtue of encapsulation by micelles [44, 69, 70]. The process is not restricted to washing textiles [71] or foods [72], but extended to broader environmental issues like soil decontamination [73, 74].

Adsorption is a leading principle of heterogeneous catalysis, which predominates many chemical engineering processes [60]. As historically summarized by Fechte et al [75], the topic was almost always spotlighted in chemical industry, historically lead by petroleum industry [76, 77] and polymer technology [78, 79]. One of the most significant mechanisms involved in heterogeneous catalysis is dissociative adsorption, i.e., a neutral molecule is dissociated upon its adsorption on the substrate. This would seem that a covalent bond stabilizing an adsorbing molecule is weaker than nonCBs enabling adsorption. This puzzling question will be solved when we consider quantum states of the adsorbing species [80] (Fig. 3) or heterogeneity of the host substrate [81-83] (Fig. 4).

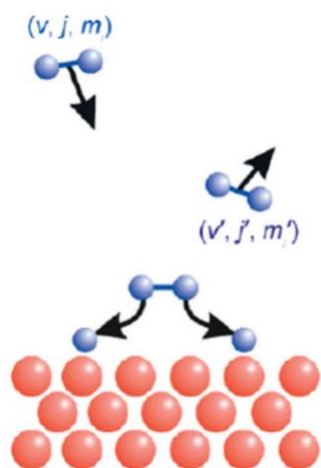


Fig. 3. Quantum state controlled dissociative adsorption [80]

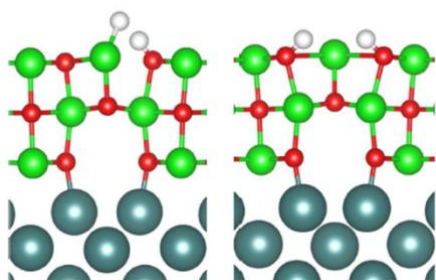


Fig. 4. Substrate controlled dissociative adsorption [81]

Recently, application of heterogeneous catalysis expanded toward environment techniques seeking sustainability. As shown in Fig. 5 [84], the catalysis-centered closed system enable the life cycle toward carbon neutrality. Smart utilization of biomass resources is one of the related top issues. To convert cellulosic resources to biofuels like ethanol, there are many steps, where heterogeneous catalyses play a crucial role [85-87]. Elimination of hazardous substances, like volatile organic species, is one of the central positions of environmental issues [88].

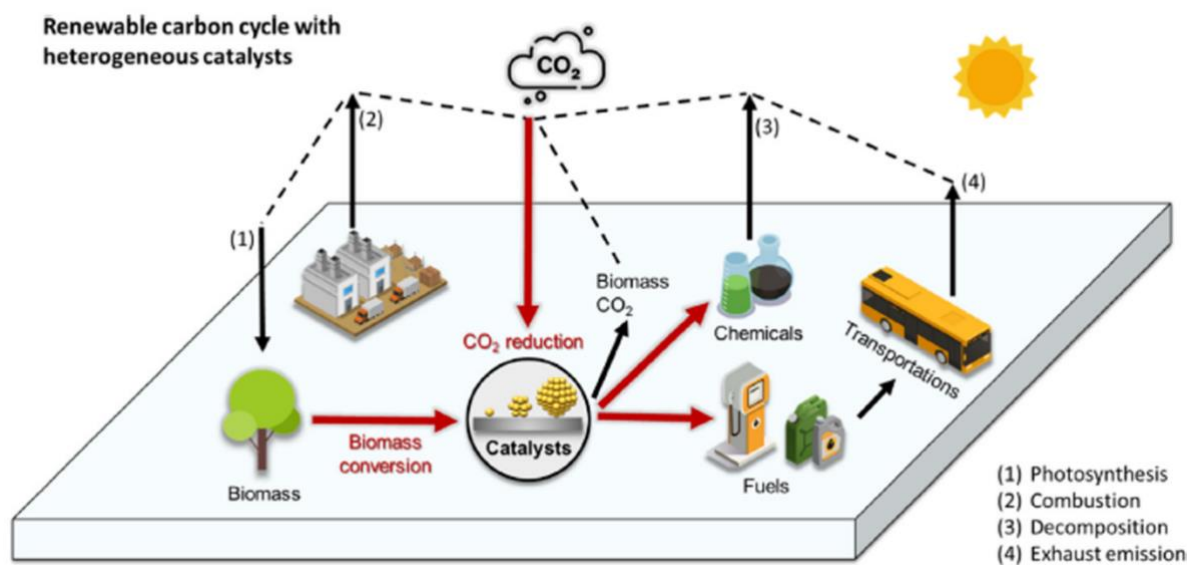


Fig. 5. A scheme of working heterogeneous catalyst. Proposed renewable carbon cycle with heterogenous catalysts to convert biomass and CO₂ into renewable fuels and chemicals simultaneously [89]

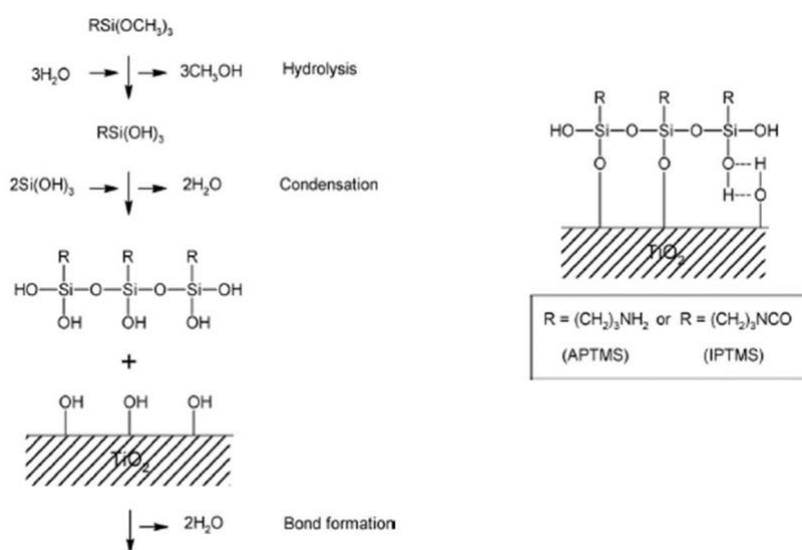


Fig. 6 Chemical grafting of organosilanes onto TiO₂ nanoparticles surface [90]

There is a fundamental phenomenon on the surface of metal oxides with water. Oxide ion, O²⁻ on the surface is particularly affinitive to protons and hence leads water adsorption. In most cases, adsorbed water does not remain as a neutral molecule but tends to polarize toward dissociation to H⁺ and OH⁻ whose tendency depends on the state of surface [91]. In case of silica, where the structure is described as a network of siloxane (Si-O-Si) bonds, dangling bond on the surface turns adsorbed water into a surface silanol group, Si-OH. The process has been investigated in detail by experiments [92] or molecular dynamic calculations [93]. Thus, the surface of typical oxides are rich in surface OH groups under the ambient conditions. Surface

modification with coupling agents mostly occurs *via* a chemical interaction with such surface OH groups, resulting in the surface grafting, as exemplified in Fig. 6 [90]. Related techniques are used for enhancing catalytic activity [94] or corrosion protection of metal surfaces [95]. One of the industrially important related genres is a color material, i.e., paints and inks. They are dispersion systems, where small solid pigment particles are dispersed in liquids called vehicles. Until recently, vehicles are mostly hydrophobic organic solvents while pigments are hydrophilic oxides or sulfides, so that the resulting paints are unstable, prone to quick sedimentation. In line with avoiding volatile organic species mentioned above, water-based vehicles are preferentially used nowadays. Depending on the vehicle polarity, pigment particles need to be either hydrophilic (water affinitive) or lyophilic (oil affinitive). Thus, surface modification of pigments need to be flexible. Use of various surfactants including amphiphilic (both affinitive) have been developed [96, 97]. Coupling agents are also important for surface modification. While their structures are similar to those of surfactants, they are grafted on the surface, with more stable and irreversible nonCBs [90, 98].

4. Crosslinking in colloidal dispersion and polymers

Crosslinking in colloidal system changes a free-flowing dispersion (sol) into solid-like states (gel). The process is generally called as a sol-gel process. This expands from a recipe of sweet jerry in kitchen to a processing of solid functional materials [99]. Most of the related science and technology is based on the hydrogel, solidified by HBs [100]. As shown in Fig. 7, network structure in hydrogel is often accompanied by hydrophobic associative force [101]. Structuring of hydrogel is predominated by the concentration of coexisting salts and pH, and mostly associated with self-assembly [102]. Such a structured hydrogel is applied intensively to tissue engineering, as will be mentioned in the next chapter.

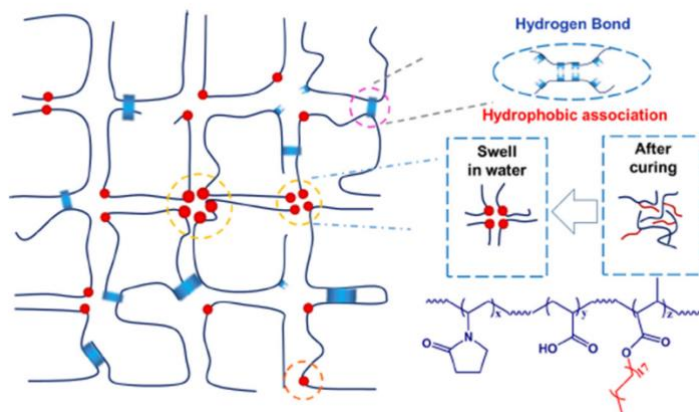


Fig. 7. Network structure of hydrogen bond and hydrophobic associating cross-linked hydrogels [100]

Linear polymers drastically changes their mechanical properties by three-dimensional crosslinking. Crosslinking of elastomer is one of the traditional technologies in rubber industry under the concept of vulcanization of natural rubber or cis- and trans-polyisoprene [103]. Mechanical properties of the rubber – clay composites are known to be improved by HBs [104]. Difference in the thermoset plastics from thermoplastic is due to the covalently crosslinked structure of the former [105]. This is out of the scope of this article. However, it is important

to note that covalent and noncovalent crosslinking are almost always mixed within a single polymeric material as shown in Fig. 8 [106]. Non-covalently crosslinked polymers or hydrogels are now under spotlight, particularly in conjunction with tissue engineering [107, 108]. Role of HBs on engineering nanocomposites was discussed in detail by Lu et al [109]. The concept of dynamic bonding, which reversibly break and reform, will give many attractive properties particularly in nanocomposite hydrogels.

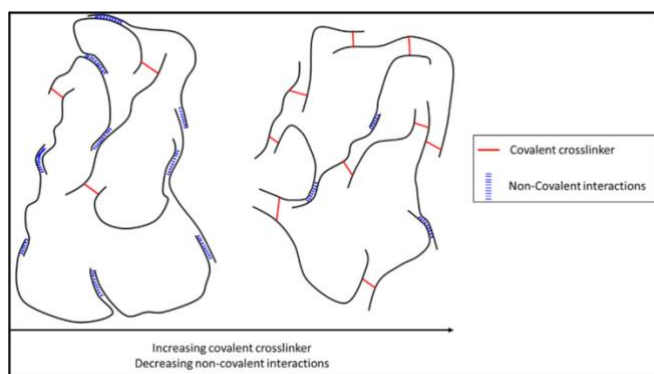


Fig. 8. Polymer network depicting covalent as well as noncovalent interactions [106]

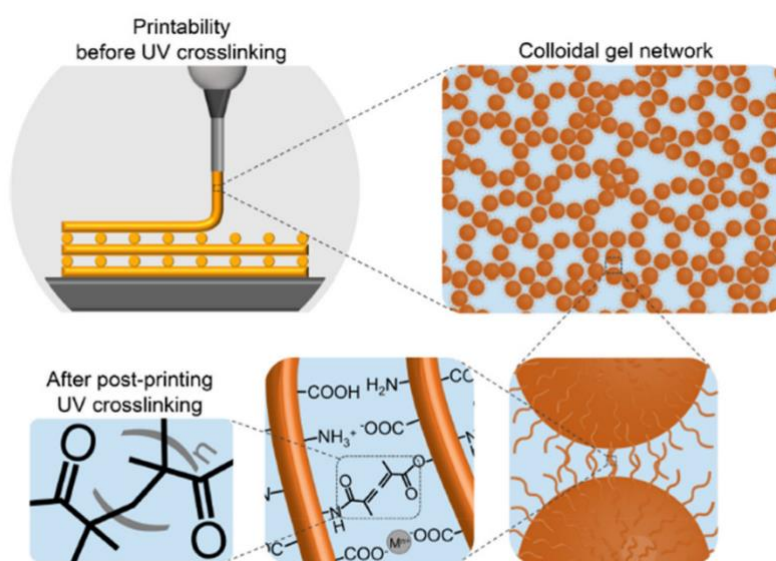


Fig. 9 Schematic illustration of extrusion-based 3D printing of gelatin-based colloidal inks [110]

Additive manufacturing using 3D printer requires quick crosslinking of the gelatin-based colloidal inks ejected from jet nozzle. Irradiation or photo-induced crosslinking is suitable for those purposes [110, 111]. Figure 9 displays the process from macroscopic to microscopic view of the related chemical issues involved [110]. Crosslinking is also leading adhesive technology. Modern robust hydrogel adhesive, frequently used for do-it-yourself activity, dual hydrogen bonding network play a significant role [112, 113]. Formation and development of HBs during preparation of hydrogel-based adhesive is shown in Fig. 10 [113].

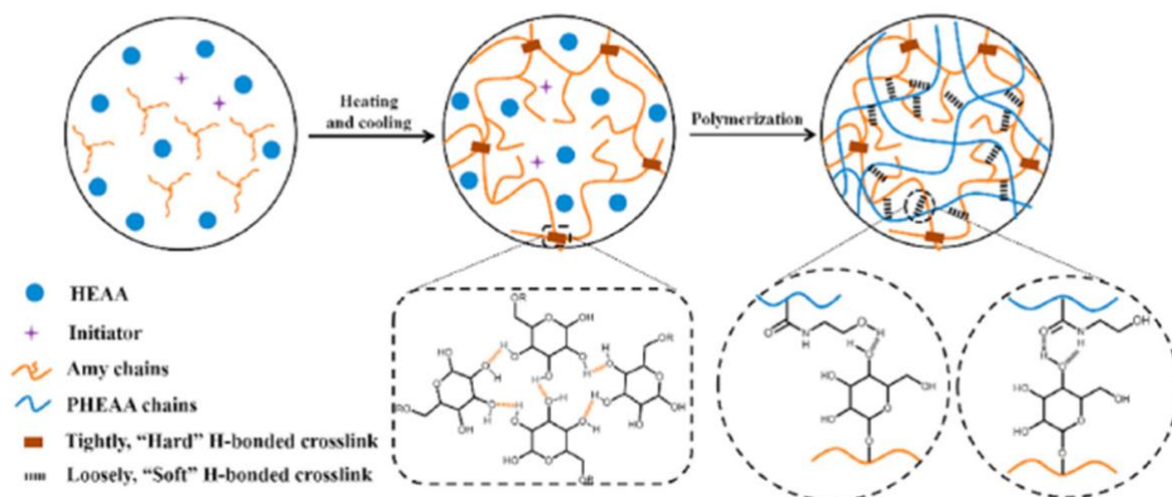


Fig. 10. Scheme of preparation of Amylopectin (Amy)/poly(N-hydroxyethyl acrylamide) (PHEAA,) double network (DN) hydrogels via a one-pot heating-cooling-thermal polymerization method [113]

5. Protein and biomaterials

Proteins are products of life, from microorganisms to human beings. They are ensembles of amino acids. To be more exact, the basic unit of proteins is a polypeptide chain of various amino acids covalently bound by peptide bonds [114]. Bio-related functions emerge, however, from the higher order structure where primary peptide chains are combined by HBs, suggested at first by Pauling and his coworkers [115, 116]. In addition to HBs, salt bridges, to be understood as a kind of nonCBs, play an important role as well [12]. Higher order protein structures are diverse. The first step, formation of secondary level structures in the form of α -helices and β -sheets is displayed in Figs. 11, where the red dotted lines are an indication of the presence of hydrogen bonds between two peptide strands [117]. The change from secondary to quaternary structure is illustrated in Fig.12 [118]. Those higher structures are then examined from various viewpoints [119, 120]. One of the top issues with protein is associated with diseases due to misfolding of higher order protein structure, called prions [121], like Alzheimer symptom [122] or bovine spongiform encephalopathy (Mad cow disease) [123]. It is really interesting but still remains mysterious how the prions are generated, despite their importance of life science [117, 124]. For these reasons, protein engineering tend to direct to therapeutics and pharmaceuticals [119, 125]. One of the latest protein technologies is also associated with vaccines against Covid-19 pandemics [126, 127]. Our brain memory storage is associated with multiple HBs pattern in complicated neuronal synapses [128, 129]. Brain science is rapidly developing area even at the molecular level, where the role of HBs is discussed on various bases [130-132]. Ambitious attempts on the synthesis of synapse organizers might pave the way to combat brain diseases such as Alzheimer's [129].

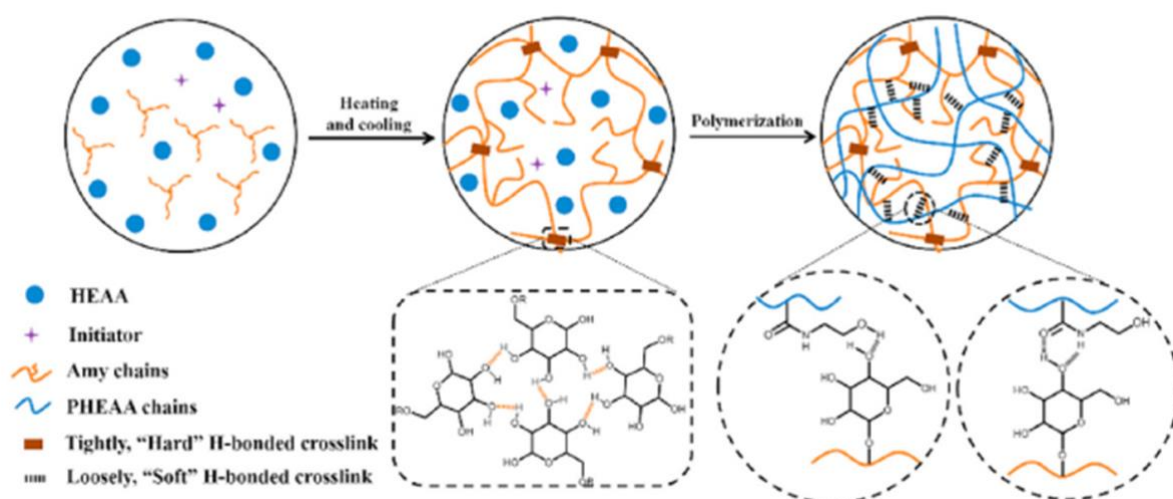


Fig. 11. Formation of secondary level structures or protein in the form of α -helices and β -sheets [117].

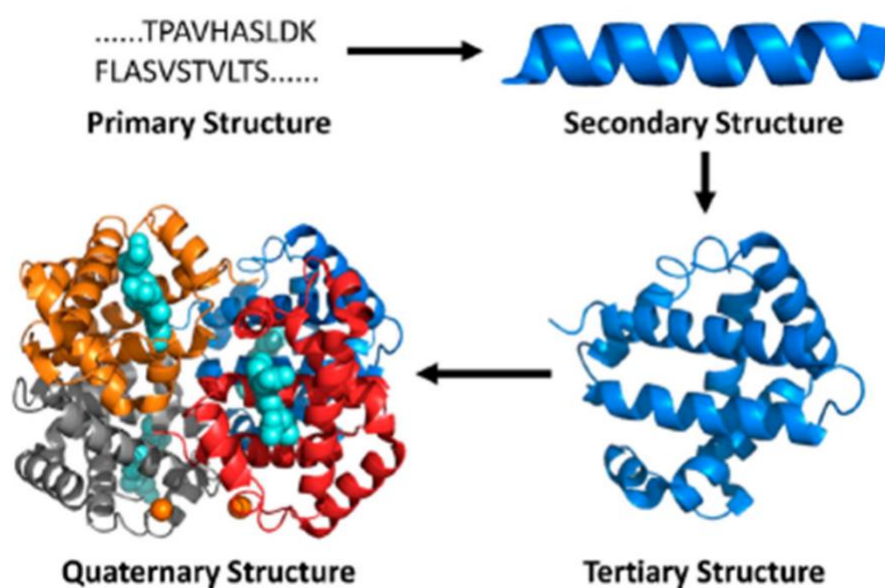


Fig. 12. Four orders of protein structure exemplified by human deoxyhemoglobin [118]

Tissue engineering is one of the rapidly developing technological genres associated with nonCBs. Development of preparing artificial bones [133] and skin [134] is remarkable. While those artificial tissues are synthesized purely chemically, as shown in Fig. 13 as an example of artificial skin synthesis [134], such tissues are also embodied from the concept of biomimetic technology [135, 136]. As mentioned in the previous chapter, most of the related materials belong to the hydrogels [100, 101, 137]. For more practical application of those materials to regeneration medicine, we have to overcome biocompatibility, which depends on the critical balance with our immune system [138, 139].

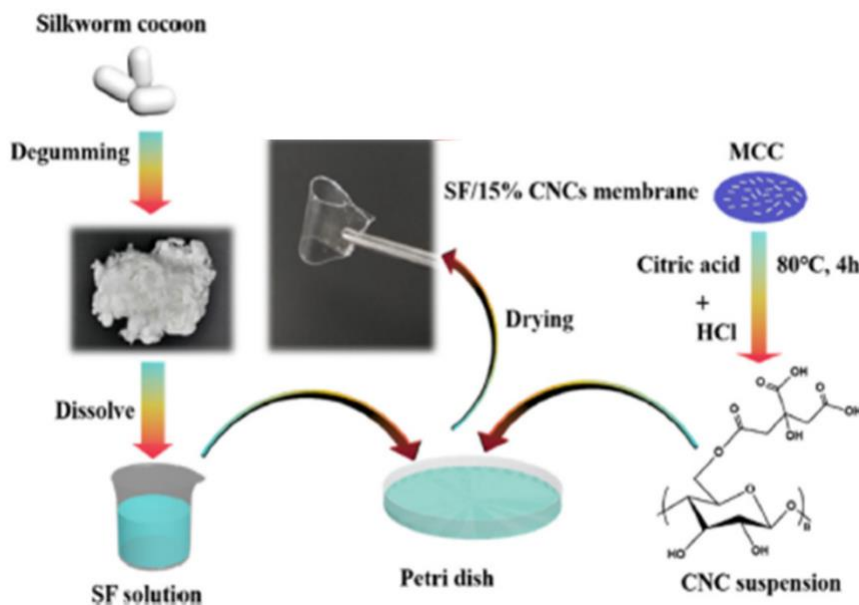


Fig. 13. Schematic diagram of preparation of artificial skin from natural silk fibroin (SF) and cellulose nanocrystals (CNC) [134].

6. Crystal engineering and nanocomposite materials

This chapter discusses two important nonCBs related items, i.e., crystal engineering and metalloxane bonds. Crystal engineering is based on the molecular crystals. Only a few inorganic substances like water, carbon dioxide or iodine form molecular crystals. In contrast, nearly all the organic molecules form molecular crystals when they order in a long range. Crystal engineering is based on the combination of HBs [29, 37]. Crystal engineering is also a part of computational chemistry, seeking appropriate combination of the element structures by nonCBs, by virtue of the database sources like the Cambridge Structural Database (CSD) toolbox [140].

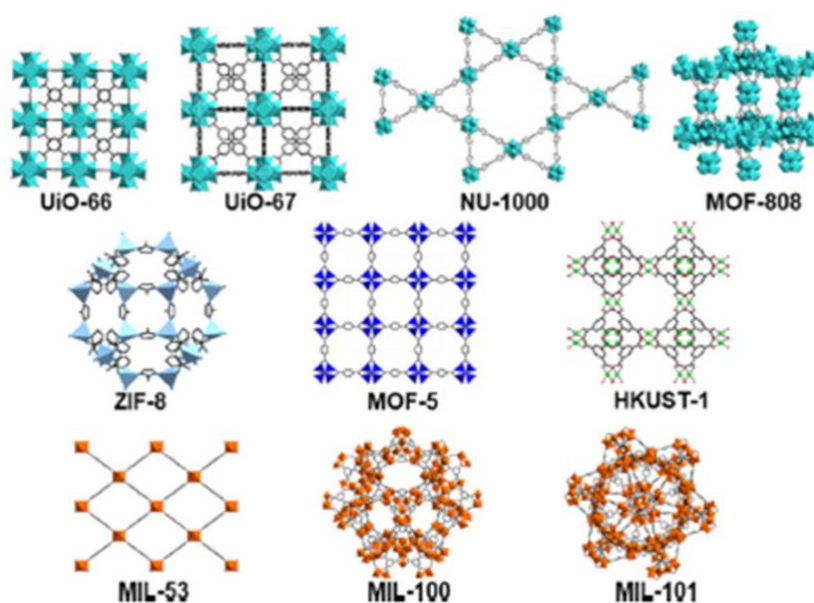


Fig. 14. Crystal structures of MOFs [141]

In last decades, interests in the metal organic frameworks (MOFs) have remarkably increased [29, 57, 142]. MOFs are organic–inorganic hybrids assembled from metal ions or clusters and organic ligands [143]. As shown in Fig. 14, we know various species of MOFs [141]. Metal organic frameworks (MOFs) are reticular solids consisting of inorganic nodes (such as metal atoms) and organic linkers. Due to its microstructure, their internal specific surface area is very large up to 7000 m². Most popular inorganic nodes are transition metal oxy-hydroxides, such as Zr₆O₄(OH)₄. When this is combined with an organic linker, benzene-1,4-dicarboxylic acid, it is named as UiO-66. For other nodes and linkers with the names appeared in Fig. 14, it is recommended to refer Table 1 of ref. [141]. They are developed in the course of improving heterogenous catalysis starting from basic solids, due to their unique properties like high thermal stability, discrete ordered structure, ultra-low densities and large internal surface area [144]. It is to be emphasized that MOFs and related materials are closely related to HBs [145, 146]. MOFs were developed in the interests of materials applications, e.g., for energy storage devices such as lithium ion batteries [147], particularly for solid-state electrolytes, the core material for all-solid rechargeable batteries [148-152]. They were also developed for medical biomaterials [153], or environmental issues such as CO₂ fixation [154]. Due to their unique structures, MOFs are also used as various templates for material syntheses [155]. MOFs are generally prepared in the framework of coordination chemistry and mainly via sol-gel processes [143]. However, other more facile and green methods are rapidly developing, among others via mechanochemical routes [156-158]. Liquid crystals, playing a key role in modern display technology, have also much to do with nonCBs and crystal technology [159, 160]. Their electrical conductivity and luminescence efficiency are also improved by designed introduction of HBs [161].

In our daily life, we have many bridging bonds, i.e., Ca-O-Si for calcium silicates in cement clinker, or Ba-O-Ti for barium titanate used in microelectronic devices. When two cationic species, M_1 and M_2 are abridged by an electronegative atoms, notably oxygen, the formed bridging bond, M_1 -O- M_2 , is called a metalloxane bond [162-165]. They play a crucial role in heterocationic complexes, notably complex oxides. When $M_1 = M_2 = \text{Si}$, it is called a siloxane bond, which plays a particularly significant role in silica chemistry [166, 167]. For the metalloxane bond formation, lattice imperfection plays particularly an important role, since bond distortion or vacancy enhances electron maldistribution and hence polarization of chemical species of concern. This was demonstrated by the change in the electronic overlap population with decreasing coordination number of a pair of atoms abridged by an oxygen atom [164].

Two genres of nonCBs with metallic atoms are introduced, where they are either hinging with other metallic species, or organic species forming metal – carbon bonds. The latter plays an important role in organometallic compounds, serving as catalysts for organic syntheses [168, 169]. In metallocene compounds, an important group of organometallics, two coplanar aromatic rings are bridged by a metallic atom *via* a special coordination [170, 171]. Both of these groups belong to the former category. Representatives of the latter category is metals abridged by electrophilic atoms. They are coined as hetero-bridging bonds were already referred in this journal [172] and play a crucial role for complexing inorganic compounds like metal oxides. Their role is particularly important in the synthesis via sol-gel alkoxide, chemical solution deposition or mechanochemical syntheses, often shortened as mechanosynthesis as already mentioned in conjunction with MOFs synthesis.

7. Concluding remarks

Despite huge diversity, nonCBs possess several general features, i.e., i) they dominate all the properties of molecular aggregates, natural or artificial, ii) they accompany general physicochemical principles, i.e., and stabilization [38, 43], often with charge transfer [42, 173]. Hunting for new, functional materials is nothing but to rationalize and design the order of nonCBs. This is in line with seeking green processes to meet sustainable development goals. Concerted action of unconventional processes like electrochemical, photochemical, sonochemical, magnetochemical or mechanochemical ones, can also be assisted by the formation of particular nonCBs. More broadly, nonCBs not only aggregate chemical species, but hinge concepts of many different genres of chemical technology, making languages of different branches understandable, for instance, those in organic synthesis and inorganic materials sciences. Systematic combination and optimization of nonCBs are in line with sustainability, a leading concept throughout the chemical technology to date and in future.

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“ХӨХӨӨ НАМЖИЛЫН ДОМОГ”- ООС МОНГОЛЧУУДЫН ИТГЭЛ БИШРЭЛ ХИЙГЭЭД ӨНГӨ, ТООНЫ БЭЛГЭДЭЛТ СЭТГЭЛГЭЭГ ШИНЖЛЭХ НЬ

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Хураангуй

Аливаа домгийн агуулгын тоймоос үзэл сэтгэлгээг шинжлэх нь үзэгдлээс мөн чанарыг илэрхийлэх явдал бөгөөд тухайн үндэстний сэтгэлгээний онцлогийг тодорхойлоход чухал хэрэглэгдэхүүн болох юм. Энэхүү судалгаанд морин хуурын үүсэлтэй холбоотой домгуудыг цуглуулж, эмхэтгэн Хөхөө Намжилын домгийн хувилбар гэгдэх “нэгэн залуу нисдэг хүлэг морио муу санаатны гарт алдсанаар морин хуур урлаж байгаа” гол мотивоор зангилагдсан 15 домгийг шүүн авч, гол санаа, өгүүлэмж, дүрээрээ нэгэн домгийн хувилбар болохыг батлав. Судалгаандаа түүхэн материалын арга, төрөл хуваах арга, текст задлалын арга, мотив судлалын арга ба харьцуулан шинжлэх аргыг голлон хэрэглэсэн.

Тус домгуудаас монголчуудын бэлгэдэлт сэтгэлгээг шинжлэхийн тулд зан үйл, соёл судлал, гоо зүйн сайхны тухай онолыг ашиглан “сэтгэхүйн ертөнцдөө хүслийн жигүүрт хүлэг болон Этүгэн эхийн дүрүүдийг бүтээсэн” байгааг шинжлэн тогтоов. Эдгээр дүрүүд нь домогт жонон хар морь, нисдэг жигүүрт хүлэг, лусын дагина, Алтайн охин зэргээр дүрслэгдэх бөгөөд хийморь хэмээх хийсвэр ухагдахууныг жигүүрт хүлэг болгон итгэж, уул усны эзэн сахиусыг лусын охин, дагина хэмээн ахуйчлан шүтэж, бэлгэшээсээр ирсэн болох нь нотлогдлоо.

Монгол хүний сүсэг бишрэлээс төрөгдсөн өнгө (ногоон өнгөөр лус буюу лусын эзнийг, хар өнгөөр хар яст харц хүн, эрэлхэг зориг, цог жавхланг, улаан өнгөөр халуун дотно, баяр баясал) болон тооны (нэг, хоёр, гурвын тоо) бэлгэдэл домог ярианд туссан байгаа нь үйл явдал, өгүүлэмжээр батлагдаж байна.

Энэхүү судалгааны үр дүн нь судлаачдын судалсан хэсэг бусад хуурын домгийн судалгааг улам гүнзгийрүүлж, цар хүрээг өргөтгөн, нэгэн домгийн хувилбаруудаас монголчуудын оор соёл, узуур сэтгэлгээг шинжилснээрээ ач холбогдолтой бөгөөд морин хуурын домгийн судлалд анхдагч болж байна.

Түлхүүр үг: *Хөхөө Намжилын домог, морин хуур хөгжим, монголчуудын бэлгэдэл сэтгэлгээ*



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Оршил

Морин хуурын домгийн тухай аман уламжлалыг цуглуулан, ном бичигт тэмдэглэн эмхэтгэн найруулсан бүтээл байх авч нарийвчлан судалж, нэгтгэн харьцуулж, үнэлгээ шинжилгээ хийн, Монголчуудын узуур сэтгэлгээг тодотгон илрүүлсэн нь цөөн юм. Морин хуурын домог нь зөвхөн Монгол туургатных болохын хувьд Монгол улс, Өвөрмонголоор голлох судалгаагаа хийх нь зайлшгүй юм. Энэ талаар хийгдсэн өмнөх судалгааг дурдвал:

Монгол утга соёлыг судлаач С.Дулам “Монгол домог зүйн дүр” гэх бүтээлдээ үлгэр, дуу, хуур хөгжим үүссэн домгийг тусгай хэсгээр өгүүлж, “Үлгэр, дуу, хуур хөгжмийн үүслийг эртний домгийн соёлт баатруудаас эхлээд эгэл хүн бүтээл болгон хэлэлцэх хоёр янзын өгүүлэмжтэй байна гэж тодорхойлсон [1] бол хөгжим судлаач Ж.Энэбиш “Монгол хөгжмийн их нүүдэл” цуврал номдоо “Морин хуурын үүслийг хуурын татлагаас тодруулах нь” гэсэн хэсгээр Хөхөө Намжил, Сүхийн саарал, Алаг дааганы домог, Аргасун хуурчийн домог, Жороо морины татлагыг жишээлэн өгүүлж, “Хөхөө Намжилын домог, Жороо морины татлагаас хэдэн зуун жилийн өмнө морин хуур буюу хуурын төрлийн чавхдаст хөгжмийн зэмсэг, тэдгээрт зориулсан хөгжмийн бүтээлүүд (татлагууд) түгэн дэлгэрч домогшжээ” гэж дүгнэсэн байдаг. [2]

Хөгжим судлаач Д.Энхцэцэг “Хуурын татлага-монголын хөгжмийн феномен болох нь” бүтээлдээ морин хуурын домгийн 3 хувилбарыг дурдаад “Хөхөө Намжил бол 18-р зууны дунд үеэр Балдан засгийн хошуу, одоогийн Өмнөговь аймгийн Хүрмэн сумын нутагт төрж өссөн, Алтайн хилийн манаанд алба хааж байсан бодит хүн” гэж үзсэн байна [3]. Харин Өвөрмонголын утга соёл судлаач Хүрэлшаа “Хөхөө Намжил, Сүх хүү бол мал аж ахуйн үед үүссэн домог бөгөөд энгийн малчин ба соёлт баатар мөн гээд домгийн гол баатар улам ахуйч шинжтэй болсон” гэж шинжилсэн [4].

ӨМИС-ийн профессор Төгсбаяр “Ажнай үүрслийн анхны уянга <Илдэн морины татаас>” хэмээх өгүүлэлдээ, дуун домог буюу хөгжмийн домгийг анх Жин улсын (Jin Chao) үеийн Цүй Бао (Cui Bao)-ийн зохиосон “Эртэн эдүгээгийн хадлага” (Gu Jin Zhu) гэдэг бичигт “Жороо морины татаас” хэмээх нэртэйгээр тэмдэглэсэн байдаг. Энэ домгийг судалж үзээд “Малчин монгол угсаатны түүх соёл ба монгол үндэстний үлгэр тууль лугаа нэгд нэгээрээ нийцэж, оньс товчоороо дүйцэж байх тул Хятадын уламжлалаас төрөгдсөн домог биш, харин Монгол өндөрлөгийн малчин угсааны домог нь Дундад хязгаарт уламжлагдан орж, хятад бичгээр тэмдэглэгдэж үлдсэн байна” хэмээн цаг хугацааны баримжааг тодорхойлсон байна [5]. Бээжингийн Их сургуулийн профессор Дулаан “Монгол ардын аман зохиолын харьцуулсан судлал” номондоо, одоогоор морин хуурын үүсэл гаралтай холбоотой 10 гаруй домог цуглуулаад байгаа ба “Сүхийн саарал”-ын хэв маягтай, “Хайр сэтгэлийн хэв маягтай”, “Бурхан чөтгөр хамтран бүтээсэн хэв маягтай”, “Хаянхярваа Дамрин бурханы хэв маягтай” гэж 4 ангилан авч үзсэн байна [6]. Дээрх судалгаанаас гадна морин хуурын домгийг тусгайлан авч судалсан судалгаа байхгүй бөгөөд хэсэг бусад мэдээллийн чанартай ном товхимолд тэмдэглэн үлдээх нь олширсон байна. Энэ талыг дараагийн түвшинд хүргэн, нөхвөр судалгааг хийхийн тулд морин хуурын үүсэлтэй холбогдох домгуудыг цуглуулж, ангилан нэгтгэж, харьцуулан дүгнэж, түүнээсээ Монголчуудын үзэл сэтгэлгээг илрүүлж, уламжлал шинэчлэлийг тодруулахыг зорьлоо.

Энэ өгүүлэлд Хөхөө Намжил – хүлэг морь – бүсгүй гэсэн дүрүүдэд зангилагдаж, хүлэг сайн морь нь хэн нэгэн хорон санаатанд жигүүрээ хайчлуулж үхсэнээр морин хуур хөгжим үүсэх шалтгаан болж буй домгуудыг цуглуулан судалж, нэгэн домгийн хувилбар болохыг баталсан. Мөн монголчууд итгэл бишрэлийн сэтгэлгээнээсээ улбаалан жигүүрт хүлэг, этүгэн эхийн дүрүүдийг бүтээсэн болох, түүнчлэн өнгө, тоогоор бэлгэдэх үзлээ домог яриандаа хэрхэн шингээн уламжлуулсныг олж тогтоов.

Судалгааны арга зүй

Тус судалгааны ажлын цар хүрээг Монгол улс болон Өвөрмонгол гэж тогтоон түүхэн материалын арга, төрөл хуваах арга, текст задлалын арга, мотив судлалын арга, харьцуулан судлах арга, зан үйлийн зүй, соёл судлал ба гоо зүйн сайхны тухай онол аргыг хэрэглэв. Өвөрмонголын Алшаа, Цахар, Ордосоор 6 сарын хугацаатай хээрийн шинжилгээгээр явахдаа нутгийн ард иргэдтэй уулзалт ярилцлага хийх, эх хэрэглэгдэхүүнийг сурвалжлан тогтоох, ном сурах бичгийг шүүх зэргээр ажиллалаа. Мөн Монгол улсын Шинжлэх ухааны академи, Хэл зохиолын хүрээлэнгийн Дуун ухааны сан хөмрөгийн гар бичмэл болон соронзон бичлэгийн хадгаламж зэрэг үнэ цэнтэй сурвалжид түшиглэн харьцуулан судалсан.

Судалгааны үр дүн, хэлэлцүүлэг

А. Монголчуудын бэлгэдэл сэтгэлгээний аман хүүрнэл “Хөхөө Намжилын домог”-ийн хувилбарууд

Монгол ардын аман зохиолын домгийн төрөлд “Хөхөө Намжилын домог” томоохон байр эзэлдэг. Энэхүү домгоос монголчуудын сэтгэлгээний онцлогийг шинжлэхийн тулд газар газар тархсан хувилбаруудыг нэгтгэн цуглуулж, үйл явдал, өгүүлэмж, дүрийн давтамжид тулгуурлан нэгэн домгийн хувилбар болохыг батлах оролдлого хийв.

Хувилбар 1. “Монгол ардын домог үлгэр” дэх “Хөхөө Намжилын домог”-т “Эрт цагт Хөхөө Намжил гэгч сайн эр баруун Алтайд цэрэгт татагдан алба хааж байхдаа нэгэн гүнжтэй танилцана. Намжилыг буцах болсонд “жонон хар” морио дурсгал болгоно... Намжил жонон хар морио унаж шөнө бүр гүнжтэй уулзсаар нэг л мэдэхэд 3 жил болжээ. Баяны ховч хүүхэн үүнийг ажиглаж мэдээд, жонон хар мориных нь жигүүрийг хайчилсанд морь нь үхэв. Намжил үүнээс болж хайртай гүнжтэйгээ, хайртай хүлэг морьтойгоо дахин уулзаж чадахгүй болсондоо туйлын их гашуудаж, морин хуур хөгжмийг урлан бүтээжээ гэж гардаг [7].

Хувилбар 2. “Хөгжмийн уламжлал шинэчлэлийн асуудалд” номон дахь “Хөхөө Намжилын домог”-т “Намжил хугацаагүй цэргийн албанд татагддаг. Төрсөн нутаг, аав ээж, амраг ханиа санахын эрхээр дуулдаг түүнийг Алтайн дагина сонсож мэдээд нисдэг хурдан хүлгээ өгч тусалжээ. Намжил энэ хүлгээ унаж шөнөд нь гэртээ, үүрээр харуулын байрандаа очдог болж гэнэ. Нэгэн удаа хар санаатай хүн түүний нисдэг хурдан хүлгийнх нь гуурсыг тас хяргасанд хүлэг нь үхжээ. Ингээд Намжил сэтгэл санаагаа засахын тулд морин хуурыг үйлдэн бий болгожээ” [8].

Хувилбар 3. “Алшаа ардын аман зохиолын цомог” дахь “Морин хуурын үлгэр” бол Өвөр монголд тархсан хувилбарын нэг юм. “Хөхөө Намжил гэдэг харц ардын адуучин хүүд баян айлын бач ихтэй хүүхэн дурлан, эд мөнгө, эрх сүрээрээ далайлган байж гэрлэжээ. Харилцан хайр сэтгэл гэж үгүйн тул Хөхөө Намжил олон жил лусын хааны охинтой сэтгэлийн үгээ хэлэлцэж, харгис хаан, хартай эхнэрийнхээ зовлонг мартдаг байв. Нэгэн удаа хаан адуун сүргээсээ морь бариулах гээд түшмэдээ явуулсанд Хөхөө Намжил эзгүй, түүний оронд нэгэн догшин харцгай адуун сүргийг манаад огт ойртуулсангүй. Үүнээс хойш хартай харгис эхнэр нь түүнийг мөшгин хардсаар лусын охинтой уулздагийг нь, түүний унаж буй хүлэг нь нисдэг жигүүртэй болохыг мэдээд хайчилж орхисонд морь нь үхжээ. Хөхөө Намжилын сэтгэлд хар үүл бууж гашуудан, морио дурсахын тулд хуур хөгжим зохиожээ” [9].

Хувилбар 4. “Алшаа зүүн хошууны аман үлгэр” дэх “Хөхөө Намжил” гэх энэ хувилбарт “Намжил ганц бүдүүн хар морио унаж асган орой алга болдог ба өглөө агнасан ан ч үгүй, усан хулгана болсон морьтой харьж ирэхэд эхнэр нь хардлын сэтгэл

төрөх болсоор удаж гэнэ. Тэр нутгийн хаан түүнийг сайн адуучин гэж мэдээд адуучин болгож гэнэ. Нэгэн өдөр хаан хоёр тахартаа адуун сүргээс морь барихыг даалгасанд Намжил эзгүй, түүний оронд хоёр хөхөө шувуу адууг нь манаад тэднийг ойртуулсангүй. Тахрууд энэ мэдээг хаанд хүргэв... Нэг өглөө Намжилын авгай нь хогоо хаяхаар гарахдаа сайр дээр хөрвөөж буй жонон хар морины суганаас жижигхэн хөөрхөн алтан жигүүр цухуйж байхыг нь үзээд буцан гүйн орж хайч авчраад хайчилж орхисноор эгэл биш эрдэнийн морь нь үхэв. Намжил эг сэггүй гурван долоо хоног хийсэн хуураа хуурдаж суутал нэг их хуй салхи ирээд, тэр хуураа орхиод алга болжээ. Эдүгээ нутгийн ардууд тэнгэрийн дагина нь ирээд аваад явчихсан” гэж ярьдаг [10].

Хувилбар 5. “Алшаа зүүн хошууны аман үлгэр” дэх “Хөхөө Намжил” домог нь хувилбар 3,4-тэй ижил үйл явдал өрнөдөг ба түүний адуун сүргийг лусын хүүхний томилсон 4 хараацай манадгаараа ялгаатай [11].

Хувилбар 6. “Алшаа зүүн хошууны аман үлгэр” дэх “Хөхөө Намжил” домогт “Цэргийн агт хариулдаг Намжил далайн хөвөө барьж адуундаа явдаг ба их сайхан хоолойгоор уянгалуулан дуулдаг байжээ. Түүний сайхан дуулахыг нь лусын хүүхэн сонсоод уярч, түүгээр дуу заалгамаар байгаагаа хэлж далайн гүн дэх орд харшдаа аваачсан гэнэ. Тэд өдөр болгон уулзаар Хөхөө Намжил түүнтэй ханилжээ. Нэгэн удаа Намжил лусын хүүхэндээ би гэрээ эргэмээр байна гэхэд хуруу инчдэхийн зуур хүссэн газраа хүрдэг жонон хар морь өгчээ. Тэр морь нь хоёр жигүүртэй бөгөөд ба таван өнгийн солонго татдаг ид шидтэй гэнэ. Шөнө болгон гэртээ хонохоо больсон нөхрийнхөө энэ учрыг авгай нь мэдээд мориных нь жигүүрийг хайчилсанд, шархаа даалгүй үхэв гэнэ. Хөхөө Намжил морио санахдаа нэг хуур хийгээд гурван жил хуураа татаж, хүлгийнхээ сэгийг эргэн үзсээр байтал суган дахь жигүүр нь ургаж гүйцээд Намжил ч үзэгдэхээ байсан гэнэ” [12].

Хувилбар 7. “Монгол ардын аман зохиолын чуулган” дахь “Хөхөө Намжилын домог”-т ногоон торгон дээлтэй лусын хүүхэнтэй ханилсан Хөхөө Намжилын тухай өгүүлнэ. Өмнө дурдсан домгуудын адилаар “Цэргийн албанд байхдаа зөвхөн дуу дуулах ба лусын хүүхэн уярч сонсоод дуу заалгахаар гэртээ аваачиж, адуун сүргийг нь тусгай хүн гарган мануулдаг. Намжил хэдийгээр сайхан амьдарч байсан ч орон нутагтаа хүлээн суух аав ээж, амраг гэргийтэй тул аргагүй явах болов. Лусын хүүхэн түүнд сайхан хул морь өгөөд түүнээс өөр морь унаж болохгүй, саахалтын хирд түр зогсож амьсгааг нь дараад очиж байгаарай гэж учирлан захисаар явуулжээ. Ингэж тэд хүлэг мориныхоо ачаар 3 жил уулзсан боловч нэг өдөр авгай нь мэдэн мориных нь гуурсыг хайчилж орхижээ. Хөхөө Намжил эмгэнэн гашуудаж, 3 сар шахам нойр хоолгүй хэвтсэний эцэст морио дуурайлган морин хуур хөгжим хийж” гэнэ [13].

Хувилбар 8. “Алшаа зүүн хошууны аман үлгэр” дэх “Алтан харуулд морь шагнасан нь” домог ярианд адуу харуулын газарт ардуудад алба тусгаж 3 жилээр татан, адуу хариулуулдаг байжээ. Нэгэн ядуу залуу энэ хэцүү албанд татагдан очоод лусын охинтой танилцдаг. Гол үйл явдлууд бусад домгийн адил өрнөх ба домог яриан төгсгөлд лусын хүүхэн нь “Би таныг аваачихаар ирлээ. Манай лусын оронд очиж энэ зохиосон хуураа татаж, дуулж хуурдвал их буян болно” гэж залуугийн зүүдэнд ирдэг. Зүүдний ёсоор болж лусын хүүхэн хилэн хар морио унаж ирээд түүнийг авч явсан гэнэ. Түүнээс хойш залуу үзэгдэхээ больж, эхнэр нь түүний амьд үхсэнийг сураглаад ч сураг чимээ олсонгүй гэнэ [14].

Хувилбар 9. “Монголын зан аалийн үлгэр” дэх “Хөхөө Намжил” -ын хувилбарт аз бусаар цөллөгөнд явж буй ардын яруу дууч Хөхөө Намжилын тухай гардаг. Түүнийг улсын эзэн авхай өрөвдөн хайрлаж, нэг хос жигүүрт сахиулсан хүлгээ өгч гэнэ. Тэд уулзан ярилцаж, алтан наран уулын цаанаас цухуйхад салж явдаг болжээ. Үүнийг мэдсэн Хөхөө Намжилын эхнэр нь сахиулсан хүлгийнх нь жигүүрийг хайчилж шатаасанд хүлэг морь нь шархаа даалгүй үхжээ. Хөхөө Намжил мориныхоо хойноос харуусан

гашуудахдаа морин хуур гэх хөгжмийн зэмсэг зохиож, дуулж хуурдаж сэтгэлийн шаналалаа тайлдаг болж гэнэ [15].

Хувилбар 10. “Хуурын татлага - Монголын хөгжмийн феномен болох нь” ном дахь нэгэн хувилбарт сарлагийн гунан хөх бяруу уналагатай, Хөхий уулаар нутагтай Намжил хүү цэргийн албанд татагдан очоод Алтайн савдагтай ханилж буй тухай гардаг [16]. Энэ хувилбарт Намжилын эгэл биш мориных нь суганы гуурсыг хайчилдаг хүн бол түүний эхнэр биш, хоньчны хар эм гэж гардгаараа бусад домгийн хувилбараас ялгаатай байна.

Хувилбар 11. “Хуурын татлага- Монголын хөгжмийн феномен болох нь” ном дахь өөр нэг хувилбарт нэгэн идэр баатар хайртай хүүхэн болох уулын дагинадаа шөнө бүр довтолгон ирдэг байтал тэр зуур харьяа цэрэг нь холдсоор, уулзан учрах аргагүйд хүрэв. Хурдан хүлэг нь газрын холыг туулж барахааргүй болсныг сэтгэлт хоёр мэдэж, арга ядахдаа хайртай хүүхэн нь хайрлан энэрэх сэтгэлдээ хүлэг морийг жигүүртэй болгосон ч харин нэг л шөнө уулзахгүй бол өөрөө амиа алдах ёстой байж гэнэ. Энэ бүхнийг мэдсэн хорон санаат эмгэн шуламс залууг ирэхийг отоож байгаад хүлгийнх нь шидэт жигүүрийг хурц хутгаар тас огтлоход сайхан хүлэг нь амь тавина. Хүлэг мориныхоо төлөө гашуудан гансравч, хайртай хүүхэн нь бас үхнэ гэж бодохоор орчлон харанхуйлах шиг болж гэнэ. Гэнэт гайхалтай санаа төрөн мориныхоо эд эрхтнээр нь морин хуур хөгжим хийж гэнэ [17].

Хувилбар 12. “Монгол домог зүйн дүр”-ийн “Балчин кээрийн домог”-т хоёр хайсан тогоо нэрэхийн зуур гадаад далайг эргээд ирдэг тийм хурдан сайхан хээр морьтой архичин залуугийн тухай үйл явдал гардаг. Уг домог нь Хөхөө Намжил гэх нэрээр тархаагүй ч түүний энэ сайхан хүлэг нь муу хүнд гуурсаа хайчлуульж байгаагаараа Хөхөө Намжилын домогтой холбогдож байна. Архичин залуу дайсанд хорлогдсон морио үзэн гашуудаж, мориныхоо толгойг дуурайлган сийлж, морин хуур хөгжмийг бүтээв гэнэ [18]

Хувилбар 13. “Монгол домгийн чуулган” дахь “Хөхөө Намжилын домог”-т Саруул гүний хошуу, одоогийн Увс аймгийн Цагаанхайрхан суманд нутаглаж байсан Намжил гэж тодорхой нэр устай залуугийн тухай өгүүлдэг. Энэ домог ярианд баян Хөхүй уулын савдагтай ханилдаг байсан Намжил баруун Алтайд цэргийн албанд очоод Алтайн савдагтай нийлж байна. Нутагтаа буцах болоход Алтайн савдаг хүлэг сайн морь бэлэглэх ба морь нь замдаа хорлогдож, Намжил зовж зүдэрч байгаа тухай дүрслэгддэг байна [19].

Хувилбар 14. Монгол Улсын Шинжлэх Ухааны Академи, Хэл зохиолын хүрээлэнгийн нутгийн аялгууны сан хөмрөгийн гар бичмэлийн хэсэгт байгаа уг домгийг анх 1972 оны 3 сарын 11-д сурвалжлан, Анчны үлгэр /Хөхөө Намжил/ нэртэйгээр тэмдэглэн үлдээсэн байна [20].

Домгийг хувилбаруудтай харьцуулж үзвэл цэрэгт татагдаж буй, ногоон торгон дээлтэй бүсгүйтэй танилцаж буй, гуурст хүлэг мориороо агшин зуур ирж очиж байгаа зэрэг үйл явдал, өгүүлэмжийн хувьд адил боловч эхнэр нь цэрэг цуглуулан нөхрөө барих, жигүүрт хүлгийнх нь жигүүрийг хуга мушгих үйлүүд ялгаатай. Хамгийн гол нь домгийн төгсгөлд морин хуур урлаж байгаа гол мотив үгүй юм. Гэсэн хэдий ч уг домгийн дийлэнх өгүүлэмж Хөхөө Намжилын домгийн хувилбартай адил байна.

Хувилбар 15. Монгол Улсын Урьдын эх Дагинын отог, одоогийн Төв аймгийн Эрдэнэсант сумын “Саруул зам” нэгдлийн төвд оршин суугч Дэмчигийн Дамбийжанцанаас 1973 оны 7 сарын 24-нд Д.Дашдорж уг яриаг тэмдэглэн авч, 2004 оны 1 сарын 28-нд Б.Катуу Хэл зохиолын хүрээлэнгийн сан хөмрөгт Д.Дашдоржийн гар бичмэлээр бүртгэн үлдээсэн байна. Домогт “Хөхөө Намжил Алтайн хязгаарт харуулын албанд яваад тэнд дуулж байхад нь Алтайн бүсгүй савдаг нөхөрлөж, нэгэн нисдэг гуурстай морь өгснөөс оройд нь гэртээ ирж, өглөө Алтайд бэлэн очдог байжээ. Гэтэл Хөхөө Намжилын айлын нэг хүн харуулын албанд Намжилтай хамт байсан авч, Намжил шиг ирж чаддаггүй байсан учир

тэр түүний эхнэр атаархаж, гуурстай мориор нисэж ирээд байгааг нь мэдсэн учир, нэг удаа сэм Намжилын морины гуурсыг хяргаснаас болж, морь нь үхээд, Хөхөө Намжил ийнхүү нааш цааш явж чадахаа больсон гэнэ” [21]. Хувилбар 14,15-р домгийн үйл явдал ерөнхийдөө бусад домгуудтай адил боловч гуурст морио алдсанаас болж морин хуур хөгжим бүтээж буй гол мотив байхгүй.

Table 1. Mythological content

	Legend name	Spreading area	Connection between main events	About how he mourned the death of his beloved horse	About how the fiddle was created
Version 1	The Legend of Khukhoo Namjil	Mongolia	A true man named Khukhoo Namjil, a princess, a black horse, a liar woman, cut off the wings.	Inside, he was filled with sorrow and grief...	Carved the head of a black horse out of wood, bent a stalk to the head, made a face from the hide, trimmed the tail with hair, and applied tree resin.
Version 2	The Legend of Khukhoo Namjil	Mongolia	Khukhoo Namjil, the singer-a mermaid-a fairy-flying horse-a lady-cut the secret wings.	He mourned the death of his precious horse, which shortens the month to day and the day to hour.	Horsehead fiddle was made.
Version 3	The Tale of the Fiddle	Alshaa	Khukoo Namjil, a horseman - a mermaid - a magic horse - a lady – cut off a golden wing.	Darkness covered his heart, and suffered from sadness all day long.	Taking the horse's tail, tuned it to the fiddle carved with a horse's head, and composed a tune for it.
Version 4	Khukhoo Namjil	Alshaa	Khukhoo Namjil, a hunter-a fairy of the sky-incarnate knight-lady-clipped the tip of the horse's wings.	He concerned about ...	made a horsehead fiddle and sawed off with the tail to make a tune.

Version 5	Khukhoo Namjil	Alshaa	Khukhoo Namjil is a horseman of a landlord - mermaid – a jeweled horse – a lady-cut off the wing	Remembering the horse made him lose his composure.	Made a horsehead fiddle.
Version 6	Khukhoo Namjil	Alshaa	Khukoo Namjil, a horseman who takes care of a military herd –a mermaid – a reincarnated horse – a lady – cut off the wings.	Missing his precious horse.	Made a fiddle and played a tune called “jonon har”.
Version 7	The Legend of Khukhoo Namjil	Mongolia	A good man named Khukhoo Namjil, a mermaid, a fine horse, a lady,	after his horse death, he was devastated and laid without food or sleep for almost 3 months.	Carved an imitation of a horse's head, made a fiddle with a horse's head, and entered a tune the story of his horse galloping.
Version 8	Awarded horse by Golden guardian	Alshaa	A poor young man – a mermaid – a velvet black precious horse –a lady- cut off the wing	Grieving to the point of death, he was next to the dead body of his horse	Made a square box out of wood, turned the tail into strings then carved a horse head, 2 wooden ears and 2 more or less matching handles. Finally created a kind of instrument.
Version 9	Khukhoo Namjil	Mongolia	A folk singer named Khukhoo Namjil – State miss – horse with a pair of wings - the lady- cut off the wing.	He deeply mourned.	Carved the head of a fiddle out of wood, put it on the neck of the fiddle, fixed it on a box covered with horse skin, tied two strings to the horse's tail and made a bow, pulled it melodiously, and made the sound of horse neighing, galloping, and stepping.

Version 10		Mongolia	A poor boy named Namjil-Altai mountain's spirit-winged horse-shepherd's jealous woman-cut off the wings .	The son was mourned.	Made a fiddle out of a horse's head, covered it with skin, and made strings out of its hair then he played it and the boy became Khuhu Namjil.
Version 11		Mongolia	A hero-a mountain fairy-evil witch- cut off the magic wings.		Made a wooden box, made a bow out of his horse's ribs, and a string out of his hair.
Version 12	The Legend of Balchin sorrel horse	Mongolia	A drunken young man-Balchin sorrel horse-evil man-cut the wings' pipe	Regretted.	The head was carved by imitating his horse head, the mane and tail were shaved then setting the horse's galloping tune.
Version 13	The Legend of Khukhoo Namjil	Mongolia	Khukhoo Namjil - Khukhui mountain's spirit- black horse-Altai mountain's spirit	Regretted.	
Version 14	A hunter's tale [Khukhoo Namjil]	Mongolia	A yong singer named Khukhoo Namjil- a girl in a green silk robe -winged horse- cut off the wing.	The dark haze pull.	
Version 15	The Legend of Khukhoo Namjil	Mongolia	Khukhoo Namjil - Altai's spirit - winged horse- cut off the wing.	I no can go to walk away and tither.	

Домог яриан судлалд 1. Цаг хугацаа, 2. Газар орон, 3. Хүн, 4.Үйл явдлыг тогтворжуулан авч үздэг нь үлгэрээс ялгагдах үндсэн зөрөө болдог [22]. Эдгээр домгийн цаг нь “эрт урьд цагт, эрт цагт, урьд цагт” гэхчлэн ерийн товч хэлбэрээр эхэлж байгаагаараа ижил. Нэрийн тухайд ихэнх нь Хөхөө Намжил гэгч гол дүрээр нэрлэгдсэн боловч 8-р хувилбарт “Алтан харуулд шагнасан морь” [23] хэмээх ондоо нэртэй байна. Энэ хувилбарын “Урьд алтан харуул гэж байв... буйд зэлүүд уйтгартай газар” гэснээс ажиглавал аглаг, алс хол, баруун Алтайн хязгаарыг зааж байгаа нь тодорхой. Харин гурван жилээр адуу хариулах гэдэг нь цэргийн албанд татагдах гэсний өөр хувилбар юм.

Амаар дамжин уламжлагдахдаа Алтайн харуул нь Алтан харуул болж хувирсан бөгөөд домгийн гол өгүүлэмж ч “Хөхөө Намжилын домог” үйл явдалтай дүйцэж байна.

Дүрийн хувьд Хөхөө Намжил буюу Намжил гэх залуу, түүний эхнэр, лусын хүүхэн, уулын савдаг гэсэн голлох хэдхэн дүртэй. Харин хувилбар 11-т Хөхөө Намжил бус нэгэн идэр баатар, хувилбар 12-т архичин залуу гэж гардаг. Хамгийн чухал нь энэ 2 домгийн гол мотив болох “хүлэг морь нь жигүүрээ хайчлуулсан тул үхэж, эзэн нь харуусахдаа морин хуур урлаж байгаа” нь Хөхөө Намжилын домгийн хувилбар болохоо баталж байна. Мөн хувилбар 14,15-д яг эсрэгээрээ тус домгийн үйл явдал ижилхэн өрнөх боловч гуурст мориных нь гуурсыг хайчилсны дараа морин хуур хийж байгаа гол мотив нь үгүй. Гэсэн ч гол дүр Хөхөө Намжил, Алтайн дагины хийж байгаа үйлдлүүд нь тус домгийн хувилбар гэдгээ нотолдог.

Домгийн цуглуулж эмхэтгэсэн байдлаас авч үзвэл 15 домог ярианы 5 нь ӨМӨЗО-ны Алшаа аймаг, 10 нь Монгол улсад харьяалагдаж байна. Монгол улсад тархсан домгийн хувилбарууд Монголын зүүн хязгаараас баруун хязгаар Алтай хүртэлх орон зайд үйл явдал өрнөж байдаг бол Өвөр монголын Алшаа нутгийн хувилбаруудад онцгойлон газар нутгийг зааж нэрлээгүй байна. Алшаагаас олдсон 5 хувилбар, Монгол улсын 4 хувилбараас бусад нь хэн, хэзээ, хаанаас бичиж тэмдэглэж авсан эх сурвалжийн мэдээлэл тодорхойгүй. Хэрвээ Алшаа нутгаар тархсан домгуудаас барагцаалж үзвэл Монгол улсын Говь-Алтай, Баянхонгор аймгуудад энэхүү домог яригддаг байсан гэж таамаглаж байна. Үүнийг тодруулж түүхийг эргэн сөхвөл “1930-аад оны эхээр Монгол улсын нийгэм, улс төрийн тогтворгүй байдал, зөрчилдөөнөөс болоод Өмнөговь, Дорноговь, Сүхбаатар, Хэнтий, Дорнод зэрэг Өвөр монголтой хиллэдэг бүх л аймгийн хүмүүсийн дийлэнх нь эх орноо орхин хил даван дүрвэсэн. Тэр ч байтугай Говь-Алтай аймгийн урд сумдын хүн ам нь бараг л бүгдээрээ дүрвэж гарсан” гэх тэмдэглэл байна [24]. Иймд судалгаанд ашиглаж буй “Хөхөө Намжилын домог” нь дүрвэгчдээр дамжин тархсан байх магадлал хамгийн бодитой болох юм. Гэтэл энд тус домгийн анхдагч эх сурвалж яагаад Монгол улсынх вэ? гэдэг асуулт ургаж гарна. Монгол улсын Шинжлэх Ухааны Академи, Хэл зохиолын хүрээлэнгийн Дуун ухааны сан хөмрөгт хадгалагдаж буй домгийн 2 хувилбарыг 1970-аад оны эхээр Б.Катуу тэргүүтэй аман зохиол судлаачид өв тээгчдээс тэмдэглэж, соронзон хальснаа буулгасан. Эдгээр эх сурвалж бол бидэнд олдоод байгаа хувилбаруудын цаг хугацааны хувьд хамгийн эхнийх тул үүгээр баримжаа болгож үзэж болно. Мөн уг домог нь одоогоор Өвөр монголын зөвхөн Алшаад тархсан, Монгол улсын нийт хүн амд тархсанаараа Монгол улсынх болохоо дахин баталж өгч байна.

Хураангуйлбал, Морин хуурын дүрс, хэлбэр, бүтэц нь бүр мориноос үүсэлтэйг домгийн хувилбарууд батлахын зэрэгцээ голлох хэдэн мотивоороо нэгэн домгийн хувилбар болохыг илтгэж байна. Мөн Хөхөө Намжилын домог нь Монгол улсад анхлан тархаад, дараа нь Өвөр монголд дэлгэрсэн байна.

Б. “Хөхөө Намжилын домог” дахь монголчуудын итгэл бишрэлийн сэтгэлгээний тусгал

Аливаа домгийн агуулгын тоймоос үзэл сэтгэлгээг шинжлэх нь үзэгдлээс мөн чанарыг илэрхийлэх явдал болно. Энэ хэсэгт “Хөхөө Намжилын домог”-ийн хувилбаруудаас монголчуудын итгэл бишрэлийн сэтгэлгээг дараах байдлаар өгүүлнэ.

1. **Жигүүрт хүлгийг бишрэн шүтэх сэтгэлгээний тусгал.** Монголчууд сэтгэхүйн ертөнцдөө хүслэнгийн жигүүрт хүлгийн дүрийг бүтээгээд, түүнийгээ бишрэн шүтэж, улмаар домог яриандаа тусгасан байдаг. Үүний хамгийн тод жишээ бол Хөхөө Намжилын унаж яваа жигүүрт хүлэг юм. Энэ хүлэг бол угтаа аз хийморийн бэлгэдэлт дүр болно.

Хийморь гэдэг нь төвдөөр “lün rta” буюу “хийн (салхин) морь” гэсэн утгатай үг. Эртний Энэтхэгийн “тэжээхүй ухаан”, дандарын ёс буюу Бурханы очирт хөлгөний ёсны ойлголт бөгөөд хүний бодол санаа ямар нэгэн хий унаа хөлөглөж, түүнийхээ хүчээр хүрэх газраа хүрч, үйлдэх үйлээ үйлддэг” гэсэн ойлголт юм [25]. Угтаа унаж эдэлдэг мориноос гадна хүний биеийн дотор байх хийг “амь баригч хий” гэж нэрлээд морин дүрсээр илэрхийлж, хийморь хэмээн ярих болжээ. Хэрэв амь баригч хий хямрах аваас үүн дээр тогтдог сэтгэл хямарч, гуньж гутарч сөрөг үр дагавар үүсдэг учиртай. Тэгвэл домгийн бүх хувилбарт жигүүрт хүлгийн жигүүр нь хайчлагдсанаар зол бус тавилан, үхэл хагацал тохиож, сэтгэлийн их шаналанд унаж байна. Энэ нь монголчуудын хэлдэг “Хийморь нь доройтож, хишиг буян нь зайлах”-тай адил өгүүлэмж төдийгүй монгол хүний хийморийг бэлэгшээх сэтгэлгээгээр морио дахин амилуулж сэргээх гэсэн үзэлт болно. Үндсэндээ домгийн жигүүрт хүлэг бол хүмүний сэтгэл зүрхэнд орших хийморийн дүрийн ахуйчилсан хувилбар болж байна.

Мөн хувилбар 12-т “Хөхөө Намжилын хувилгаан морь суниахад суганаас нь жигүүр цухуйх бөгөөд таван өнгийн солонго татдаг” [26]-аас “Бурхан багш нирван дүрийг үзүүлэхдээ тэргүүний үснээс нь 5 өнгийн гэрэл гарч 5 манзуршир болон хувилсан” [27] бурханы шашны гэрэл гялбааг эрхэмлэх үзэлт илрэх ба агуулга, цар хүрээг улам тэлсэн жигүүрт хүлгийн дүрийн бас нэгэн хувилбарт дүр болж байгаа юм. Түүнчлэн үлгэр туульд гардаг “Үүлтэй тэнгэрийн доогуур, үзүүртэй модны дээгүүр” нисдэг хүлэг морьтой адил уул усыг алгасан, цаг хугацааг товчлон нисдэг гэж дүрслэгдсэнээрээ уран сэтгэмжит дүр болон хувирав. Энэ мэт хувилбарт дүрийг бүтээсэн домог дахь жигүүрт хүлэг нь монголчуудын итгэл бишрэлээс төрөгдөн бий болсон байна.

2. Уул ус, этүгэн эхийг бишрэн шүтэх сэтгэлгээний тусгал. Хөхөө Намжилын домог яриан бүх хувилбарт гарч буй лусын охин, Алтайн дагина, уулын савдаг гэгч эм үүтгэлтэй дүр нь энэхүү газар дэлхий, этүгэн эхийн өөр нэг хэв шинжит дүр болно. Уг дүр нь домог зүйн үүсэл хөгжлийн эхний үед юм үзэгдлийг амьдчилах, хүмүүншүүлэх сэтгэлгээнээс үүсэлтэй бөгөөд амилагч, үүсгэгч, үүдэгч гэх агуулгатай ухагдахуун гэж эрдэмтэд үздэг. Монгол хэлний их тайлбар тольд: 1.Эх болсон дэлхий, газар шороо 2.Эм удган, бөө гэж тайлбарласан байна. Энэ нь үр шим төгөлдөр эх газрыг нэрлэж байгаагаас гадна газар дэлхийн эзэн савдгийг давхар илэрхийлэх утгатай.

Судлаач Х.Буянбатын бичсэнээр: “Эхчлэлийн нийгмийн үед бөө мөргөлийн шашны үйл хэргийг эрхлэн гүйцэтгэдэг нь “удган” хэмээгдэх эмэгтэй бөө байжээ. Эмэгтэй бөө болох тэдгээр удган нь модны шүтлэгийг багтаасан газар дэлхийн шүтлэгийг эх этүгэний шүтлэг хэмээгдэх ойлгогдохуунтай болгосон байна. Үүний үр дүнд модны шүтлэгийн хүрээнд “удган мод” буй болж, тэр нь угтаа этүгэний бүрэлваа болжээ. Тухайн модонд эмэгтэй бөөгийн эзэд сахиус, онгод шүтээн оршдог” [28] хэмээгээд “Үүдлийн өлзий мөртэй, үржлийн үрийн хутагтай эмэгтэй шүтээн, эх шүтээн”-ий ойлголтыг улам тодорхой болгосон юм [29]. Домогт өгүүлэхээр газар доороос гэнэт гараад ирэх, далай дотроос гарч ирэх, хад хавцлыг хагалан гарч ирэх зэрэг өгүүлэмжүүд нь эгэл жирийн бус эзэн савдгийн шинжтэй ба Хөхөө Намжилыг нутагтаа очихыг хүсэхэд лусын дагина гэнэт алга болж, түүний байсан газар нь эмээл хазаартай морь эзнээ хүлээх шиг газар цавчлан зогсох дүрслэлээс этүгэн эхийн дүр маань уул ус, лус савдгийн эзэн хэмээх олон дүрд хувилж, хувилбарт домгуудыг үүсгэснийг харж болно. Энэхүү монгол хүний сүсэг бишрэл, итгэл үнэмшлээс төрсөн этүгэн эхийн дүр нь одоо ч аман зохиолын бүхий л төрөлд оршсоор байгаагийн илрэл нь Хөхөө Намжилын домог дахь эдгээр эм үүтгэлт дүрүүд болно.

Үүнээс үзэхэд монголчуудын итгэл бишрэлийн сэтгэлгээ нь ямар нэгэн хийсвэр ухагдахууныг бодитой болгон ахуй амьдралдаа буулгаж, амьдчилан үзээд түүндээ сүслэн биширч, сэтгэлийн их таашаалыг хүртдэг болохыг мэдэж болно.

В. “Хөхөө Намжилын домог” дахь монголчуудын бэлгэдэл сэтгэлгээний тусгал

Монголчуудын бэлгэдэл зүй, бэлгэ тэмдгийн ертөнцтэй танилцсанаар тэдний биет болоод биет бус соёлын өвийн онцлогийг таньж мэдэх, улмаар монгол утга соёлын нууцын чанадад нэвтрэх боломжтой. Энэ хэсэгт Хөхөө Намжилын домог ярианд илэрсэн монголчуудын бэлгэдэлт сэтгэлгээг өнгө ба тоо гэсэн хоёр талаас шинжилье.

1. **Монголчуудын өнгийг эрхэмлэх бэлгэдэлт сэтгэлгээний тусгал.** Байгаль, нийгэм, хүмүүний оюун санааны ертөнцөд өнгөөр тэмдэглэж үл болох юм үзэгдэл гэж бараг үгүй. Иймд монголчуудын эртнээс шүтдэг шүтээнээ өнгөөр хэрхэн дохиолж ирсэн язгуур сэтгэлгээг судалж үзвэл “Цагаан өнгөөр бөөгийн онгодын сэтгэлийг, хөх өнгөөр тэнгэрийг, ногооноор лусыг, улаанаар нар, галыг, хараар савдаг шивдэг” гэх мэтчилэн төлөөлүүлдэг байжээ [30]. Морин хуурын үүслийн домогт хар, ногоон, улаан, шар зэрэг өнгөөр дүрүүдээ тодотгох ба тухайн өнгөний бэлгэ чанарыг дүрийнхээ уугал чанартай хамтатган итгэл үнэмшил, сүсэг бишрэлийн амьд дүр болгон домогложээ. Тухайлбал: лусын хүүхэн, ногоон торгон дээлтэй охин, хар ногоон хүлэг морь зэрэг нь цөм лусыг төлөөлж буй. Лус гэдэг бол ус, усны эзэн. Газар эхийн биеэр ус хэмээх амин судас гүйж, биеийг сэргээж, нөхөж байдгийн адилаар хуурын сайхан ая эгшиг хүн бүрийн сэтгэлийн шаналал, уйтгар гунигийг үргээж, баяр баясал бэлэглэх хөгжимдүүр болж байна. Иймийн тул лус хийгээд түүнтэй холбоотой дүрүүд гол дүрийн залууд ямар нэгэн байдлаар нөлөөлж, морин хуур үүсэхэд гол шалтгаан болж байна. Нөгөө талаар ногоон өнгийг газар дэлхий, үржил шим, хайр сэтгэлийн бэлгэ тэмдэг гэж үздэг тул хүлэг морио хүндлэн хайрлахын учир дахин амилуулан, сэтгэл зүрхэндээ оршоож, нийгэм нийтэд түгээн дэлгэрүүлэх аялгуу сайхан ая эгшигийг бүтээж байна. Мөн ногоон өнгөөр “өвс ногоо, цэцэг навчны урган төлжих, цэцэглэн дэлгэрэх” [31] цаг хугацааг илэрхийлдгээс урин дулаан зуны дэлгэр цагт домгийн үйл явдал өрнөж буйг анзаарч болох юм.

Улаан өнгийг монголчууд эртнээс нааш халуун дотно, баяр баясгалан, баатар зориг, сүр жавхааг илтгэдэг гэж бэлэгшээж ирсэн. Домог дахь “Алтайн дагина элгэн улаан хадыг хагалж гарч ирдэг” [32] өгүүлэмж нь улаан өнгөт хад чулууг ер бусаар шүтэж ирсэн монгол хүний сэтгэлгээн илрэл юм. Судлаачид “Улаан өнгөт хад чулууг шүтэх нь балар эртний хүмүүсийн ан агналын соёлоос үндэстэй гэж таамагласан байдаг. Тэд хүн амьтны сүнсийг цусанд байна гэж үздэг. Цус бол улаан өнгөтэй. Тэгэхээр улаан өнгөт хад чулууг хүн амьтны сүг сүнс буюу эзэд сахиус оршиж байх онцгой юм хэмээн шүтдэг” [33] хэмээснээс харвал элгэн улаан хадыг хагалж гарч ирж буй дагина бол монголчуудын бүтээсэн эзэн сахиусын бэлгэдэлт дүр яахын аргагүй мөн.

Хар өнгө бол домог яриан бас нэгэн чухал дүр болох амраг хоёрыг учруулж, хонгор хоёр зүрхийг баясгахад хүчээ өгч байсан хүлэг морины зүс юм. Энэ хүлэг морь нь ихэнхдээ хар буюу хилэн хар гэж дүрслэгддэг. Монгол утга соёл судлаач С.Дулам “Бэлгэдэл зүй” бүтээлийнхээ “Өнгийн бэлгэдэл” хэсэгт “Төрийн харуул хайчийн хүнд албанд зүтгэгсдийн буюу хар яст харц хүний унах хүлэг нь тас тэмдэггүй хар морь байдаг” [34] гэж тодорхойлсон нь Хөхөө Намжил бол цэргийн албанд татагдсан ядуу залуу юм гэдгийг давхар баталж өгсөн билээ. Мөн эртнээс “Хар өнгө бол хүч чадал, эрэлхэг баатар, цог жавхаагийн бэлгэдэл” [35] болж ирсэн болохоор жонон хар мориог домог яриандаа амилуулан бүтээж, цаг хугацаа, орон зайг товчилдог увдист дүр болгон бэлэгшээжээ. Харин хувилбар 7-д лусын охин сайн хул морио ядуу залууд бэлэглэдэг. Хул морь гэж санамсаргүй хэлсэн зүйл биш бөгөөд “Алтан (цагаан) яст хан ноёдын сурвалж бүхий хүний хүлэглэдэг хүлэг нь алтан шарга(л), аранзал зээрд, халиун, хонгор, хул зэрэг гэгээн зүсмийн морьд байдаг” [36] хэмээх тодорхойлолтыг баталж байна. Энэ мэтчилэн монголчуудын өнгийг эрхэмлэх, түүнийг бэлэгшээн үзэх сэтгэлгээ нь домогт далд утга санаагаар оршиж, анхдагч төсөөлөлтэйгээ үндэс язгуур холбоотой байсаар байгааг харуулж байна.

Монголчуудын тоог эрхэмлэх бэлгэдэлт сэтгэлгээний тусгал. Монголчууд “тэгш тоог энэ ертөнцийнх, сондгой тоог нөгөө ертөнцийнх” гэж сэтгэх ёс байдаг. Морин хуур нь бүхэлдээ нэгийн тооны бэлгэдэл. Учир нь хоёр хялгасан утасны нэг (“фа”утас) 150 ширхэг хар өнгөтэй азарганы хялгасаас бүрдэж, хоёр дахь нь (“си бемоль” утас) 120 ширхэг цагаан өнгөтэй гүүний хялгасаар бүрэлдэж, нумны утасны 90 ширхэг хялгастай нийлээд 360 ширхэг болдог нь нэгэн бүтэн тойргийн градусын тоотой тэнцэнэ. Бүтэн тойрог үүсгэж буй нь нэг буюу түүний бэлгэдэлт чанартай шууд холбогдох бөгөөд “андын барилдлагын эв санааны нэгдэл болон хам олны эв эе”[37]-ийг илэрхийлж байна. Чухамдаа домогт эзэндээ туйлын үнэнч хүлэг сайн морь, үхсэний дараа ч орхиж чадахгүй байгаа эзэн хүний сэтгэлийг эв нэгдэл, хам олны санаагаар гаргаж байгаа нь бэлгэдлийн утгаар ингэж тайлагдаж байгаа юм. Мөн морин хуур нь хоёр чих, хоёр тэвх, хоёр хялгастай байдаг ба тэдгээрийг хоёрын тооны бэлгэдэлт утга, арга билгийн хослол гэж ойлгож болох төдийгүй ахуй амьдралын бодит зүйл гэж хүлээн авч болно. Өөрөөр хэлбэл хазгай хэлтгийгүй, эв эе, арга билгийн бэлгэдэл болсон уг тоон утгаар Хөхөө Намжил хийгээд түүний үнэнч сайн нөхөр хүлэг морь, мөн Хөхөө Намжил хийгээд нэгэн эмэгтэй гэсэн хослолуудыг харуулж, хорвоо ертөнц бол аливаа зүйлийн хослол, хамтралжил байдаг гэсэн санааг илтгэж байна.

Түүнчлэн монгол ардын бэлгэдэл зүйд гурвын тоогоор цаг хугацааг хэмжих, болзох, ажил үйлийн бүрдлийг илэрхийлэх бөгөөд эдгээр хувилбаруудад гурвын тоо олонтаа давтагдана. Тухайлбал, хүлэг морио үхсэний дараа 3 жил сахин суутал гэнэт амилах, гурван жил хуураа татаж хүлгийнхээ сэгийг эргэн үзсээр байтал суган дахь жигүүр нь гэнэт ургаж гүйцэх, эг сэггүй гурван долоо хорин нэгэн хоног хуураа татаж санаа болж суухад нь лусын хүүхэн нь ирээд аваад явах зэргээр өгүүлж буй нь аливаа юмны охь шимийн бүрэлдэх цаг хугацааг хэмжих дээрх санааг далд утгаар илэрхийлж байна.

Дүгнэлт

Морин хуурын үүсэлтэй холбогдох 50 гаруй домгийн хувилбаруудыг цуглуулан, харьцуулж үзээд “нисдэг хүлэг морьтой нэгэн залуу хорон санаатны гарт түүнийгээ алдаад, гашуудан харуусахдаа морин хуур хөгжим урлаж байгаа” гол мотивтой Хөхөө Намжилын домгийн 15 хувилбарыг түүж авав. Уг домгуудын агуулгыг хураангуйлбал “амь – үхэл – итгэл” гэсэн гурван зүйл дээр зангилагдах бөгөөд тэд бүгд нэгэн домгийн хувилбар болохыг үйл явдал, өгүүлэмжээр нь баталлаа. Зарим хувилбарын тухайд Хөхөө Намжил бус нэгэн идэр баатар, архичин залуу гэх зэргээр гардаг боловч “хүлэг морь нь жигүүрээ хайчлуулсан тул үхэж, эзэн нь харуусахдаа морин хуур урлаж байгаа” гол өгүүлэмжээ хадгалан үлдсэн тул тус домгийн хувилбарын баталгаа гэж үзэж байна. Мөн хувилбар 14,15-д яг эсрэгээрээ домгийн үйл явдал ижилхэн өрнөх боловч жигүүрт мориных нь жигүүрийг хайчилсны дараа морин хуур хийж байгаа төгсгөлийн мотив нь үгүй. Гэсэн хэдий ч гол дүр Хөхөө Намжил, лусын дагины хийж байгаа үйлдлүүд нь тус домгийн хувилбар болохыг илтгэнэ. Мөн эдгээр домог нь Монгол улсад үүсээд Өвөр монголд тархсан болохыг эх сурвалжийн мэдээллээс тогтоов.

Түүнчлэн эцэг тэнгэр, эх дэлхий, уул усны лус савдаг болон аз хийморийг бэлгэдэх жигүүрт хүлгийн дүрийг ахуйчлан бүтээж, түүнийгээ шүтэн бишрэх, аргадан залбирах сэтгэлгээгээ домог яриагаар уламжлуулан дамжуулахдаа олон хувилбарт дүрийг бүтээсэн болох нь тодорхой байна. Мөн эзэн - хүлэг хоёроор эв эе, хам цуг, аливаа зүйлийн хослол, хамтралжил зэрэг “нэг, хоёр”-ын тооны утгат чанарыг бэлгэдэхийн зэрэгцээ цаг хугацааг гурваар хэмжин бүрдэл боловсролын утгыг илтгэх өгүүлэмж давтагдаж байгаа нь нотлогдож байна.

Хөхөө Намжилын домгуудын дүр, мотивыг ингэж харьцуулан судалж, нэгтгэн шинжилсэн нь аман зохиол судлалд анхдагч бөгөөд цаашид бусад домгийг нарийвчлан судлах суурь судалгаа болж байгаагаараа ач холбогдолтой.

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AN ANALYSIS OF THE MENTALITY FOR MONGOLIANS' SYMBOLISM BASED ON THE MYTH OF "KHUKHU NAMJIL"

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Abstract

Analyzing the symbolic mindset from an overview of the content of any myth is an expression of essence from phenomena, and it will be an important tool for determining the characteristics of the nation's mentality. Therefore, many legends of the origin of the Morin huur (Horsehead fiddle) were collected and compiled in the course of my research; then 15 selected myths which are called similar versions of Khuhu Namjil tied to the main motif with the main idea of "A young man who lost his magical flying horse to a villain was depressed and made fiddles for him" were confirmed that it's the same version of the same myth in terms of their main content, narrative, and characters. Accordingly, this research mainly used historical material, genre division, text analysis, motif, and comparative study methods.

In order to analyze the symbolic mentality of the Mongolians from the myths by using some theories of ritual, cultural studies, and aesthetics, it was analyzed and determined that "the characters of the horse with the wings of desire and the mother "Etugen" were created in their world of intellection". These characters are represented by the legendary "Jonon" black horse, flying winged horse, mermaid, and "Altai"s maiden and it was proved from the content that the abstract concept of spirit is believed to be as a winged horse, and the talisman of the owner of mountains and springs has been worshiped as a mermaid and a fairy for ages. In addition, it has been proved that the symbols of colors (such as green color representing "Lus" or the owner of Springs, black color as civilian, bravery, and splendor, and red color is as warmth and joy) and numbers (one, two, three) were created from Mongolian people's devotion and belief are reflected in the legend by using the events and the narratives in it.

Basically, by deepening and expanding the scope of the study of the legend of the fiddle, which previous researchers studied, and by clarifying the meaning of the event and the ideology or mindset of the characters, it is not only innovative but also brings one step closer to the further research of the legend related to the origin of the fiddle thus, the results of this research are significant and a pioneer in the study of fiddle mythology.

Key words: Legend of Khukhoo Namjil, the horsehead fiddle, the mentality of Mongolians' symbolism



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HISTORY OF DEVELOPMENTS IN GEOPOLYMER SCIENCE IN NEW ZEALAND: A BRIEF REVIEW.

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Abstract.

This brief review covers some of the highlights of the research into the chemistry and various applications of aluminosilicate geopolymers carried out in the Chemistry Department of Victoria University of Wellington over the last 20 years. Because these materials are generally amorphous to X-rays, the technique of Nuclear Magnetic Resonance with Magic Angle Spinning (MAS NMR) played a unique and important role in these studies. Many potential applications of geopolymers, were investigated over this period, including their use as structural materials, catalysts for commercially important organic reactions, bioactive materials and photoactive materials. Most of the initial work was carried out on clay-based starting materials because of their purity, but more practical materials were also developed, based on the by-products of industrial processing (fly ash, blast furnace slag, red mud, etc) This work led to more than 62 published papers in international journals, some of which are discussed here.

Keywords: Geopolymers, Clay minerals, Solid state MAS NMR,



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A brief summary

Geopolymers, or inorganic polymers as we have preferred to call them because their origins are not necessarily from geological materials, were described by Joseph Davidovits [1] as X-ray amorphous materials formed by reacting dehydroxylated kaolinite clay with alkali. These materials were described by Davidovits as “sialates”, containing “siloxo” Si-O-Si units. This use of sialate terminology is confusing however, as the term had been used since the 1950’s to describe the salts of 9-carbon monosaccharide acid (sialic acid), and for this reason our group adopted the name “inorganic polymers” for these materials. Following the work of Davidovits, most of our initial studies were on clay-based materials, produced by the reaction of an alkali or alkali silicate with dehydroxylated kaolinite [3,4] or a mixture of silica fume and alumina [5], with the aim of producing pure products for advanced applications. However, we quickly realized that these clay-based materials are related to building materials reported much earlier, produced by reacting blast furnace slag or fly ash with alkali [6], and some of our later studies were on the formation and properties of geopolymers from fly ash [7,8,9], volcanic ash [10a,b] and water treatment residue [11]. A useful property of the geopolymers from water treatment residue was their ability to immobilize heavy metal contaminants in waste water [12].

The initial studies of our research group in Wellington were directed towards determining the atomic structure of metakaolinite-based geopolymers. Since these are X-ray amorphous, an analytical technique was required that did not depend on the crystallinity of the sample. Such a technique is solid-state nuclear magnetic resonance spectroscopy with magic-angle spinning (MAS NMR). This technique is also specific to a particular element in the structure, in this case Si and Al, and showed that both structural Si and Al are in tetrahedral coordination with oxygen [3]. Since the Al in the starting kaolinite is in octahedral coordination with oxygen, the charge imbalance accompanying the formation of a geopolymer must be compensated by the incorporation of hydrated cations from the activating alkali (commonly Na⁺, as confirmed by ²³Na solid-state MAS NMR [3]), but we showed by ³⁹K MAS NMR spectroscopy [4] that other monovalent cations such as K⁺ can also play a charge-balancing role. This proposed structure is shown in Figure 1.

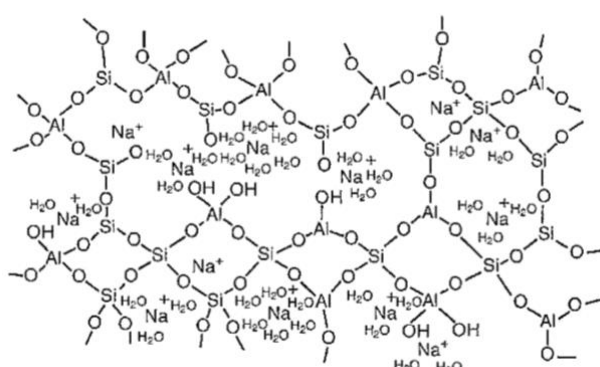


Fig.1. Proposed geopolymer structure based on MAS NMR measurements.

Further investigations showed that a much wider range of charge-balancing cations can be exchanged into the geopolymer structure, with complete exchange of Na by Ag^+ , NH_4^+ and Pb^{2+} , and a lower degree of exchange by Li^+ (82%), Cd^{2+} (78%) and Mg^{2+} (57%) [13]. The NH_4^+ form is particularly important as the starting compound for the incorporation of a number of other ions such as Eu^{3+} , Sm^{3+} and Mn^{3+} , to form geopolymers with photoluminescent properties [14,15].

Some of our early research was based on the premise that geopolymers might be formed containing tetrahedral units such as BO_4 [16] or PO_4 [17] units in place of AlO_4 , and this was shown by ^{11}B and ^{31}P MAS NMR spectroscopy respectively to be the case. Furthermore, the chemical similarity between gallium and aluminium, and germanium with silicon led to our successful synthesis of a geopolymer partially substituted with gallium [18] and a germanium-substituted geopolymer [19]. These syntheses, and our demonstration of the ion-exchange properties of geopolymers give an insight into the versatility of these materials and opened up the possibility of a range of further applications. Although most of our geopolymer research was conducted on the 1:1 layer-lattice aluminosilicate mineral kaolinite, we also investigated a 2:1 aluminosilicate (pyrophyllite), and found that although thermal dehydroxylation of this mineral at 800°C was insufficient to disrupt the structure and form a geopolymer, high-energy milling resulted in 4, 5 and 6-fold aluminium coordination, and successfully formed a geopolymer at 60°C [20]. Our attempt to form magnesium analogues of aluminosilicate geopolymers from the 1:1 layer lattice magnesiosilicate chrysotile was successful, as shown by ^{25}Mg MAS NMR, as was the product from chrysotile, but the 2:1 layer lattice mineral talc proved to be particularly resistant to geopolymerization [21].

One of the drawbacks to any application of geopolymers is that they fail in a brittle mode, a typical characteristic of inorganic materials. To overcome this problem, we have investigated embedding various types of fibres in a metakaolin-based geopolymer matrix. These unidirectional fibres include basalt [22] and the natural fibre New Zealand flax (phormium tenax); the incorporation of 10wt% of this fibre increased the flexural strength of the geopolymer from 5.8 MPa to about 70 MPa [23]. The effect of incorporating either coarse carpet wool or finer Merino wool fibres into a geopolymer was found to be improved by pre-treating the wool with formaldehyde which increased its resistance to the alkaline environment and produce a 40% improvement in the flexural strength of the geopolymer [A number of our geopolymer studies exploited their ability to support photoactive species, including Cu_2O nanoparticles [25] and a composite of $\text{TiO}_2+\text{Cu}_2\text{O}$ [26]. The latter was shown to efficiently destroy hazardous organic pollutants in wastewater [27]. The catalytic properties of geopolymers were also extensively investigated, and these materials were shown to act as environmentally benign solid acid catalysts in heterogeneous organic reactions such as the Beckmann rearrangement of cyclohexanone [28] and Friedel-Crafts alkylation reactions [29]. These model reactions were carried out using metakaolin-based geopolymers, but in view of the fact that fly ash geopolymers are cheaper and more practical starting materials, a series of Friedel-Crafts benzoylation reactions was carried out using fly ash geopolymers, with excellent yields [30]A number of other potential applications for geopolymers were investigated by our group. These included their possible use as colour-change humidity indicators by incorporating the acid-base indicator thymol blue which showed a promising reversible colour change from light tan (in the dry state) to deep blue in the damp state, reflecting the change in pH of the geopolymer as it lost or gained moisture [31].

Since the porosity of a metakaolinite-based geopolymer can be controlled by controlling its composition, especially its H_2O/Al_2O_3 ratio, a potential application for porous geopolymers produced in this way was proposed as a means of counteracting heat island effects in hot climates. These porous materials were developed to act as passive cooling systems by exploiting the latent heat of evaporation of water [32]. Another method for generating porous metakaolin-based geopolymers developed by our group involved incorporating polylactic acid fibres in the uncured geopolymer. The aligned PLA fibres were decomposed under the alkaline conditions during curing and drying of the matrix, producing an aligned pore structure [33].

The group also investigated the possibility of using geopolymers as stationary phase media for column chromatography. These materials were found to produce excellent separation of three model aromatic compounds, and their performance compared very favourably to other commonly used chromatography media. Furthermore, they were chemically stable to strong column-cleaning solvents and could be re-used [34].

Another interesting geopolymer application developed by our group was their use as precursors for the carbothermal reduction and nitridation (CRN) synthesis of advanced SiAlON ceramics. A mixture of kaolinite-based geopolymer and carbon was heated to $1400^{\circ}C$ under a nitrogen atmosphere, and the presence of the charge-balancing cations in the geopolymer produces a mixture of β -SiAlONs of low and high z-value [35].

In a study of potassium aluminosilicate geopolymers containing 10 wt% of calcium hydroxide, calcium phosphate or calcium silicate, these calcium-containing samples were exposed to simulated body fluid (SBF) to determine their behaviour as potential bioactive materials for bone repair. The alkalinity of the samples was lowered by heating to $600^{\circ}C$, but they were otherwise unchanged, as shown by ^{29}Si and ^{43}Ca MAS NMR spectroscopy. All these samples formed calcium phosphate upon reaction with SBF, and the concentrations of Al leached from the samples were acceptable for use as biomaterials. The strengths of all the samples was adequate for biomedical applications, but that of the $Ca_3(PO_4)_2$ sample was slightly greater, making it the more promising material [36]. This brief summary covers only a small part of the work of the New Zealand geopolymer group over the last 20 years, but more extensive details of our work in several of these research areas can be found in the book chapters [37-43] and summarised in Figure 2.

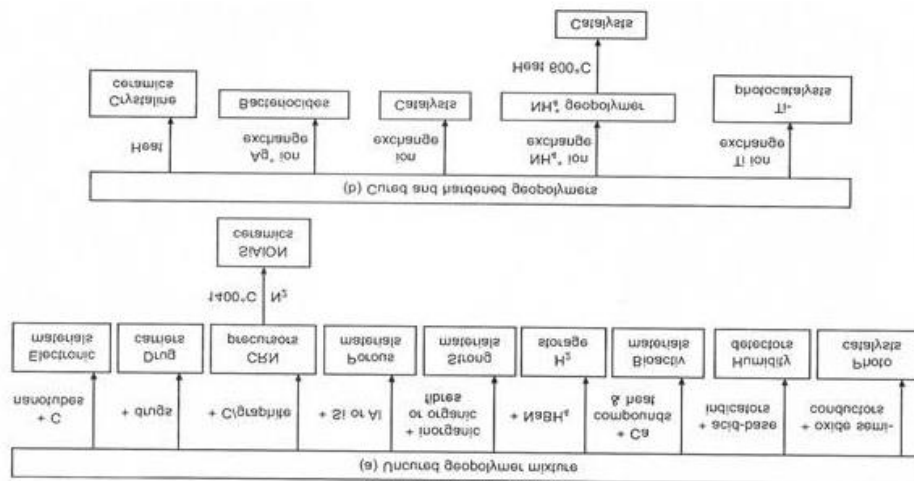


Fig.2. A brief summary of geopolymers application.

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FACILE SYNTHESIS OF ORGANOSILOXANE-MODIFIED HYDROPHOBIC GEOPOLYMER THROUGH PEPTIZATION OF POLYDIMETHYLSILOXANE

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Abstract

We report a scalable, facile synthetic process for hydrophobic geopolymer containing organosilane. Using polydimethylsiloxane (PDMS) as an organic precursor, the surface of sodium and potassium geopolymers of varying precursor composition was functionalized with degraded PDMS oligomers by first partially hydrolyzing PDMS in a hot, concentrated NaOH or KOH solution and subsequently by undergoing geopolymer synthesis with metakaolin. Both types of geopolymer yielded nonporous hydrophobic materials with external surface areas of 0.6475 and 4.342 m²/g for sodium and potassium geopolymer, respectively. The materials showed an oil capacity of 75 and 134 wt%, respectively. X-ray diffraction patterns of the samples indicate that the PDMS functionalized sodium geopolymers contain zeolite A and sodalite, while the potassium geopolymers were amorphous with two overlapping broad humps in contrast to the typical geopolymers.

Keywords: metakaolin, geopolymers, synthesis, surface modification, zeolites, amorphous structure



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Introduction

The production of organic/inorganic hybrid materials, such as organically modified silicates (ORMOSILs), is a major emerging field within materials chemistry [1]. The possibility of creating such materials within geopolymer research has been relatively less explored. Geopolymers are inorganic nanomaterials that consist of highly porous amorphous aluminosilicate frameworks with smaller aluminosilicate clusters on the nanometer scale [2-5]. Given that the geopolymer synthesis closely resembles the sol-gel chemistry of silica, we suspect that it would be possible to create a new type of geopolymer-based organic/inorganic hybrid materials. Indeed, the production of such materials has been reported by using various crosslinking silanes [6, 7], as well as oligomeric polysiloxanes [8].

In contrast to the readily crosslinking silanes, the incorporation of chemical-resistant siloxanes into geopolymer network structure is more challenging but would provide a new way of utilizing used silicone oil, polydimethylsiloxane (PDMS). Approximately a half million tones of silicone oils were produced in 2018 [9], but silicone oils have a low recycling rate because it does not meet the same refining and performance standards as unused oil. Disposal to landfills is not ideal as it does not decompose in the natural environment, and its high thermal stability makes it inefficient to depolymerize and upcycle [10]. The production of geopolymer is highly scalable and the ability to incorporate potentially used silicone oil gives these materials potential for sustainable large-scale application. Using recycled silicon oil in the proposed geopolymer materials would increase the recycling rate of the oil while also providing the material its hydrophobic character.

Our specific synthetic approach for geopolymer/PDMS hybrid material involves first heating and stirring PDMS in a strong alkali solution. Under such conditions, PDMS can be hydrolyzed into smaller oligomers with anionic ends [11]. Metakaolin (a calcined kaolin clay) powder is added to the PDMS/alkali solution and homogenized using a high-shear mixer. After homogenization, the mixture is heated in a closed container at 90 °C to form the PDMS-functionalized geopolymer product. Finally, the product is filter-washed with water, ethanol, and toluene to remove any excess organics and then dried for further characterization.

Experimentals

Synthesis

For the potassium geopolymer, samples were prepared by dissolving the precursor potassium hydroxide (Sigma-Aldrich; ACS reagent, $\geq 85\%$) in 200 mL of ethanol (Sigma-Aldrich; ACS reagent, $\geq 99.5\%$). The solution was added to the PDMS (Sigma-Aldrich; poly(dimethylsiloxane), hydroxy terminated: viscosity ~ 65 cSt) in a sealable bottle and stirred at 80 °C for 24 hours. The solution was then placed in the rotary evaporator with an 80 °C bath and 120 rpm rate to remove the ethanol. After evaporation, the PDMS and potassium hydroxide were added to a beaker containing the precursor water. The shear mixer was used to stir the solution at 200 rpm while the metakaolin powder (BASF, MetaMax[®]) was slowly added until homogenous. Once all the metakaolin was added, the mixing rate was increased to 600 rpm and allowed to continue for 40 minutes. Equal parts of the mixture were then put into two centrifuge tubes and placed in a 90 °C oven. One half of the total mixture was heated for 24 hours and the other 72 hours. After heating, each sample was filter washed with water, ethanol, and toluene to remove excess alkali and organic chemicals. The same procedure was repeated for the sodium geopolymer samples, replacing the potassium hydroxide with sodium hydroxide

(Sigma-Aldrich; ACS reagent, $\geq 97\%$). **Table 1** shows the nominal compositions of every prepared sample in addition to the silicon source ratios.

Table 1. Nominal molar ratios of precursor mixtures with respect to aluminum and the molar ratios of the silicon sources, metakaolin and PDMS.

Molar Composition				Si Source Ratio (metakaolin:PDMS)
Na/K	Al	Si	H ₂ O	
4	1	3	22	1:2
4	1	2	28	1:1
3	1	2	24	1:1
3	1	4	32	1:3
3	1	2.7	15	1:1.7
2.5	1	2	22	1:1
2	1	2	20	1:1

Characterization

The geopolymer powders were created into disk-shaped pellets using a hydraulic press pelletizer. As pellets, water drops were placed upon their surface to observe the hydrophobicity of each sample. The samples that absorbed the least amount of water were selected for further analysis. Gas sorption analysis was conducted on the most hydrophobic composition to determine the porosity and surface area of the materials. SEM images of those samples were taken in tandem with EDX analysis to analyze the microstructures of each sample. The oil capacity of these samples was measured using dibutyl phthalate as the oil. Droplets of oil were slowly added to a known mass of geopolymer powder by using spatula rub-out test (ASTM D281-12(2021)). The powder was mixed with the oil after every droplet, and the addition stopped when no more oil was being absorbed by the sample. XRD analysis was conducted on the materials to determine if they had any crystal structure. This allowed for a comparison of the effects nominal molar composition and reaction time had on the final structure of the materials.

Results and Discussion

Success at functionalizing the surface of geopolymer with organic silane saw its first indication with the hydrophobic nature of the powder product created from the new synthesis procedure. Forming the powders into pellets allowed for more consistent and reliable observation and comparison to determine which molar compositions created the most promising products. By creating pellets out of the PDMS-modified geopolymer, the hydrophobicity of each composition could be observed. It was found that the 3:1:4:32 nominal composition produced the most hydrophobic material. The sodium-containing sample of the most hydrophobic composition is shown in **Figure 1**. The oil capacity measurement was conducted on the most hydrophobic composition for the 24-hour reaction time samples. The

materials showed an oil capacity of 75 and 134 wt%, respectively, for the sodium and potassium geopolymers.

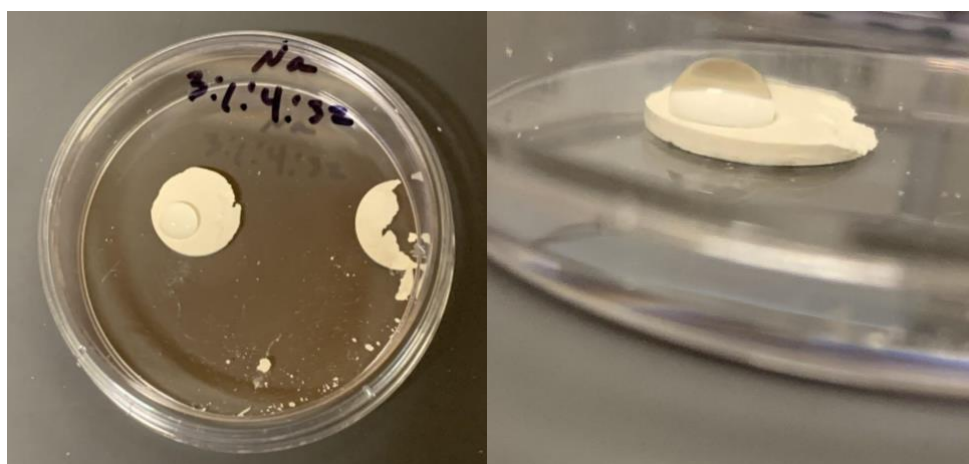


Fig. 1. Image from above and from the side of a PDMS-modified sodium geopolymer pellet with nominal molar composition 3:1:4:32 that was cured for 24 hours.

The gas sorption analysis was conducted on the most hydrophobic composition for both the sodium and potassium geopolymers. Nitrogen was used to determine the BET surface area and BJH pore size and volume. The data for the 3:1:4:32 samples with 24 hour reaction time are shown below. Next steps involved determining whether the products with organics incorporated still had high surface area. The data in **Table 2** show very low surface areas for both sodium and potassium geopolymers functionalized with PDMS.

Table 2. Gas sorption data for the 3:1:4:32 PDMS modified geopolymer compositions with 24-hour reaction time.

	BET Surface Area (m ² /g)	t-Plot External Surface Area (m ² /g)	BJH Desorption cumulative pore volume (cm ³ /g)	BJH Desorption average pore diameter (nm)
NaGP	0.65	0.88	0.001	9.0
KGP	4.3	6.4	0.02	15

Following the surface area analysis, SEM images of the most hydrophobic samples were taken. **Figure 2** shows images of the 3:1:4:32 compositions of sodium geopolymer and potassium geopolymer, respectively. The SEM images explained in part the observed low surface areas. Micron-sized particles were present in both types of organic modified geopolymer. In addition, thin sheet-like structures were present which indicated that there was unreacted metakaolin still present after the reaction supposedly reached a conclusion. The unreacted metakaolin was present in samples with 24-hour reaction times and 72-hour reaction times. These observations are in stark contrast to the previous reports on the production of

geopolymer nanomaterials with high surface areas in which no PDMS was used but with the same precursor compositions [12-15].

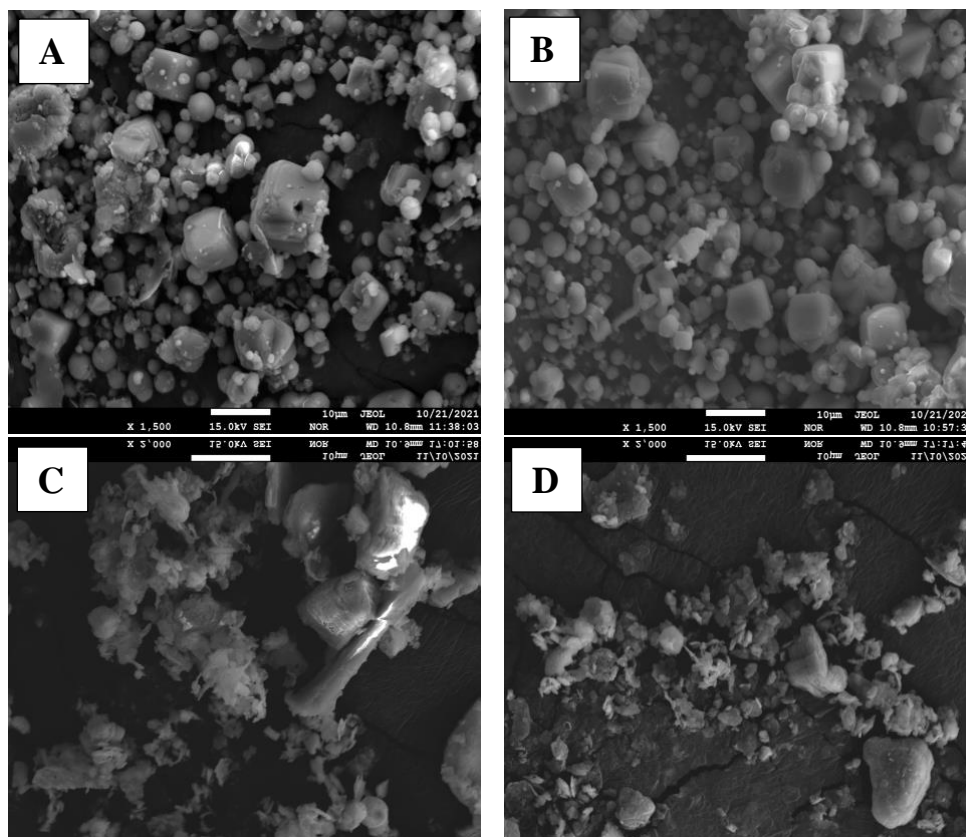


Fig. 2. SEM images of PDMS modified geopolymers with nominal molar composition Na(K):Al:Si:H₂O = 3:1:4:32. Pictured is sodium geopolymer with a 24-hour reaction time (A) and 72-hour reaction time (B) and potassium geopolymer with a 24-hour reaction time (C) and 72-hour reaction time (D).

Powder XRD patterns were obtained for all the prepared samples. Comparisons were made between different compositions and reaction times and it was found that there were few differences in diffraction patterns between different compositions and reaction times. In **Figure 3**, the patterns of the 4:1:2:28 and 2:1:2:20 samples were shown after 24 and 72 hours of heating, as representatives. The peaks of the patterns for sodium geopolymer were matched consistently to zeolite A and sodalite structures, as shown in Figure 4 for the sodium geopolymer of molar composition 4:1:2:28 after 24 hours of heating. It is noted that there is an appreciable amount of amorphous phases, judging from the uneven background, especially in the region of $2\theta = 20 - 30^\circ$.

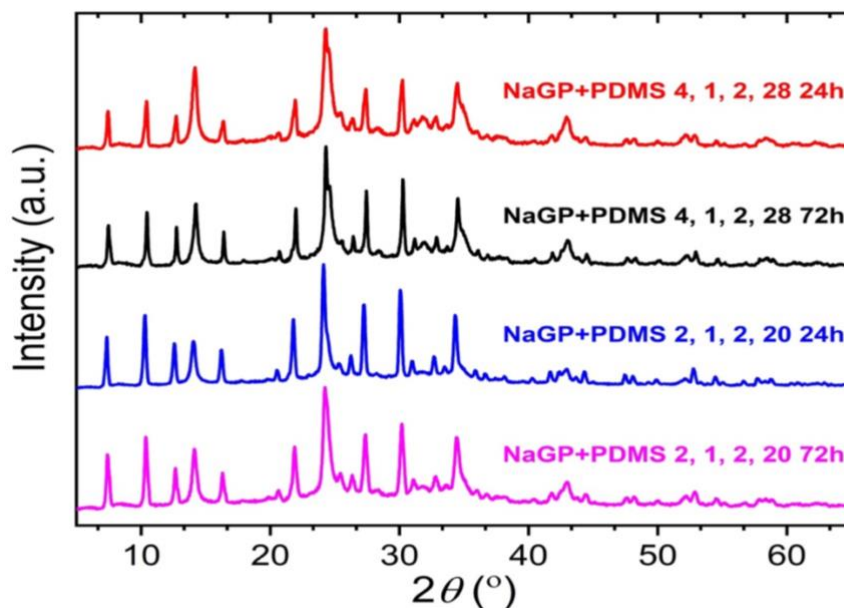


Fig. 3. Powder XRD patterns for the sodium geopolymer compositions with molar ratios 4:1:2:28 and 2:1:2:20.

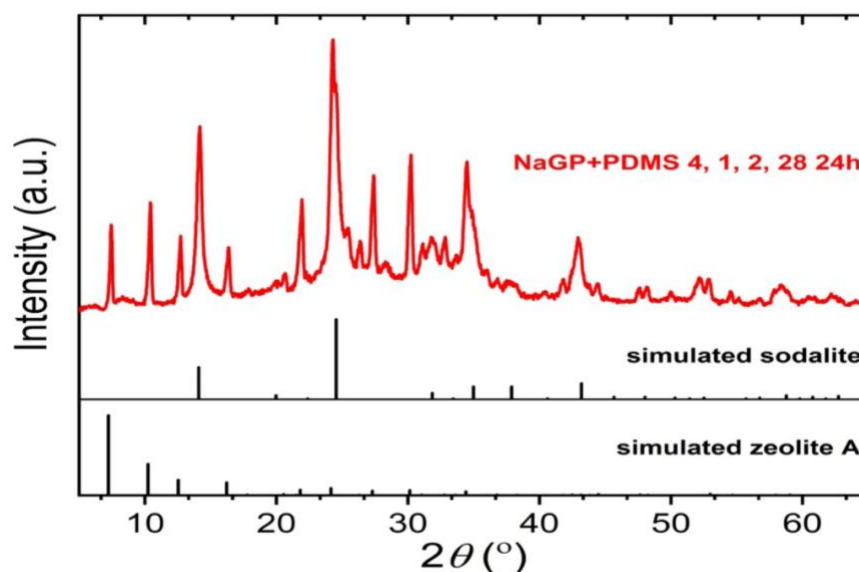


Fig. 4. Powder XRD pattern for the sodium geopolymer of molar composition 4:1:2:28 after 24 hours of heating, with reference peak positions for zeolite A (red) and sodalite (blue).

Meanwhile, all the powder XRD patterns of the potassium geopolymer samples showed that the products were amorphous. In **Figure 5**, the patterns of 3:1:4:32, 4:1:2:28, and 2:1:2:20 samples were shown after 24 hours of heating, as representatives. They show a broad hump with a maximum intensity at $2\theta \sim 29^\circ$ and a small shoulder around 26° . The maximum intensity position is slightly higher than the typical position (28°) found for a typical potassium geopolymer, while the shoulder corroborates the presence of unreacted metakaolin observed in the SEM studies (**Figure 2**).

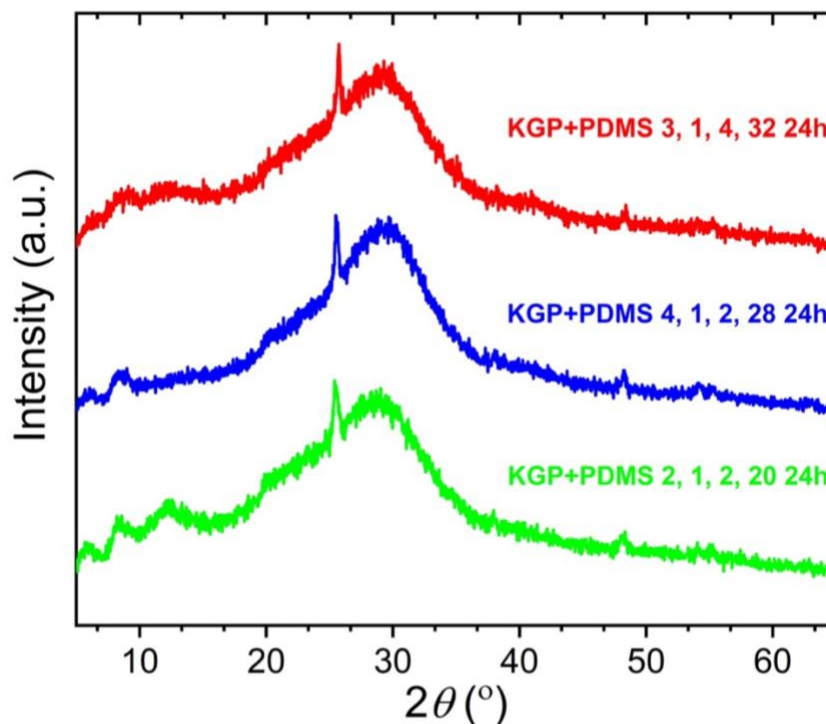


Fig. 5. Powder XRD patterns of the PDMS-modified potassium geopolymers with 24-hour reaction times and molar ratios of 3:1:4:32 (top), 4:1:2:28 (middle), and 2:1:2:20 (bottom).

Conclusion

We have shown that poly(dimethylsiloxane) (PDMS) polymer can be incorporated in geopolymer, imparting a hydrophobicity to the geopolymer, through a new scalable synthetic procedure. While the PDMS is highly stable against decomposition or hydrolysis, the pretreatment of the PDMS in ethanol at 80 °C allowed the production of reactive PDMS oligomers which subsequently blended with other geopolymer precursors. The products were in the form of powder particles that were highly hydrophobic, showing significant oil absorption capacity, although their external surface area is very small. The changes in the tested precursor compositions did not affect the nature of the products. The sodium geopolymer products were mainly zeolite A and sodalite, while the potassium geopolymers were all amorphous. The results are promising in the utilization of PDMS, including recycled PDMS, in the production of functional geopolymer materials.

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A THEMATIC REVIEW OF NEIGHBOURHOOD BUILT ENVIRONMENT FACTORS THAT AFFECT THE SENSE OF COMMUNITY.

The present paper was presented as an invited lecture at the ICE and Success, an International Conference.*

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ABSTRACT

Communities, being vital to human existence, provide members with a sense of identity and purpose. The physical environment of these communities plays a critical role in shaping this sense of belonging, warranting further investigation into this relationship. Despite some research indicating that the built environment influences the local community feeling, the specific aspects and their degree of influence remain largely unknown. This study aims to identify which physical features exert the most impact, and what factors need to be currently addressed. This study conducts a thematic analysis to explore how the built environment of a neighbourhood affects community sentiment, focusing on articles published between 2017 and 2023. The research materials were sourced from the SCOPUS and Web of Science databases based on specific inclusion criteria, with keyword searches yielding 37 peer-reviewed articles. Following a thorough inclusion and exclusion procedure, the final selection of 25 papers was compiled for assessment. Upon conducting a thematic analysis of the 25 selected papers, a total of seventeen physical elements were initially identified. However, so far, only eleven out of these seventeen physical parameters put forth by Kim & Kaplan have been used. These include clubhouses or recreation amenities, population density, the distance between sidewalks and residences, the diversity in types of housing, the overall street layout, lakes, greenways, street trees, landscaping, architectural style, the overall design quality of the residences, and block size. Moreover, it was found that aspects of the neighbourhood are associated with physical activity, satisfaction with the community, a sense of belonging, and the perception of one's position within the neighbourhood. Factors of urban landscape directly impact community contentment, sense of belonging, and perceived quality of life. Physical attributes correlate with levels of physical activity and the sense of community, while aspects of planning and policy are associated with community identity, belonging, and architectural aesthetics

influencing the sense of community. The codes presented in this paper elucidate the relationship between a neighbourhood's-built environment and the sense of community it fosters. The research contributes by examining this category and its variables, pinpointing specific themes within related topics across various publications. This analysis will offer valuable insights for future studies, particularly those focusing on communities within Malaysia.

Keywords: Neighbourhood, Built environment, Sense of community, ATLAS.ti 8, Thematic review, Variables.

*ICE and Success multidisciplinary, an International Conference dedicated to the 25th Anniversary of CITI University, was held on October 13, 2023, in Ulaanbaatar, Mongolia.



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INTRODUCTION

The built environment can greatly affect how individuals perceive their neighbourhoods. Their affinity for their community may increase when it is well-maintained, boasts appealing architecture, and abounds with green spaces. Additionally, community feelings can be nurtured by providing public places like parks and meeting points where people can gather and interact. It's necessary to research further into how the physical characteristics of communities can contribute to individuals' sense of community, given its significant impact. Findings from various studies indicate that the physical attributes of a built environment can shape the sense of community, though the specifics of this relationship remain unclear. Additionally, it's uncertain which specific features have the most persistent influence. While it's acknowledged that a community's sense of togetherness can be linked to different physical elements, it's yet to be determined which of these aspects is most recent and should be prioritized in future studies.

The basic proposition of this study is that the constructed environment in the area could be categorized, offering beneficial physical factors that can potentially impact the community feel. It investigates a thematic evaluation of how the built environment in neighbourhoods influences the sense of community, using a code-to-document examination method with ATLAS.ti 8 to analyse articles published from 2017 to 2023.

Due to changes in the business environment and increases in town population after World War II, several Southeast Asian countries had problems with urbanisation. New towns have developed in response to urbanization's problems. The Garden City in British author E. Howard's late 19th-century novel *Garden City* served as the model for the new modern area. This idea was popular around the world as a replacement for the urbanization-related poverty that dominates large cities [1]. Kuala Lumpur, the Malaysian capital, expanded because of population increase. The Malaysian government proposed new urban development plans to improve living and urban conditions. To accommodate the growing population of Kuala Lumpur, Petaling Jaya (PJ), Malaysia's first major township, was built beginning in 1953. According to British urban planning requirements, it was created based on a modern dream metropolis [2]. Following Petaling Jaya's growth in the 1950s, various new communities farther from Kuala Lumpur grew rapidly in the 1990s. Bayan Lepas, Minden, and Batu Kawan are in Penang, whereas Subang Jaya, Shah Alam, Bangi, and Klang are all in the Klang Valley. Skudai and Pasir Gudang were developed to the south of Johor Bahru [3].

New Urbanism and Neighbourhood

In the US, "New Urbanism" architecture and urban planning gained popularity at the turn of the century as a response to urban expansion [4]. New urbanism design principles may be advantageous for structures, parcels, blocks, cities, regions, communities, districts, and corridors [5]. The guiding principles demand planning growth into a variety of somewhat mixed-use, pedestrian, and transit-friendly neighbourhoods [6]. The Charter of the New Urbanism [7] lists the 10 essential design components of the New Urbanism, such as transit-oriented development, walkable urbanism, trains, and sustainability.

Sense of Community

People, places, and communities make up society. The communities in which people live and work have an impact on their social lives. By interacting, participating, acting, sharing interests, and resolving issues, people create norms of society and culture within their communities. People live in communities, which are made up of their homes, places of

worship, and places of business. The architectural characteristics of any community may reflect how its citizens see or express themselves, the environment in which they live, the social context in which they interact, and the impact that this has on the environment and communal life. Community psychologists contend that a community is a dynamic system with both structural and functional elements [8]. The [9] sense of community theory, depicted in Figure 1, was examined. This hypothesis included four characteristics of a community: shared emotional links, group membership, mutual influence, and shared ideals. These four elements may help to develop a vibrant community. Residents are more likely to feel secure and at home, engage in local events, and help one another out when they're in need when there are strong community links. It also helps to lessen stress in the community and enhances wellbeing, satisfaction with life, and self-esteem [10].

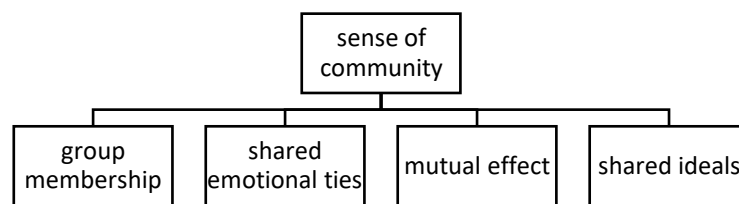


Fig. 1. Four characteristics among community members [9].

A sense of community (SOC), defined by [9], is the belief that each group member is essential to the success of the group and that their demands will be met because of their devotion to one another. Two distinct writers— [11], [12]—define the sense of community. According to [11], it is the attitudes that members of a community have about each other and the neighborhood. It was described by [12] as the sense of community and group identification that was formed via meaningful contacts with others. Only a few of the impacts at the neighborhood level that a vibrant neighbor community has been associated with include a fear of crime, community participation, and greater collective resilience [13].

In today's fast-paced environment, people usually prioritise their own goals and professional objectives over forging bonds with others around them. However, creating a sense of community in a community has several advantages that both a person and the community may enjoy. For instance, studies show that communities with a strong sense of community frequently have fewer crime rates and better security measures. A sense of community may also improve a person's mental and physical health. People who have strong relationships to their community are more likely to vote, recycle, assist others, and give [14] because these connections make them feel at home. Strong social links promote empathy, self-assurance, and fulfilment [15]. According to different research [16], [17] the basic requirements of the complex are satisfied, there is safety and security because of the family's continuing existence, and there are high-quality public and green spaces. By taking part in neighborhood events, volunteering their time to neighborhood organizations, and mingling with their neighbors, individuals may forge links and build a strong feeling of community. By performing something to benefit themselves and those around them, people may contribute to the creation of a comfortable and secure environment. In developing nations like Malaysia, there are now many housing developments being built. Given the importance of the local community's sense of community, which provides numerous benefits, this study is essential to developing a community which is both psychologically and physically healthy.

Neighbourhood built environment (NBE) factor and variables.

To get a response to the question on which aspect is current and requires examination in the most recent research. Next, a thorough analysis of the physical variables affecting SOC will be provided. According to the study, there are a variety of physical elements that influence the Sense of community (SOC). Among the well-known are [18][16], [18], [19] and more researchers. To determine the proper physical components for this study, various theories and physical factors in related theories should be mentioned first, followed by a study of the similarities between all of them. This section discusses the neighbourhood-built environment categorise that impacts the sense of community.

As stated by New Urbanist planning ideas [19], The way streets separate and connect a neighbourhood has an impact on the movements of people and activities inside that area, and one of its primary goals is to improve the sense of community [20]. [19] illustrates these concepts by showing how each of the four areas influences residents' feelings of community. By feeling at home (community attachment), connecting with others (social interaction), feeling a part of the community (community identity), and having access to local exploration (pedestrianism), residents can foster a stronger sense of community and [19] have disclosed that with physical features of the built environment contains both built environment variables (transport, safety and danger, overcrowding and privacy) and physical qualities (danger, crowdedness, privacy, and crowdedness). In their research, [19] looked at the impact of a total of seventeen (17) different physical features on people's feelings of belonging in a community. Residential density, lakes and greens paths, distance between sidewalks and homes are the first three variables. The 4th to the last variable being architectural style, continued with block size, clubhouse/recreational facilities, overall layout, street trees and landscaping the overall size, the arrangement of houses, street width, location of the garage, on-street parking, lot size, mixture of housing types, overall design quality of houses and finally, the street's layout.

[18] used three (3) main factors namely Aesthetics, Streets and services, and Buildings as shown in Fig. 2. Major attractions, aesthetic pleasantness, artists' involvement in building detailing, harmony, architectural style, and regional and distinctive features are some of the physical aspects that fall under the category of aesthetics. Streets and services, the second major factor, also has a few specific components, including a mixed-use neighbourhood, community services, accessibility, public parking, public transportation, walkable streets, activities like street vendors and squares, parks, services, and shops, as well as recreation. Other factors include the duration of residence, the availability of affordable housing, the building line, window sizes and solid-to-void ratios, the building frontage, human scale in high-rise buildings, and lower floors that are visually separated from the upper floors fall under the category of buildings. [21] applied the five (5) physical factors to examine the impact of urban form on community sustainability. Local stores are the most important component, followed by the length of shoreline in each neighbourhood, the prevalence of automobiles, the size of the housing size, and finally, residing in historic structures.

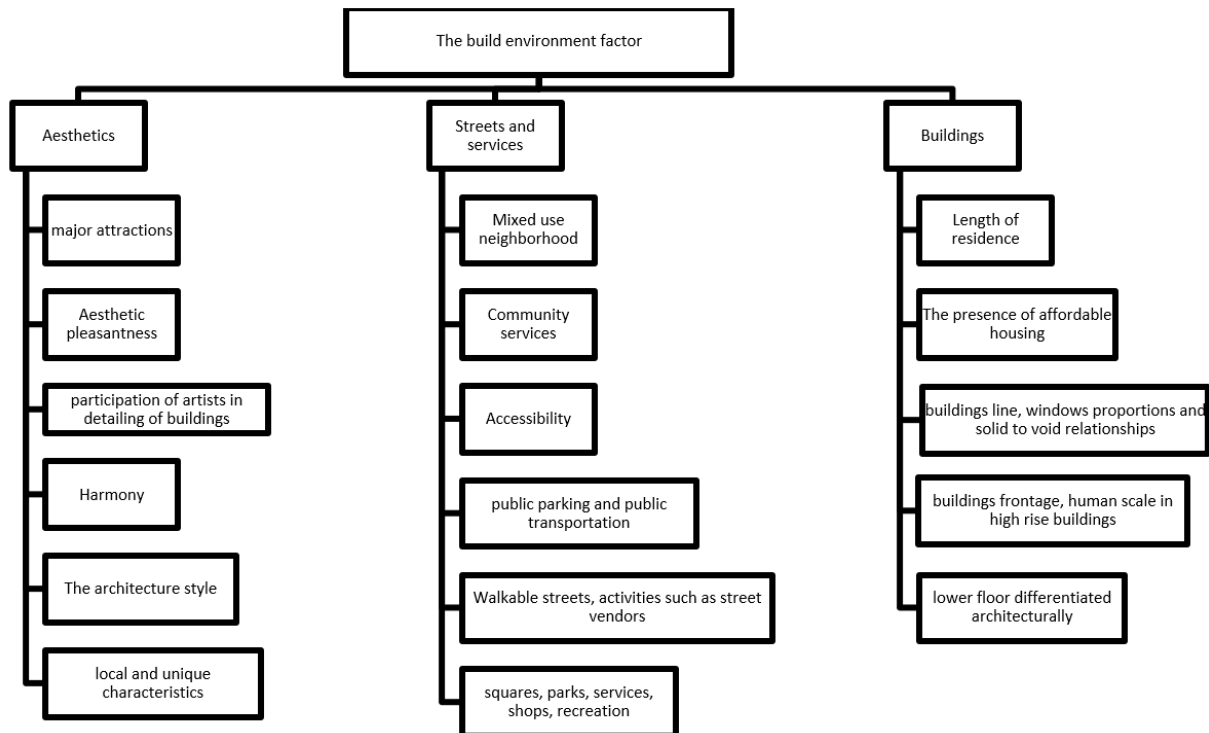


Fig. 2. The build environment factor. Adapted from [18]

There are some similarities among the researchers cited after examining several physical parameters that have an impact on SOC from various experts. To describe the similarity of related physical characteristics, [19] list of the major physical factors are employed. It was also chosen because the study by [19] listed seventeen (17) physical characteristics, the highest number among comparable studies.

Despite the surge in publications on the subject, no study article has addressed the most recent changes in the built environment's impact on community sense. The literature that addresses this issue from 2017 to 2023 will be highlighted in this article due to the significance that the built environment has on a sense of community. It also tries to address the following query:

RQ 1. Which physical aspects have the most influence and how many factors are still important that impact to the sense of community to adapt at this moment?

MATERIALS AND METHODS

The approach of this study utilises a theme analysis procedure in a literature review, leading to the name "thematic review" using ATLAS.ti 8 as the tool, as described by [22]. [23] define thematic analysis as the process of detecting patterns and developing themes and neighbourhood-built environment factors through extensive reading on the issue. The next stage is to determine the pattern and create a category to comprehend the trend of the built environment that influences the development of the sense of community in the country. The research tenets are to assess and interpret the data to recommend further research on the built environment that effects the subject's sense of community. The literature was chosen based on several criteria, including: 1) publication between 2017 and 2023; and 2) include at least one term (s) related to community, neighbourhood, and built environment.

Table 1. Search strings from Scopus and Mendeley

SCOPUS	<p>("sense of community" AND "neighbourhood" AND "built environment") AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "ARTS") OR LIMIT-TO (SUBJAREA , "PSYC")) AND (LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017))</p>	25 results
WoS	<p>"Sense of community" AND "neighbourhood" AND "built environment" (All Fields) and 2017 or 2018 or 2019 or 2020 or 2021 or 2022 or 2023 (Publication Years)</p>	25 results

The literature search was conducted in the areas of "sense of community" AND "neighbourhood" AND "built environment". 25 items from (SCOPUS) and 25 papers from (Web of Science) surfaced in the initial search. However, 7 articles were omitted because they provided erroneous conclusions and anecdotes, or they failed to address neighbourhood, built environment, and community sense. It was also discovered that several of the articles were overlapped, had broken links, or were either incomplete or unavailable in their entirety. The final paper to be reviewed has been reduced to 25 articles (table 1) due to the incomplete information. The main papers for the articles were uploaded to ATLAS.ti 8, and each paper was then categorised by 1) author; 2) issue number; 3) periodical, 4) publisher, 5) volume and 6) year of publication. By doing this, it will be possible to study the articles according to the year in which they were written and determine how the discussions have changed over time. The quantity of selected articles may be thoroughly analysed in this way using the suggested method. By categorising the study's country, number of yearly studies, word cloud to filter the most frequently used terms, and in-depth analysis of the topic or primary subject area, NBE that affects SOC, there are 25 final documents in ATLAS.ti 8, which represents the total number of articles that were finalised. Refer to Fig. 3.

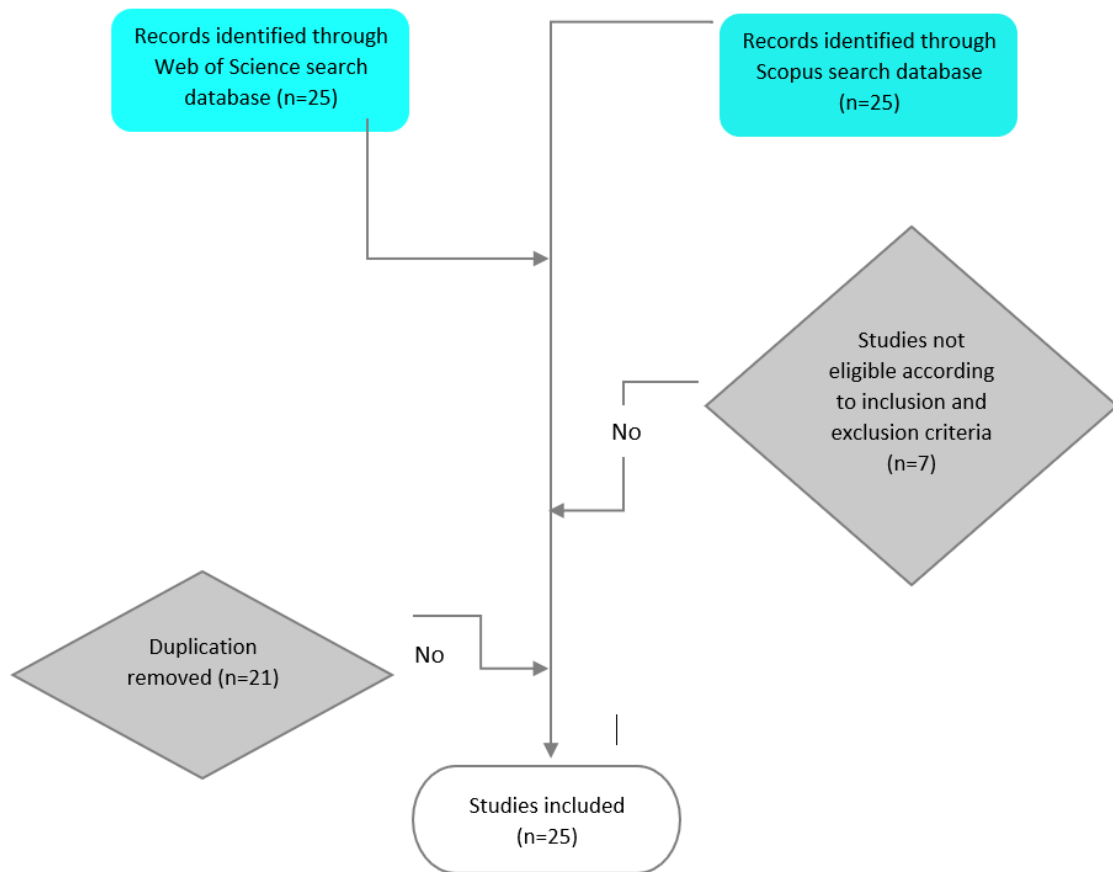


Fig. 3. Inclusion and Exclusion criteria in the thematic review

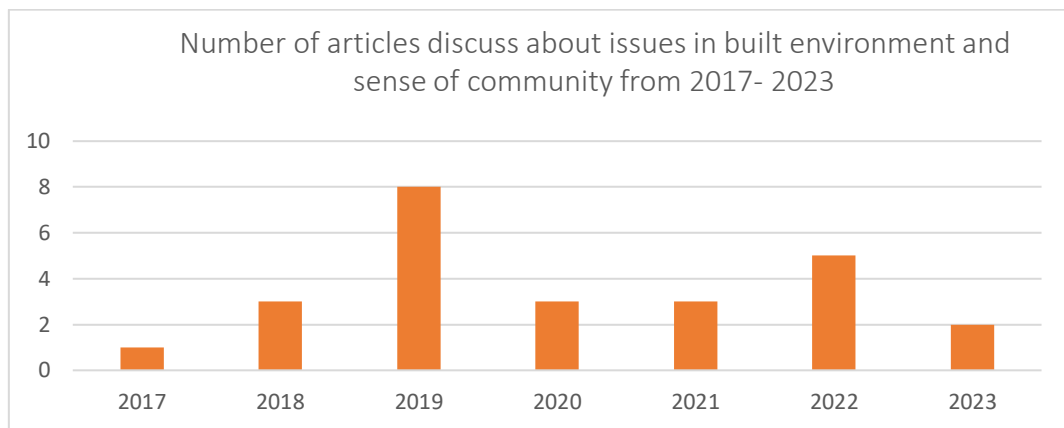


Fig. 4. Paper breakdown according to the year of publication.

The screenshot displays the ATLAS.ti software interface. The top menu bar includes File, Home, Search & Code, Analyze, Import & Export, Tools, and Help. The toolbar contains various icons for document management and analysis. The main workspace is divided into three panes:

- Explore:** Shows a tree view of the project structure, including Documents (25), Codes (27), Memos (0), Networks (8), Document Groups (116), Code Groups (3), Memo Groups (0), Network Groups (0), and Multimedia Transcripts (0).
- Document Manager:** Displays a list of document groups with columns for Document Groups, Author, and Count. The list includes authors such as Adams, Richard E., Agboola, Oluwagbe..., Akcali, Seyda, Alaniz, Francisco Uri..., Al-Betawi, Yamen N., Alhusban, Ahmad A., Alhusban, Safa A., Ashraf, Pakinam, Ayad, Hany M., Azizul, Muhammad..., Bahl, Deepak, Banerjee, Tridib, Blackstaffe, Anita, Brauer, Michael, and Cahantimur, Arzu.
- Code-Document Table:** Shows a list of documents with columns for ID and Name. The list includes documents such as Wang (2023) - A Bibliometric Analysis of Neighborhood Sense of Community, Du (2023) - Associations between neighborhood environment and sense of community belonging in urban Chi, Farahani (2022) - The death and life of Australian suburbs: Relationships between social activity and the physic, Huertas-Delgado (2022) - Associations between parental reasons for choosing a neighborhood and adolescent, Akcali (2022) - The Pentagon Model of Urban Social Sustainability: An Assessment of Sociospatial Aspects, Con, Willer (2022) - Rebranding place "to build community": neighborhood branding in Buffalo, NY, He (2022) - Urban greenery mitigates the negative effect of urban density on older adults' life satisfaction: Evid, Ashraf (2021) - INVESTIGATION of the SENSE of COMMUNITY LEVELS: VARIABLES, DIMENSIONS and SPATIAL, and He (2021) - Transit-oriented development, perceived neighbourhood gentrification and sense of community: A.

Fig. 5. Metadata generated in ATLAS.ti 8.

Results and Discussions

There are two categories of results: quantitative and qualitative. Based on a study of 25 documents in the primary document, the quantitative section resulted in the word cloud below. 'Community' and 'social' are words that appear often throughout the article, as shown by the word cloud's biggest word. As was stated in the outset, the focus of this study is the built environment of the area, which influences the sense of community.

Despite the growing tendency, no review study has yet discussed how neighbourhood-built environments affect a sense of community. Data collection, preparation, and interpretation of the findings are outlined in a study protocol that follows a logical flow based on prior research. According to the study of the word cloud, the term "community" is used 2253 times, followed by the word "social" at 1712 times, while cities and health are referenced 1039 times and 872 times, respectively (refer Fig. 6). Over time, trends from publications have increased. Since there were only one papers published in 2017 and three in 2018, there has been a noticeable growth, with 8 articles published in 2019, compared to just 3 articles in 2020 and 2021, 5 articles in 2022, and just 2 articles this year (refer Fig. 7). The primary goal of this study's literature review, which began in 2017, is to concentrate on the most recent articles from the last 5–6 years and to determine the trend for the year 2023. Because of its concentration on search strings, indexes, and exclusion criteria, the author wishes to underline that this study does not appear to be limited or exhaustive. The author, on the other hand, claims that it is based on the research question and represents the literature.

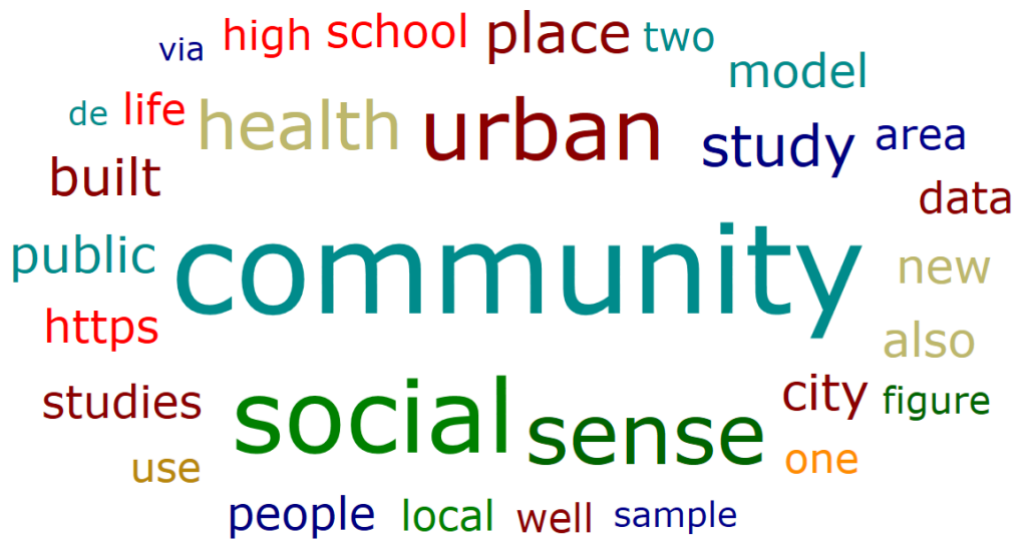


Fig. 6. Word cloud generated from 25 articles.

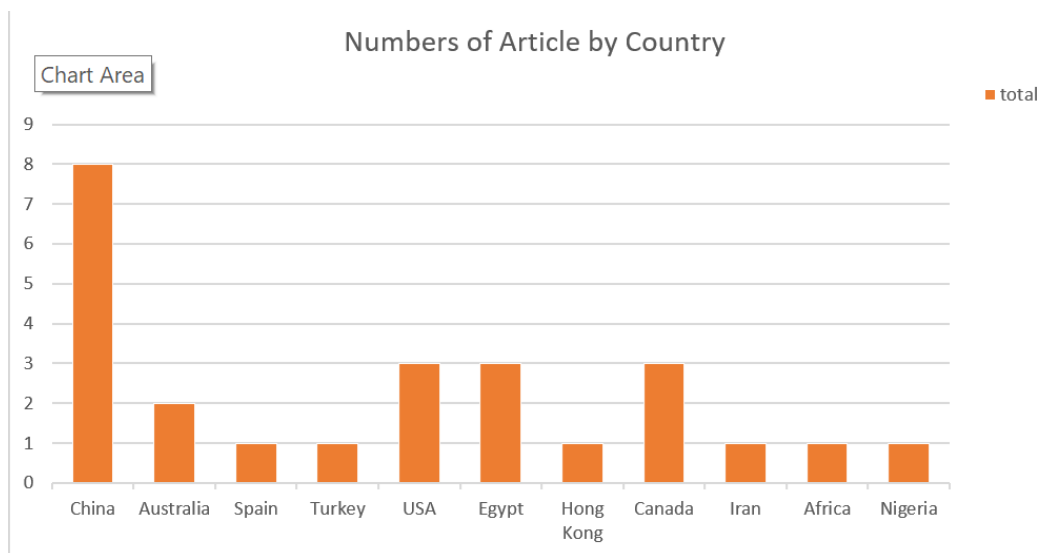


Fig. 7. Numbers of articles based on country published.

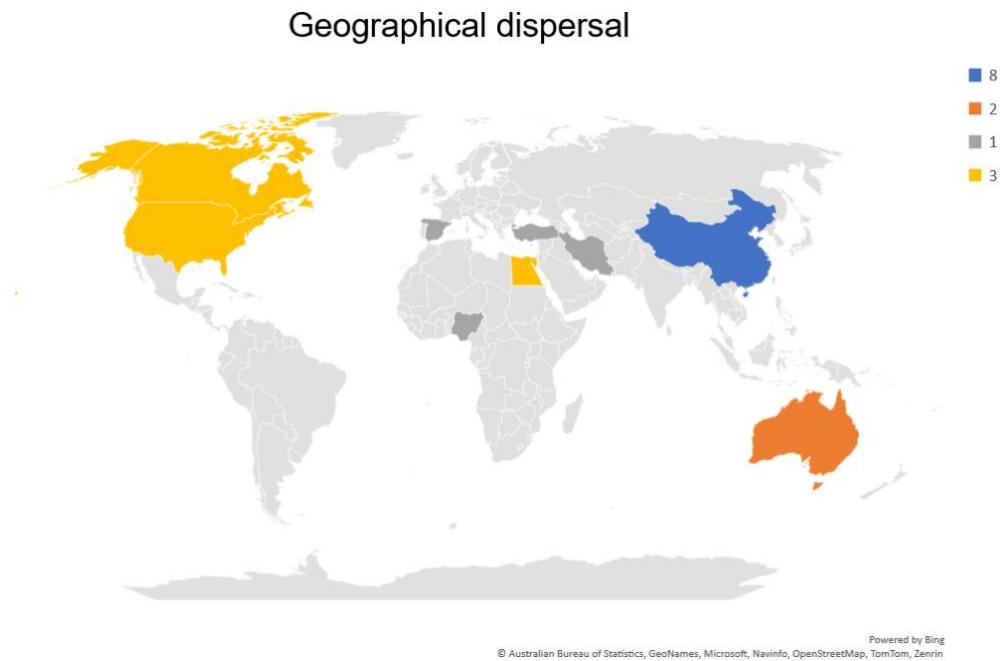


Fig. 8. Location and number of articles based on country published.

a) Quantitative results

The results given below suggest that the built environment, which influences the sense of community, influences a variety of journal choices. As previously indicated, if the only term used in this search is "Neighbourhood Built Environment," the number of articles found will be in the thousands. The findings, however, indicate a considerable and more concentrated decline when narrowing the search phrase to "sense of community" AND "neighbourhood" AND "built environment", demonstrating that the topic is still novel and needs further research. However, the rising attention indicates that the phrases "sense of community," "neighbourhood," and "built environment" have become more popular. The article's development, as shown in the accompanying diagram, may provide evidence of this, see Table 1.

The most recent publications in this field of research are primarily published in China shown in Fig. 7 and Fig. 8. [24] stated that specialists in urban planning and public health, walkable neighbourhoods are a good way to promote active lives, and he investigates the effect of attitudes and perceptions on walking in Beijing's historical area. Although there is little evidence for non-major Chinese cities, the built environment of the neighbourhood may have an impact on residents' recreational activities [25]. The cross-community variances have not yet been thoroughly clarified, according to [26], he pointed out that the current conceptual framework is primarily concerned with investigating the direct effects of personal characteristics on sense of community. In Guangzhou, China, the contentment of home-owners and their willingness to relocate were examined in three different urban areas by [27] while [28] mention that urban policy-makers and planners are becoming more aware of the possibility that urban greenery could improve citizens' quality of life in high-density cities by lessening the consequences of congested settings. [29] concentrated on the perceived environment in the study while also considering mediating influences such as neighbourhood social interaction and location satisfaction.

One of the documents that drew our interest was a study in Egypt. Three related studies—[18]—examine the built environment, social circumstances, and historical context of the places that have an impact on how our society feels, while [30] research focuses on analysing how

citizen empowerment and participatory mapping might improve the planning process and in an effort to establish a link between neighbourhood sense of community and several variables, including the physical surroundings, cultural environment, and socioeconomic elements in three specific regions, [31] undertakes an investigation. Three studies in the USA are more concentrated on neighbourhood design that impacts the physical activity studied by [32][33], while [34] study on urban landscape impacts the sense of community. Three articles from Canada namely [35]–[37] study physical activity that impacts neighbourhood design and becomes the most discussed issue among all the scholars from various countries.

b) Qualitative results

To address the research question in the qualitative parts, this study will investigate current trends pertaining to build environment components that affect a sense of community in great detail. The five main criteria are determined by the article's directions and topic. The themes below were drawn from several publications: neighbourhood (12); urban landscape (6); physical quality (3); Planning Policy (2); and architectural design (2) as shown in Fig. 10. In the next section, it will be discussed about the main physical factors that affect SOC and SOC factors that are affected by NBE in answering the research question on the current trends in the built environment is are that impacts the sense of community.

i) Neighbourhood.

From the study, it can be concluded that five main physical neighbourhood characteristics impact the SOC which are neighbourhood (12); urban landscape (6); physical quality (3); Planning Policy (2); and architectural design (2) as shown in Fig. 10. [38] research focuses on how local market squares in rural South-West Nigeria affect social development principles including the sense of community. The study's physical criteria included economic, social, and aesthetic criteria. The latter included aesthetic elements like beautification and green space as well as social criteria like games, sports, nature, relaxation, and sightseeing. Along with cultural heritage-based values like historical, festival, and ritual events, he also used religious-based activities like prayer areas, convention centres, and retreat programmes. He also made use of areas for community service. Subsequently, [37] examine the effectiveness of a single-item test to measure someone's sense of community connectedness in capturing the complexity of the main idea. He used the density of the population, respondent's type of residence, views of neighbourhood issues and crime, and facilities nearby to measure the Social Capital, Neighbourhood Characteristics, and Rootedness in the studies. Using three different neighbourhood designs, while statistically adjusting for socioeconomic characteristics and neighbourhood decision-making factors, the correlation between levels of weekly transportation and leisure physical activity was examined by [35]. He evaluated factors such as the layout of neighbourhoods (grids, modified grids, and curves), accessibility to highways or major roads, proximity to town centres, places of employment, schools, or other services, recreational facilities, street aesthetic appeal, street cleanliness, the quality of leisure infrastructure, green spaces, and tracks, as well as a variety of housing options. [32] mention a straightforward but overlooked measure, that shows how the built environment of the neighbourhood is connected to an emotional experience of community, is kids playing.

On the other hand, [30] research focuses on analysing how citizen empowerment and participatory mapping might improve the planning process. Consequently, it is an effort to assess the social and spatial experiences of the neighbourhood to look at the relationship between those activities, their perception of the built environment, and their sense of community. In this study, [31] make an effort to establish a link between a neighbourhood's sense of community and a number of criteria, including the geographical surrounds, cultural

context, and socioeconomic elements in three particular places. Research from [39] examined the connection between parents' motivations for picking a neighbourhood to reside in and their teens' physical activity and [29] concentrated on the perceived environment in the study while also considering mediating influences such as neighbourhood social interaction and location satisfaction.

Up to twelve researchers address the topic or primary physical component that is a study connected to NBE that impacts the SOC in this neighbourhood as a reference to Fig. 10. It is the study's most tangible aspect. It also demonstrates that this element has recently taken centre stage in study, and that further, deep research is needed.

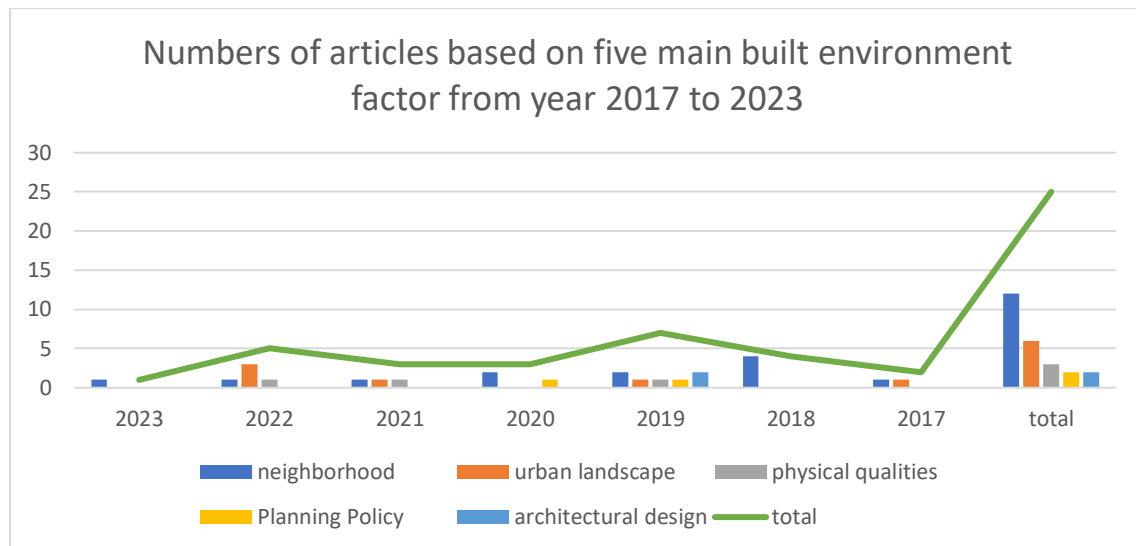


Fig. 9. The number of articles is based on five main built environment factors that impact the sense of community from the year 2017 to 2023.

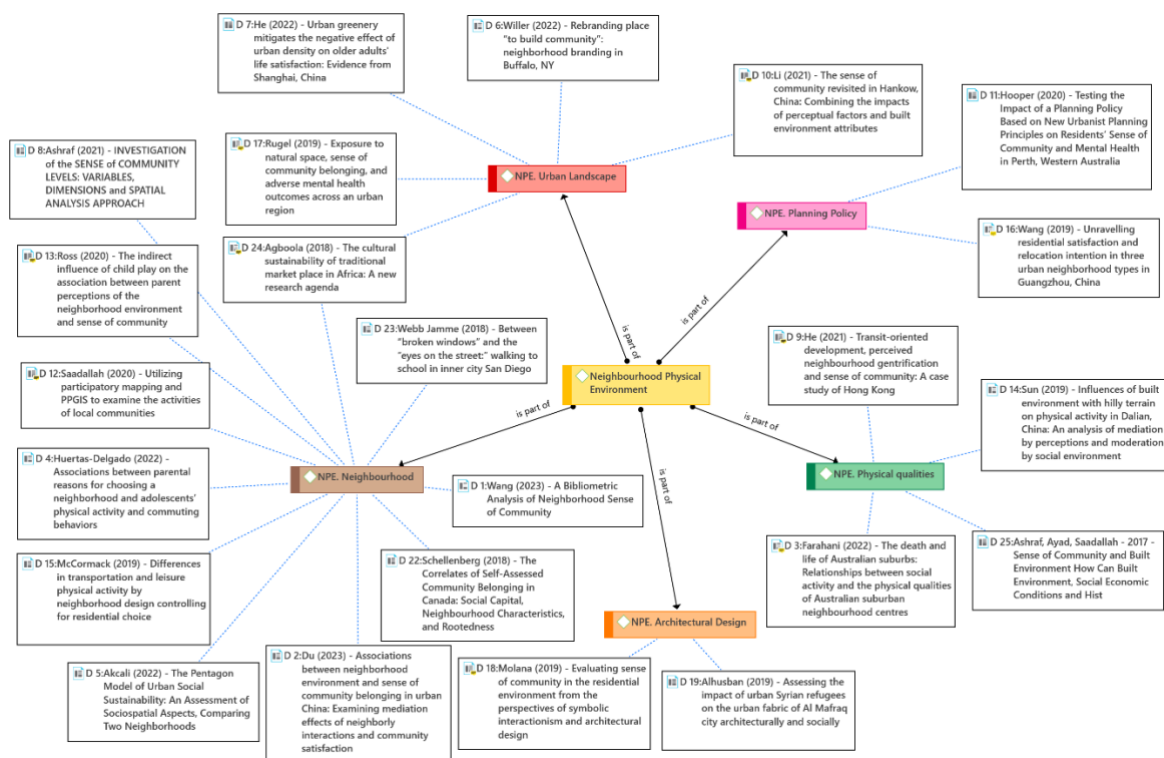


Fig. 10. The overall thematic review formulation on the neighbourhood-built environment that impact the SOC.

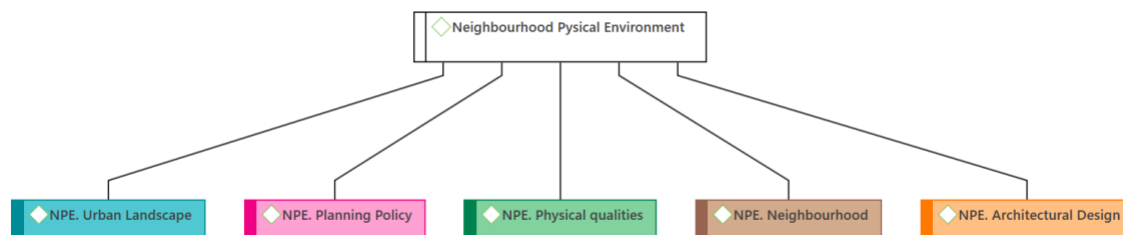


Fig. 11. Neighbourhood Built environment factor theme based on the study.

ii) Urban Landscape.

Six out of the twenty-five articles in this study, or the urban landscape, represent the second-largest physical element as shown in Fig. 9. Adolescents' sense of community is linked to positive experiences in public open spaces such as playgrounds and general peer social well-being [40] while natural greenery, such as street trees and parks, and blue areas, such as oceans and rivers, are characteristics of urban design that assist in alleviating these demands and building social capital, according to [36]. According to [26], the present conceptual framework is primarily concerned with investigating the immediate effects of personal characteristics on the sense of community. He measured a variety of physical aspects in this study, such as municipal amenities, food, shopping, and daily services, as well as sports and leisure facilities. While [28] state that urban policymakers and planners are becoming more aware that urban greenery may help residents of high-density cities enjoy an improved quality of life by mitigating the negative consequences of congested settings. [34] investigates the suburban community's decline. It specifically examines how toponym changes affect the urban landscape and sense of community. Finally Through the identification of five dimensions which are person, place, people, perception, and process for the research Accessibility, social infrastructure, open spaces, and places for routine operations are some of the physical metrics taken into account in the place factor, according to Akcali and Cahantimur's pentagon model for urban social sustainability published in 2022 [41] also taking into consideration the factor of urban design, building type, density, mixed land use, and centre quality. Most of the studies indicate that people who place a high value on their green or open spaces report greater social networks, better social interactions, and increased safety and security.

iii) Physical Qualities

For the third element, physical attributes, [25], [42]–[44] are the primary factors for researchers as shown in Fig. 10. [18] used three (3) main factors namely Aesthetics, Streets and services, and Buildings. Major attractions, aesthetic pleasantness, artists' involvement in building detailing, harmony, architectural style, and regional and distinctive features are some of the physical aspects that fall under the category of aesthetics. Housing density, land use mix, street link, and accessibility are the physical variables employed in [45] study as metrics. [42] investigate whether transit-oriented development strengthens or lowers its sense of community. Based on public opinions, [42] examined the ties between the existence of an urban train system, the thought of neighbourhood gentrification, and the sense of community while [46] study 2022 focused to ascertain how social activities in a quickly expanding suburban neighbourhood centre relate to the built environment's physical properties. Observations of behaviour, a range of building typologies and uses, mobility and accessibility, perceptions of safety and security, population density, and physical spatial quality were all measured

(particularly landscape, size, and café culture). Although this topic of physical attributes has been chosen, it also encompasses all existing high-quality built settings, such as urban landscape, neighbourhood, and architectural design. In general, the neighbourhood's physical condition can be beneficial to encouraging interactions with others and group activities.

iv) Planning Policies.

The physical design and layout of cities and neighbourhoods, according to conventional town planning theories, may promote social interactions, neighbourhood links, and a sense of community. Buildings, lots, blocks, cities, regions, neighbourhoods, districts, and corridors may benefit from new urbanism design concepts [5]. [47] stated that there is growing concern that the constructed form created by typical suburban architecture may be detrimental to its residents' psychological health, sense of community, and social well-being. This study investigates the assertion that suburban neighbourhood development in Perth, Western Australia, was designed using New Urbanist-inspired planning concepts. The indicators used include Community Design, Movement Networks, Lot Layout, and Public Parkland. [27] work seeks to fill this gap by offering an updated and comprehensive analysis of inner-city relocation and by revealing the complex relationships and processes between residential satisfaction and resettlement against a backdrop of overall residential inequality. In summary, implementing neo-traditional neighbourhood design principles or wise planning helps a neighbourhood promote a strong feeling of community and mental wellness. Fig. 10 showed the author discussing Planning Policy in their studies.

v) Architectural design

Designing buildings in a way that encourages occupants to leave their homes and into public places promotes social interaction [48]. People are more likely to be satisfied with their area and have a stronger feeling of community when they see outstanding accessibility, walkable street quality, beautiful architecture, and tranquil surroundings [29]. Two researchers focus on architectural design as a built environment factor for their studies which is [17], [49][17], [49]. The built environment, which includes urban planning, built environment, and architecture and their surroundings, affects how people act and interact with one another [17] and a physical component was used in the study to measure design elements like the use of colour, weights, signs and street art, balcony areas, decoration of windows and displays, architecture, size, and repair standards, as well as other decorative situations that deviate from standard practises [49]. Finally, merging the research domains of urban sociologists, community psychologists, and architects through symbolic interactionist ideas may be an advantageous method for looking at the aspects influencing the feeling of community and larger urban dynamics.

A proposed conceptual framework for the neighbourhood-built environment that impacts the sense of community.

To continue the field's information development, the theme review generates recommendations for new research. These propositions are demonstrated by reading, analysing, and defining research in accordance with the conceptual framework in Fig. 12. Using neighbourhood-built environment main variables as a measure that impacts the sense of community.

- 1) Neighbourhood factors are associated with physical activity, community satisfaction, sense of community, perceptual factors, and community belonging.
- 2) Community satisfaction, a sense of community, and perceptual factor are all correlated with urban landscape features.

- 3) Physical quality factors are connected to physical activity and a sense of community.
- 4) A sense of community and a sense of belonging to the community are related to planning policy factors.
- 5) Architectural Design factors are associated with community belonging.

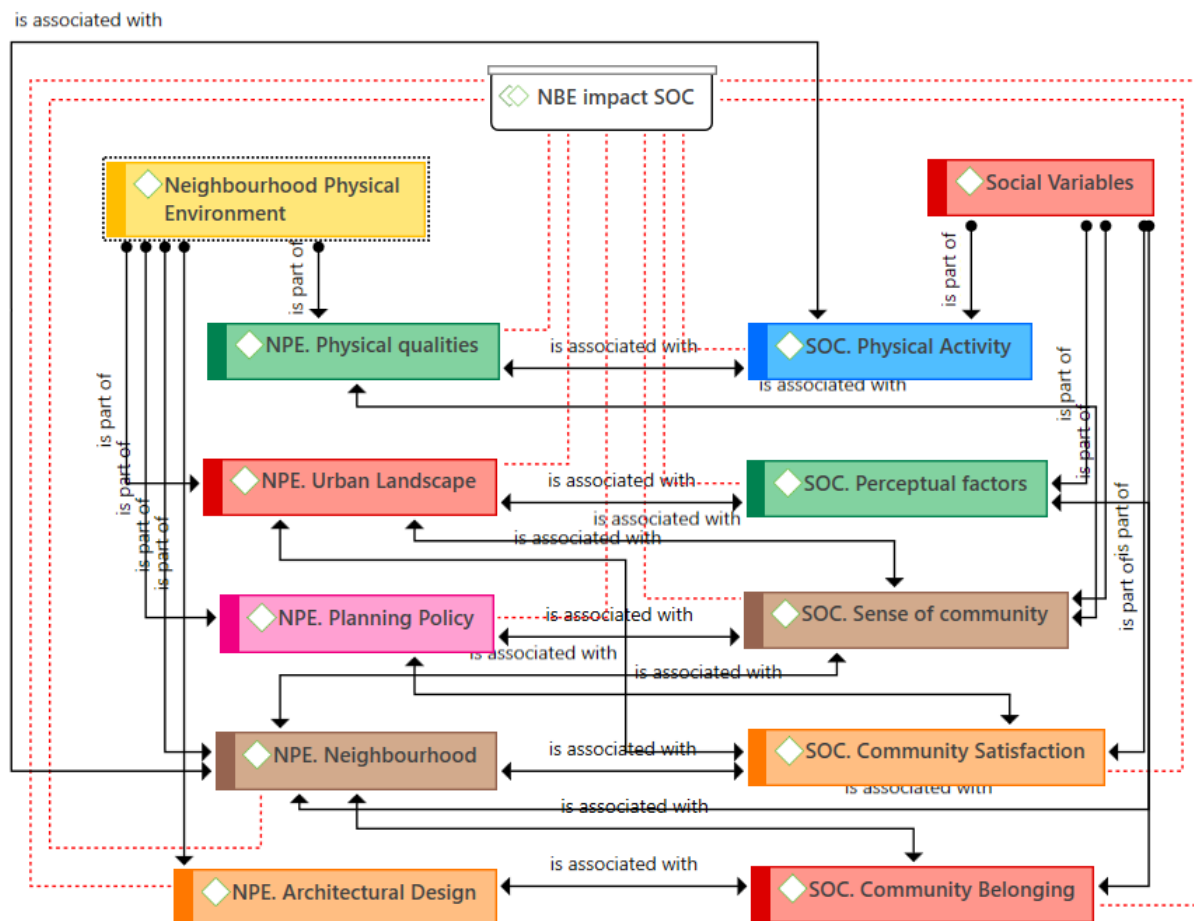


Fig. 12. Proposed conceptual framework of the neighbourhood-built environment that impacts the sense of community.

A description of the author, the physical aspects of the neighbourhood-built environment, and the influence on social and SoC are translated into a table based on the whole study mentioned above as per Table 2.

Table 2. Comparison and compilation from various Author on Physical Environment elements that impact SOC that are similar according to Kim and Kaplan (2004) 17 physical factors.

No	Source	Neighborhood Built Environment factor	activity	Sense of Community (SoC)

1	Ashraf, Ayad, & Saadallah (2017)	Built environment	Overall SoC	sense of community
2	Agboola et al. (2017)	public open spaces	adolescents' sense of community	SoC
3	Agboola et al. (2018)	market squares	Community attachment	social development
4	Schellenberg et al. (2018)	density of the population, respondent's type of residence	Social Capital, Neighbourhood Characteristics, and Rootedness	SoC
5	McCormack et al. (2019)	town centres, workplaces, schools, shops, or services, recreational facilities, street aesthetic appeal, street a clean environment, housing, and the leisurely infrastructure, green spaces, and tracks	leisure physical activity	SoC
6	Rugel et al. (2019)	natural greenery	boost social capital	SoC
7	Sun et al. (2019)	Housing density, land use mix, street link, and accessibility	Physical activity	SoC
8	Wang et al. (2019)	resettlement	residential satisfaction	SoC
9	Alhusban et al. (2019)	urban planning, built environment, and architecture and their surroundings	people act and interact with one another	SoC
10	Molana & Adams (2019)	use of colour, weights, signs and street art, balcony areas, decoration of windows and displays, architecture, size, and repair standards, as well as other decorative	Community identity	SoC
11	[50] [51]	diverse architecture, and green spaces	higher levels of social cohesion and	SoC

			community participation	
12	Ross et al. (2020)	built environment of the neighbourhood	emotional experience of community, is kids playing	SoC
13	Saadallah's (2020)	built environment	sense of community	SoC
14	Hooper et al. (2020)	traditional suburban architecture	social well-being, sense of community, and psychological wellness	SoC
15	Ashraf et al. (2021)	physical surroundings, cultural setting, and socioeconomic features	neighbourhood sense of community	SoC
16	He et al. (2021)	transit-oriented development	Community attachment	SoC
17	D. He et al. (2022)	urban greenery	higher quality of life	SoC
18	Willer (2022)	urban landscape	Community attachment	SoC
19	Akcali & Cahantimur (2022)	social infrastructure, open spaces, and locations	social networks, better social interactions, and increased safety and security	SoC
20	Farahani et al. (2022)	building typology, perceptions of safety and security, population density, and physical spatial quality	social activities	SoC
21	(Du et al., 2023)	view excellent accessibility, walkable street quality, beautiful architecture, and calm surroundings	Community attachment, Community identity, social interaction, Pedestrianism	stronger sense of community

Table 3. Chart show the total number of physical environment elements used by different studies from different authors and years based on Physical environment that impact the SOC.

year	2014	2014	2017	2018	2018	2018	2019	2019	2019	2019	2019	2019	2020	2020	2020	2020	2021	2021	2022	2022	2022	2022	2023	total	Ranking
source	Kim & Kaplan (2004)	Farahani & Lozanovska, 2014	(French et al., 2014)	Ashraf et al., 2017	Agboola (2018)	Webb Janme (2018)	Schellenberg (2018)	Kujawski (2019)	Alhusban (2019)	Molana (2019)	Rugel (2019)	McCormack (2019)	Sun (2019)	Ross (2020)	Saadallah (2020)	Hooper (2020)	Li (2021)	Ashraf (2021)	He (2022)	Akcali (2022)	Huertas-Delgado (2022)	Farahani (2022)	Du (2023)		
Neighbourhood places																									
club house/ recreational facilities	1		1	1		1			1		1		1	1			1	1		1	1		1	13	1
Planning Strategies																									
residential density	1	1				1						1						1	1			1	1	8	5
distance between sidewalk and home	1	1	1								1							1			1			6	6
mix of housing types	1	1	1												1									4	7
overall layout				1		1			1										1	1		1		5	6
street layout	1	1	1			1					1	1						1	1		1	1	1	10	4
overall size									1															1	
on-street parking																								0	
lot size																								0	
arrangement of houses																								0	
Urban Landscape																									
lakes, greens paths	1		1	1					1		1		1				1	1		1	1			10	3
street trees, landscaping	1	1		1					1	1							1	1				1		8	9
street width	1																							1	
Architectural design and physical quality																									
architectural style		1	1	1				1	1				1					1		1	1	1		10	2
overall design quality of houses		1	1					1																3	10
block size			1																			1		2	11
garage location																								0	
	8	7	9	4	0	4	0	2	6	2	3	2	3	1	1	3	2	5	5	4	5	5			

Based on the Table 2 and

Table 3, the physical features that were most found to contribute to a sense of community were club house or recreational facilities, architectural style, residential density, street layout, lakes and green paths, overall layout, mix of housing types, distance between sidewalk and home, street trees, and landscaping. On the other hand, overall size, on-street parking, lot size, arrangement of houses, garage location, and street width were the physical features that were least commonly found to contribute to a sense of community.

The total number of physical features identified was 81, with 22 unique sources across a range of years 2014 to 2023. The physical features were identified from a variety of sources, including academic articles, planning documents, and design standards.

In conclusion, these findings suggest that the physical design of a community can have a significant impact on the sense of community felt by its residents. By prioritizing the physical features that are most strongly associated with a sense of community, designers and planners can create more vibrant and cohesive communities.

Variables from the study.

We discovered that there are numerous formulations as follows based on the 17 physical factors from Kim & Kaplan 2004 and utilised as a reference for research from other sources that also employ physical factors that impact SOC.

We discover some physical characteristics that are the most to the least important from various studies in the table above. The most physical aspect recreational facilities factor which has a total of thirteen (13) as per used by [17], [30]–[32], [35], [37], [38], [41], [44], [52][19], [53]. The second most physical factor is architecture style similarly, which is used by 10 researchers [17], [31], [32], [38], [41], [43], [44], [49], [54][19] Similarly used from the third to fourth physical criteria 10 times each, roadway design, and lake and garden paths. Eight researchers

utilised this study, and street and landscape trees were the sixth most frequently used while residential density is ranked as the fifth significant physical factor affecting SOC by eight (8) scholars. Six researchers utilised the distance from the house to the pavement for this study, placing it in seventh position. Overall layout, mixed of housing type, overall design quality of house and block size are ranked from eight to eleven.

Residents' sense of community has been proven to be affected by the establishment and upkeep of recreational amenities in neighbourhoods. According to research, an individual's engagement with the local community is positively connected with the physical closeness to community resources, especially recreational facilities [55].

Additionally, the availability of green spaces and recreational amenities has been highlighted as key components in creating a feeling of identity and belonging within communities [56]. According to research, providing community amenities encourages individuals to walk more [57].

Gardens, lakes, and parks in public places have a huge influence on the sense of community in a neighbourhood or city. They serve as a gathering place for people to socialise, relax, and participate in leisure activities. Those who use public green areas daily get several health benefits. Exposure to nature has been found in studies to reduce stress and anxiety, increase mood, and stimulate physical activity. Time spent in green places can also help to decrease blood pressure, enhance cardiovascular health, and increase the immune system [58]. Opportunities for social contact and community development are provided by public green areas. They serve as a gathering place for individuals of all backgrounds to interact and take part in leisure activities. People can meet one other, become acquaintances, and develop connections in green settings [59]. Individuals and communities gain greatly from public green places such as gardens, lakes, and parks. They help physical and mental health, the environment, and can be economically beneficial. Furthermore, they contribute to the development of a sense of community by facilitating social contact, developing a sense of belonging, and encouraging civic involvement. Investing in public green areas is thus not only an investment in the environment, but also in the community.

The use of technology-mediated communication may also have an influence on people's feeling of community. Studies have shown, for instance, that while social media and other online platforms can help people in geographically dispersed communities connect and communicate, they may also cause a decline in face-to-face interaction, which is essential for creating and maintaining strong communal ties [60]. Hence, while planning infrastructure, public places, and communication platforms, it is crucial to take the density of a community into account and how it affects people's feeling of community.

The degree of social connectedness people feel inside a given group or community is referred to as a person's sense of community. People's feeling of community can be significantly impacted by a neighbourhood's density. According to research [61], high-density communities, such as those seen in urban regions, may cause a decline in social contact and lower levels of community cohesiveness. This is explained by elements like constrained physical space, greater competition for resources, and a lack of places for collective meeting. In contrast, low-density communities, such as rural areas or small towns, may promote higher levels of social interaction and a stronger sense of community because of things like larger physical space, greater accessibility to communal gathering spaces and resources, and a smaller population of people with whom to interact.

While one of the primary elements cited by research addressing the physical influence on SOC is the overall layout or planning of an area. The sense of community within a neighbourhood or development may be significantly impacted by developing a community-oriented layout design. A sense of community may be fostered among residents by incorporating features like

common spaces, pedestrian-friendly paths, and plenty of lounging spots. A sense of ownership over the place may be fostered and an atmosphere that really represents their wants and wishes can be created by incorporating community members in the planning and design process. Planning a neighbourhood layout is an important part of developing a cohesive and supportive community. Neighbourhoods may build a deeper sense of community by prioritising the needs and preferences of community members in layout design, eventually promoting better social cohesiveness and resilience over time. Additionally, while creating a neighbourhood layout, it is critical to consider elements such as accessibility and inclusion. These might involve including wheelchair ramps, accessible parking areas, and seats with backrests to accommodate those with impairments. The overall layout or planning of a community has a considerable influence on the residents' sense of community.

According to several academics, the most important component is a diversity of housing types. A mix of housing types can have a variety of effects on the sense of community. For example, it may foster a more varied community comprised of people from various backgrounds, socioeconomic levels, and ages. Because people have diverse experiences and viewpoints to offer, this variety may lead to a more active and interesting community.

Second, a variety of housing types can promote greater connection and socialising among community members. People are more likely to meet into each other when walking to and from their homes, or while enjoying shared amenities such as parks or community centres, in a neighbourhood with a mix of single-family homes, townhouses, and apartments. This can lead to more spontaneous encounters and sociability, which can contribute to the development of a stronger sense of community.

Finally, a diverse range of housing types might result in a more equal allocation of resources and services within a community. For example, in a neighbourhood with a variety of housing types, there may be a combination of public and private amenities available to all members of the community, such as parks, community centres, and libraries. This can contribute to the creation of a more balanced and just community in which everyone has access to the resources and services they require to prosper. Overall, a range of housing types may have a substantial influence on an urban area's sense of community by fostering a more diversified, sociable, and equal neighbourhood.

Researchers agreed that the overall design quality of houses constitutes a physical component. This illustrates that quality is a physical factor that affects SOC. The design quality of houses has a considerable impact on a neighbourhood's sense of community. It has an impact on how people view their living environment and interact with one another. Residents benefit from good design because it encourages social interaction and a sense of belonging. Homes with aesthetically appealing facades and well-designed exterior areas that are in tune with their surroundings provide a pleasant impression and a friendly mood. These elements encourage inhabitants to spend more time outside, participate in activities, and socialise with their neighbours. Poorly built houses, on the other hand, might have a negative impact on the sense of community. Homes that are physically unpleasant, have minimal outside space, and are not in harmony with their environment can cause people to feel isolated and disconnected. This might result in a lack of social engagement and a sense of alienation from the community. As a result, it is critical to examine the general architectural quality of houses in a neighbourhood to foster a sense of community. This may be accomplished by urging developers to incorporate communal spaces, green spaces, and outdoor facilities that promote social contact. Moreover, zoning and building laws can be implemented to guarantee that dwellings are created in harmony with their surroundings and contribute positively to the general beauty of the community. Finally, the general architectural quality of houses has a substantial influence on a neighbourhood's sense of community. Well-designed homes encourage social interaction and a sense of belonging, as well as contributing to the general beauty of the neighbourhood. To

stimulate social contact and a strong sense of belonging, it is therefore critical to consider the design quality of houses in any development plan.

Additionally, there is a physical component that Kim & Kaplan initially employed, which comprises overall size, on-street parking, lot size, layout of the home, and garage position. However, it is now used twice as often and is less frequently used until 2023.

Based on this investigation, it was discovered that from year 2014 to 2023, various physical variables were employed less frequently. Of the 17 physical factors used by Kim & Kaplan, only eleven have been applied thus far: club house/recreational facilities, residential density, distance between sidewalk and home, mix of housing types, overall layout, street layout, lakes, green paths, street trees, landscaping, architectural style, overall design quality of houses, and block size. The six additional physical variables which is total size, on-street parking, lot size, home layout, street width, and garage location were less often employed in research conducted between 2014 and 2023. In summary, this study concluded only eleven physical characteristics that are still often employed in current research as per Fig. 13.

Physical Character	Commonly used from 1995-2023	Less used from 1995-2023
	<ul style="list-style-type: none"> club house/ recreational facilities residential density distance between sidewalk and home mix of housing types overall layout street layout lakes, greens paths street trees, landscaping architectural style overall design quality of houses block size 	<ul style="list-style-type: none"> overall size on-street parking lot size arrangement of houses street width garage location

Fig. 13. Neighbourhood physical character commonly used and less used based on Author study.

CONCLUSION

In this article, two methodologies from the 25-research reviewed in the study were used. The first portion, titled "Quantitative," centred on data that was statistically extrapolated from ATLAS.ti 8. Regardless of growing interest in the subject, there isn't a review paper that considers how the built environment affects a sense of community. According to Kim Kaplan's seventeen known physical factors, which were used to formulate the study's main question, "which physical aspects have the most influence and how many factors are still important that impact to the sense of community to adapt at this moment?" we can categorise the factors into five categories: neighbourhood, urban landscape, physical attributes, planning policy, and architectural design. Only eleven of the seventeen physical parameters proposed by Kim & Kaplan have been employed thus far: clubhouse/recreational amenities, residential density, the distance between the sidewalk and a home, the variety of housing types, the general layout of the street, lakes, greenways, street trees, landscaping, architectural style, the overall design quality of the homes, and block size. Less often used in studies between 2014 and 2023 were

the six additional physical factors total size, on-street parking, lot size, home layout, street width, and garage position.

Even though the nation is still growing there is still a chance to build a neighbourhood that will foster a feeling of community and benefit both the neighbourhood and the nation. Even though several physical components might impact SOC, the study must continue to uncover the most innovative and effective ones. On the qualitative, thematic side, it is additionally emphasised how important it is to describe how the neighborhood's built environment contributes to a sense of community that helps both the local community and society. Numerous articles advocate NBE to support the SOC approach and as a framework for describing how the implementation process works.

This article's primary contribution is a review of the research on how NBE affects SOC. The practical aim is to enhance or add additional NBE elements that influence SOC and benefit the local community. This article presents recent research that is crucial for understanding how NBE impacts SOC theory and how it is applied to the fields of physical planning, built environment, and social aspects. Consequently, it is essential to research the most recent NBE and SOC frameworks. To have a good effect on the neighbourhood, nevertheless, it must make clear how NBE and SOC are related by examining the theoretical framework to reduce its negative impact on neighbourhood social life. Knowing which physical elements most effectively influence SOC holistically is crucial to achieving a better result. It is intended that by applying the physical aspects of NBE to this SOC successfully, it will be possible to use it to develop a neighbourhood suitable for the surrounding region.

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АЗИ НОМХОН ДАЛАЙН ЧӨЛӨӨТ ХУДАЛДААНЫ ХЭЛЭЛЦЭЭР, БҮС НУТГИЙН ЭДИЙН ЗАСГИЙН ИНТЕГРАЦ БА МОНГОЛ УЛС

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Хураангуй

Ази Номхон далайн бүс нутагт Чөлөөт худалдааны хэлэлцээр (ЧХХ) нь худалдаа хөрөнгө оруулалтын бодлого, эдийн засгийн интеграцын чухал бүрэлдэхүүн хэсэг болж байна.

Монгол Улс бүс нутгийн чөлөөт худалдааны сүлжээнд нэгдэн орсноор бүсийн хэмжээний эдийн засгийн интеграцад орох боломж буй болж бараа, үйлчилгээний чанар, өрсөлдөх чадвар, технологи, иновацийн чадамж нэмэгдэхээс гадна хөдөлмөрийн хуваарийн дагналт хийгээд урт хугацааны бизнесийн өгөөж, олон улсын хөрөнгө оруулалт, технологийн дамжуулалт өсч, худалдааны дүрэм хялбаршин элдэв хориг арга хэмжээ арилах сайн талтай.

Монгол Улс олон чиглэлээр нэгэн зэрэг интеграцид орох их нөөц бололцоотой гэж үзэж байна. Бидний байгалийн баялгийн нөөц хийгээд газар зүйн байрлал тухайлбал, хоёр том зах зээлийн дунд оршдог нь боломж болно.

Түлхүүр үг: Чөлөөт худалдааны хэлэлцээр (ЧХХ); Номхон далайн түншлэлийн хэлэлцээр (ТРП), Бүс нутгийн иж бүрэн эдийн засгийн түншлэлийн хэлэлцээр (RCEP); Зүүн Өмнөд Азийн орнуудын Холбоо (АСЕАН)



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Оршил

Монгол улсын гадаад бодлогын чиг баримжааны үндсэн баримт бичигт “*XXI зуун гарсаар дэлхий дахинд даяаршил улам бүр тэлж, шинжлэх ухаан, мэдээллийн технологи үсрэнгүй хөгжин, улс төр, эдийн засгийн интеграц өргөжиж, улс хоорондын харилцан хамаарал гүнзгийрч байна. Олон улсын харилцаа өнгөрсөн зууны сүүлийн хагасын хоёр туйлт үеийнхээс эрс өөрчлөгдлөө. Хөгжлийн шинэ томоохон төвүүд тодорч, олон улсын харилцаанд тэдгээрийн үзүүлэх нөлөө өсөх хандлагатай байна*” гэж заасан байна [1]. Өнөөдөр даяаршил хийгээд үндэсний эрх ашиг түүнчлэн гадаад худалдааны либералчлал болон үндэсний үйлдвэрлэлийг хөгжүүлэх бодлого зэргийн уялдаа агаад зөрчлөөс үүдэн багагүй сорилттой тулгарч буй авч Ази Номхон далайн бүс нутагт Чөлөөт худалдааны хэлэлцээр (ЧХХ) нь худалдаа эдийн засаг, хөрөнгө оруулалтын бодлогын чухал бүрэлдэхүүн хэсэг болж байна. Өдгөө тус бүс нутагт олон талт ба хоёр талын нийт 80 орчим ЧХХ үйлчилж байгаа төдийгүй нилээд олон хэлэлцээр байгуулагдах шатандаа явж байна. Бүс нутгийн улс орнууд өөрийн орны эдийн засгийн хөгжлийн онцлог, гадаад худалдааны экспорт, импортын бүтэц хийгээд голлох түнш, тэдний байр суурь зэрэгтэй уялдуулан Номхон далайн түншлэлийн хэлэлцээр (TPP, Trans-Pacific Partnership), Бүс нутгийн иж бүрэн эдийн засгийн түншлэлийн хэлэлцээр (RCEP, The Regional Comprehensive Economic Partnership), Ази Номхон далайн чөлөөт худалдааны хэлэлцээрийн асуудалд хандаж ирсэн онцлогтой.

Номхон далайн түншлэлийн хэлэлцээр (TPP), нь олон улсын эдийн засгийн харилцаан дахь томоохон цар хүрээг хамарсан хэлэлцээрийн нэг гэж үздэг бөгөөд нэгдэн орсноор гишүүн орнуудад экспортын хөнгөлөлт эдлэх, хөрөнгө оруулагч талуудын маргаан шийдвэрлэх системд хамрагдах боломж бүрдэх түүнчлэн эл Хэлэлцээрт гарын үсэг зурах нь бүс нутгийн худалдааны либералчлалыг дэмжиж буйн илрэл болох чухал ач холбогдолтой гэсэн байр суурийг гишүүн орнууд баримталж ирсэн аж.

TPP-ээс гадна түүнтэй зэрэгцэн ирсэн АСЕАН-ы гишүүн орнууд Бруней, Камбож, Индонез, Лаос, Малайз, Мьянмар, Филиппин, Сингапур, Тайланд, Вьетнам түүнчлэн Австрали, Хятад, Энэтхэг, Япон, Өмнөд Солонгос, Шинэ Зеланд зэрэг 6 улс багтаж байгаа Бүс нутгийн иж бүрэн эдийн засгийн түншлэлийн хэлэлцээр (RCEP)-ийн эхлэл 2012 оны 11-р сард Камбожид болсон АСЕАН-ы Дээд хэмжээний уулзалт дээр албан ёсоор тавигджээ. Нээлттэй эх сурвалжид мэдээлснээр “*2022 оны байдлаар 3.4 тэрбум хүн ам, 49.5 их наяд ам.доллартай тэнцэх ДНБ (GDP) тус RCEP-ийн гишүүн орнуудад хамрагдаж байна.*” [2]. Эдийн засгийн талаасаа RCEP илүү ашигтай хэдий боловч дээрх хоёр хэлэлцээр нь бие биеэ үгүйсгэхгүй, харин ч нөхөх агаад улс орнуудад илүү чөлөөтэй худалдаа хийх давхар боломж бүрдүүлж байна хэмээн АСЕАН-ы ихэнх гишүүн орнууд үзэж байгаа бололтой.

Зүүн Өмнөд Азийн орнуудын Холбоо (АСЕАН) (англиар- Association of South East Asian Nations) — Зүүн Өмнөд Азийн 10 орны Засгийн газар хоорондын улс төр, эдийн засаг, соёлын хамтын ажиллагааны бүс нутгийн байгууллага. Бангкок хотноо 1967 оны 8 дугаар сарын 8-нд тухайн үеийн таван орны Гадаад хэргийн сайд нар Индонезийн

Адам Малик, Малайзийн Абдул Разак, Сингапурын С.Раджаратнам, Тайландын Танат Кхоман, Филиппины Нарцисо Рамос нар “АСЕАН-ны Тунхаглал”-д гарын үсэг зурснаар АСЕАН бий болсон хэмээн үздэг. \”Бангкокийн Тунхаглал” гэдгээр нь олон нийт судлаачид илүү мэддэг/.Тухайн орнууд бүс нутагт Коммунизм дэлгэрэх айдас, бүс нутагт ноёрхлоо хадгалах бодлого явуулж байсан их гүрнүүдэд итгэхгүйд хүрсэн, тогтвортой байдлыг хүссэн, эдийн засгаа хөгжүүлэх сонирхол өндөр байсан зэргийг судлаачид АСЕАН үүсэн байгуулагдсан үндсэн шалтгаан гэж үздэг. АСЕАН-ны урьтал бол 1961 онд байгуулагдсан Филиппин, Малайз, Тайландыг нэгтгэсэн Зүүн Өмнөд Азийн Холбоо /ASA/ нэртэй байгууллага байсан. Индонезийн Бали арал дээр1976 онд болсон анхны дээд хэмжээний уулзалтын үеэр Зүүн Өмнөд Ази дахь найрамдал, хамтын ажиллагааны болон АСЕАН-ны Тунхаглалын тухай Гэрээ байгуулснаар уг байгууллагын эрх зүйн үндсийг тавьжээ.

Дараа нь 1984 оны 1 дүгээр сарын 7 -нд Бруней-Даруссалам, Вьетнам1995 оны 7 дугаар сарын 28-нд, Лаос, Мьянмар 1997 оны 7 дугаар сарын 23-нд, сүүлд Камбож 1999 оны 4 дүгээр сарын 30-нд нэгдсэнээр АСЕАН 10 гишүүн орноос бүрддэг болсон түүхтэй. 2002 онд Зүүн Тимор ажиглагч болох хүсэлт гаргасанаар Папуа шинэ Гвиней, Зүүн Тимор хоёр улс АСЕАН-ны ажиглагчийн статустай байна.

АСЕАН-ны гишүүн орнуудын нийт газар нутаг 4.4 сая ам дөрвөлжин км. Мөн гишүүн орнуудын нийт хүн ам нь 625 орчим /2016 оны байдлаар/ сая хүн буюу дэлхийн нийт хүн амын 8,8% эзэлж байна.



Fig.1. Asian countries in the World state map. Adapted from reference [2].

АСЕАН бол барааны, үйлчилгээний, хөрөнгө оруулалтын, хөрөнгийн болон ажиллах хүчний чөлөөт солилцоо бүхий „ASEAN Economic Community“ (AEC) буюу эдийн засгийн нэгдмэл бүс байгуулахаар ажиллаж байгаагаас гадна хил дамнасан зам тээврийн болон эрчим хүчний “Их Меконгийн дэд бүс” зэрэг өргөн далайцтай төслүүдийг хэрэгжүүлэхээр төлөвлөж байна. Түүнчлэн санхүү, валютын интеграцын нэлээд зүгширч буй эхлэл болох Chiang Mai Initiative Multilateralisation (CMIM) гэх зэрэг

нь валютын ханшийн ноцтой хэлбэлзлээс урьдчилан сэргийлэх хяналтын механизмын зэрэгцээ их хэмжээний хөрөнгийн нөөцийг бүрдүүлсэн санхүүгийн ба валютын интеграцийн дэвшилтэй хандлага учраас энэ нь яваандаа Азийн валютын сан болон хөгжих ирээдүйтэй гэж үзнэ. Энэ тал дээр АСЕАН-ы “өргөтгөл” буюу АСЕАН+3 гэх арга хэмжээний хүрээнд БНХАУ, Өмнөд Солонгос болон Япон Улс нааштай хандаж байгаагийн гадна чөлөөт худалдааны хэлэлцээрийн сүлжээгээрээ дамжуулан дэлхийн хамгийн том чөлөөт худалдааны бүс болох тууштай зам дээр байна гэж дүгнэж болно. Ингэснээр энэ эвсэл Зүүн Азийн түлхүүр байгууллага болон хөгжих боломжтой.

АСЕАН+3 нь үр дүнтэй интеграцын үйл явцын катализатор болох ирээдүйтэйгээс гадна бүс нутгийн улс төрийн маргааныг зохицуулах (одоохондоо бүрэн ашиглаагүй) потенциалтай агаад АСЕАН+3 механизм нь тухайн улс өөрийн сонирхолоо хамгаалахад тогтвортой түшиг тулгуур болох боломжтой.(Энэ нь тухайлбал Филиппин Улс болон БНХАУ-ын хоорондох газар нутгийн маргаан дээр тод харагдсан). Энэ бүхэн бол АСЕАН+3 нь Монголын хувьд бүс нутгийн интеграцийн үүднээс илүү оновчтой байж болохыг харуулж буй үнэмшилтэй нотолгоо.

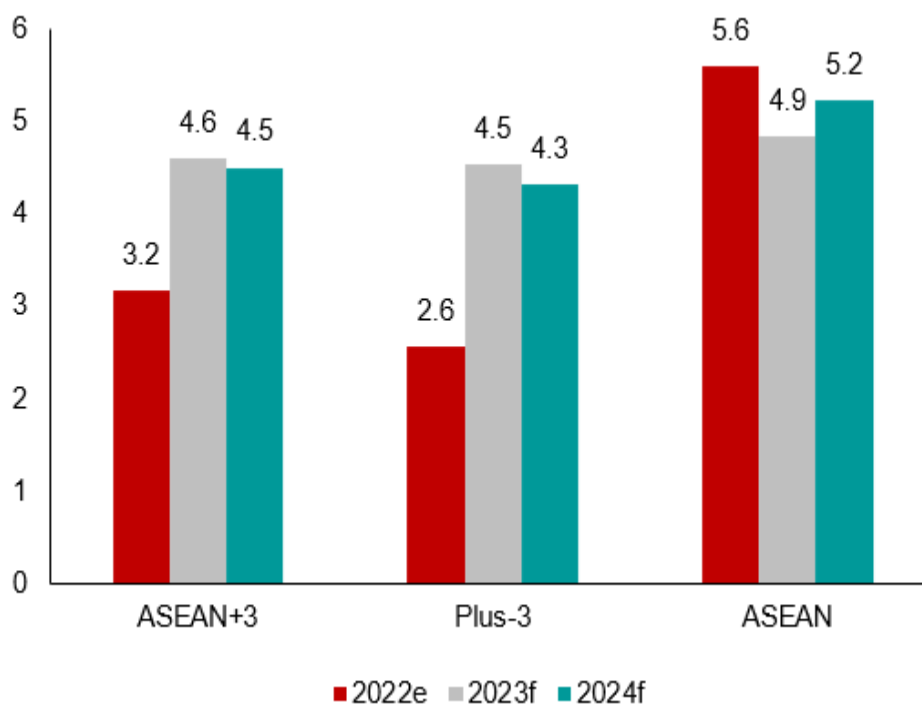


Fig. 2. ASEAN+3: AMRO Growth Estimates and Forecasts, 2023-2024

(Percent year-on-year) Note: e = estimates; f = forecast. Regional aggregates for growth are estimated using the weighted average of 2021 GDP on purchasing power parity basis; <https://amro-asia.org/asean3-regional-economic-outlook-2023-in-five-charts/>, Adapted from reference [3]

Социалист лагерь 1990-ээд онд нуран унаж олон улсын байдалд гүнзгий өөрчлөлтүүд гарсанаар АСЕАН гишүүдийн эгнээгээ тэлэн өргөжүүлэх, цаашид хамтын ажиллагаагаа гүнзгийрүүлэх сонирхол нь улам идэвхижсэн. 1990 онд бүс нутагт АНУ-

ын бүх талын нөлөөг сулруулах зорилгоор Малайз Улсын зүгээс АСЕАН-ны гишүүн орнууд дээр БНХАУ, Япон, Өмнөд Солонгосыг нэгтгэсэн “Зүүн Азийн Эдийн засгийн Зөвлөл” /East Asia Economic Caucus/ байгуулах санал дэвшүүлсэн байдаг. Гэвч АНУ, Японы эсэргүүцэлтэй тулгарч санаачилга мухардалд орсон боловч гишүүн орнууд санаагаа орхилгүй хөөцөлдсөний дүнд 1997 онд зүүн Азийн эдийн засгийн хямралын дараагаар Малайзын дээр дурдсан санаачилга Чиангмай-д сэргэж АСЕАН болон АСЕАН+3 /Хятад, Япон, Өмнөд Солонгос/ хоорондох эдийн засгийн интеграцлалыг гүнзгийрүүлэхэд чиглэсэн Чиангмайн санаачилга /Chiang Mai Initiative/ “АСЕАН + 3” "ASEAN Plus Three" гэсэн ойлголт бий болсон [4].

Монгол Улс газар зүйн байршлаараа бол Өмнөд Азийн орон биш гэдэгтэй маргах аргагүй. Үүнээс гадна дээр дурдсанчлан АСЕАН-ы интеграц нэлээд их урагшлан хөгжчихсэн байгаа. Гэлээ ч гэсэн Монгол Улсын хувьд Зүүн Өмнөт Азийн АСЕАН+ томьёоллын дараачийн орон болж нэгдэх боломжийг сүвэгчлэн хайж, нухацтай авч үзэх, өөрөөр хэлбэл, АСЕАН+3 томьёоллыг өргөтгөн АСЕАН+4 болгохыг хичээх шаардлагатай байна. Үүний тулд Монгол Улс АСЕАН+3 –ын бэлхэнээ хэрэгжүүлсэн интеграцийн дэвшлийг нөхөж гүйцэх буюу түүнд элсэн орох интеграцын гэрээгээр тавигдах шаардлага, шалгууруудыг аль болох хангахад ирээдүйн бодлогоо чиглүүлэн ажиллах хэрэгтэй. Энэ үүднээс Монгол Улс одоогийнхоосоо илүү тууштайгаар өөрийн эдийн засгийн үйл ажиллагаа болон гадаадын хөрөнгө оруулалтын орчинг үлэмж сайжруулах, ялангуяа хууль эрх зүйн тогтвортой байдлыг хангах, хүнд суртлыг арилгах, худалдааны хөнгөлөлт, эрчим хүчний хангалт, зам тээврийн дэд бүтэц зэргийг сайжруулах болон иргэдийнхээ боловсролыг дээшлүүлэхэд гойд анхаарах шаардлагатай нь ойлгомжтой юм. Иймд юуны өмнө бид АСЕАН-ы гишүүн орнууд голлон санаачилсан бөгөөд цөмийг нь бүрдүүлж байгаа Бүс нутгийн иж бүрэн эдийн засгийн түншлэлийн хэлэлцээр (RCEP)-т нэгдэн орох нь зүйтэй гэж үзэж байна.

АСЕАН нь гишүүн орнуудынхаа эдийн засгийн хөгжил, интеграцлалыг чухалчилахаас гадна бүс нутгийн энх тайван, тогтвортой байдалд багагүй анхаарч ирсэн. Зүүн Өмнөд Азийн бүс нутгийг цөмийн зэвсэгээс ангид байлгах үүднээс 1995 оны 12 дугаар сарын 15-нд “Цөмийн зэвсэгээс ангид бүс байгуулах Зүүн Өмнөд Азийн Гэрээ”-нд /Southeast Asian Nuclear-Weapon-Free Zone Treaty / гишүүн орнууд гарын үсэг зурсан.

Үүнээс гадна дэлхий нийтийн анхаарлын төвд байгаа байгаль хамгаалах, ногоон орчин зэрэг үйл хэрэгт өөрийн гэсэн хувь нэмрээ оруулж ирсэн НҮБ өөрийн Ерөнхий Ассамблейд оролцох ажиглагчийн статусыг 2006 онд АСЕАН-д, харин АСЕАН “яриа хэлэлцээний түнш”-ийн статус НҮБ-д олгосон байна

Азийн хөгжлийн Банкны судалгаанаас харахад 2021 оны байдлаар Ази номхон далайн орнуудын гадаад худалдаанд ХАА-н бүтээгдэхүүний хувьд 46% нь бүрэн, 28% нь хэсэгчилсэн хэлбэрээр, мөн үйлдвэр үйлчилгээний 41% нь бүрэн, 25% нь ямар нэг хэмжээгээр ЧХХ-т хамрагджээ [5].

Монгол Улс бүс нутгийн чөлөөт худалдааны сүлжээнд нэгдэн орсноор жижиг дунд үйлдвэрлэлийн хөгжлийг дэмжих тогтолцоог бэхжүүлэх, түүнд хөдөө аж ахуйг

илүү түлхүү хамруулах, худалдаа үйлчилгээний либералчлалыг нэмэгдүүлэх чингэснээр бүсийн хэмжээний нэгдсэн эдийн засгийн интеграцад орох боломж буй болж бараа, үйлчилгээний чанар, өрсөлдөх чадвар, технологи, иновацийн чадамж нэмэгдэхээс гадна илүү өргөн зах зээл нээгдэнэ. Түүнчлэн хөдөлмөрийн хуваарийн дагналт хийгээд урт хугацааны бизнесийн өгөөж өсөх, олон улсын хөрөнгө оруулалт, технологийн дамжуулалт, нутагшуулалт хийгдэн худалдааны дүрэм хялбаршин элдэв хориг арга хэмжээ арилах сайн талтай гэж юм. Дэлхийн худалдааны байгууллагын гишүүн орон мөртлөө Монгол Улс одоогоор Японоос өөр ямар ч улстай чөлөөт худалдааны хэлэлцээр байгуулаагүй байгаа цорын ганц улс бөгөөд \Өнөөгийн байдлаар БНСУ-тай ЧХХ байгуулахаар судалгааны ажил, хэлэлцээ хийж байна\ энэ нь юуны өмнө Зүүн Азид улам бүр нэмэгдэж буй чөлөөт худалдааны олон улсын хэлэлцээрүүдийн олон улсын хэлэлцээр “„Noodle Bowl“ гэгчийн [3] дундах нэгэн онцгойрол болон харагдаж байгаа нь нууц биш юм. Харин интеграцийн ямар хэлбэрийг Монгол Улс тэргүүн эгнээнд хэрэгжүүлэх ёстой вэ гэдэг асуулт нэлээд эрсдэлтэй байгаа. Эдийн засгийн чухал түншүүдтэйгээ хоёр талын чөлөөт худалдааны хэлэлцээрийн сүлжээ байгуулах гэж чармайх нь бидний хувьд тийм ч зөв зүйл биш гэж үзнэ. Учир нь Монгол Улс зөвхөн ашигт малтмал дээр суурилсан, жижигхэн бөгөөд сулхан хөгжсөн эдийн засагтай орны хувьд БНХАУ, ОХУ зэрэг өөрийн шууд эдийн засгийн хамаарал бүхий улсуудтай яриа хэлэлцээ хийхэд анхнаасаа л сул дорой байр суурьтай байх магадлалтай.

Номхон далайн түншлэлийн Хэлэлцээр (ТНН)-ийн хувьд хоёр тивийг хамарсан эвслийн оролдлогуудын интеграцийн нөлөө одоо хүртэл тун чамлалттай байгаа бөгөөд ойрын үед өөрчлөгдөх магадлал маш бага байна. Тэгээд ч ТНН-д Хятад, Солонгос болон Орос байхгүй үүнээс гадна АНУ уг хэлэлцээрээс гарсан зэрэг нь ирээдүйг нь улам бүрхэг болгож байна. Ази-Номхон далайн эдийн засгийн хамтын ажиллагааны байгууллага АПЕК-т (Asia-Pacific Economic Cooperation, АПЕК) гишүүнээр орох магадлал Лаос, Камбож, Мьянмар зэрэгтэй харьцуулбал Номхон далайн гарцаас алс хол, өөр интеграцын сүлжээнд хамрагдаагүй Монголын хувьд тун бага юм.

Харин зөвхөн Европын Холбоо ч биш, сүүлийн үед маш амжилттай хөгжиж байгаа Зүүн Өмнөд Азийн бүс нутгийн хамтын ажиллагааны нийгэмлэг (АСЕАН) бол баялгийн хуваарилалт болон нийгэм эдийн засгийн хөгжлийг хөхүүлэн дэмжих нөлөө бүхий бүс нутгийн интеграцийн тод жишээ юм. Учир нь ийм интеграц бол оролцогч талууд зах зээлдээ харилцан нэвтрэх боломжийг нь нэмэгдүүлэн аж үйлдвэрийн болон эрчим хүчний үр ашигтай үйлдвэрлэлийг эрчимжүүлж, санхүүгийн ба хөрөнгө оруулалтын шинэ эх үүсвэрийг нээж өгдөг. Үүгээрээ уг бүс нутгийн орнуудын хөгжлийн янз бүрийн хурдацыг уялдуулахад тус дөхөм болж байгаа нь харагдаж байна.

Дүгнэлт

Монгол Улс олон чиглэлээр нэгэн зэрэг интеграцид орох маш их нөөц бололцоотой гэж үзэж байна. Бидний байгалийн баялгийн нөөц хийгээд газар зүйн байрлал тухайлбал, зөвхөн хоёрхон хөрштэй буюу хоёр том зах зээлийн дунд оршдогос гадна шууд хиллэдэг гуравдах хөршгүй болон далайд гарцгүй нөхцөл байдлыг харин ч бүр боломж бололцоо хэмээн авч үзэж болно.

Монгол Улсын эдийн засагт ойрын ирээдүйд шийдвэрлэх чухал нөлөөтэй гэж үзэхүйц байгалийн баялгаа боловсруулан борлуулахын тулд амархан хүрч болохуйц зах зээл хэрэгтэй байгаа. Монголын түүхий эдийн баялгийг худалдан авах сонирхол зөвхөн АНУ болон ЕХ-оор хязгаарлагдахгүй юм. Хамгийн сонирхолтой борлуулалтын зах зээл гэвэл ирэх жилүүдэд эдийн засгийн хөгжлийн өсөлтөөр АНУ болон ЕХ-ноос ч илүү байх өндөр магадлалтай бөгөөд бидний хувьд “хамар хашаагаа” тойроод л хүрэхүйц, зам тээврийн хувьд ойр дөт орших Япон, Өмнөд Солонгос, АСЕАН-ы орнууд болон ялангуяа Хятад Улсыг багтааж буй бүс нутаг юм. Бас нэг өөр аспект бол Монгол Улс бол зүйн хувьд Зүүн Хойт Азийн төвд байрлалтай, өөрөөр хэлбэл зүрхэнд нь оршдог бөгөөд үүгээрээ Оросын түхий эдийн болон эрчим хүчний зах зээлийг Хятадын аж үйлдвэрлэлээс өргөн хэмжээгээр зааглахаас гадна (Хятад улс бол Оросын хувьд эдүгээ худалдааны хамгийн том түнш болон хувираад байгаа) бас Хятадын аж үйлдвэржсэн зүүн хойд мужууд болон харьцангуй бага нээгдсэн баруун хойд мужуудын хооронд газар зүйн хувьд зааглах буюу нөгөө талаас авч үзвэл гүүр болох байрлалтай юм.

Мэдээж хэрэг, одоохондоо Монгол Улсад тээврийн болон эрчим хүчний дэд бүтцийн шинэчлэл болон өргөтгөлд хэрэгцээтэй хөрөнгө дутагдаж байгаа. Гэхдээ эцсийн дүндээ бүс нутгийн интеграцчилал л Монголын ирээдүйд эдийн засаг, улс төрийн нэн чухал бодит боломжуудыг буй болгоно гэсэн дүгнэлтэд хүргэж байна.

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ASIA-PACIFIC FREE TRADE AGREEMENT, REGIONAL ECONOMIC INTEGRATION AND MONGOLIA

Research note

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Abstract

Mongolia is believed to have great potential for simultaneous integration in many fields. Our natural resources and geographical location, such as having only two neighbours, being in the middle of two large markets, and having no direct border with a third neighbour and landlocked situation, can be considered an opportunity.

Mongolia's economy needs an easily accessible market to process and sell its natural resources, which are considered crucial in the near future. Interest in purchasing Mongolia's raw material wealth is not limited to the US and the EU. The most interesting sales market is that in the coming years, economic development growth will be higher than that of the USA and the EU. For us, Japan, South Korea, and ASEAN countries, which are close by road and can be reached just around our "nose fence", and especially is a region that includes China. Another aspect is that Mongolia is geographically located in the centre of Northeast Asia, i.e. in the heart of it, which not only separates Russia's raw material and energy markets from China's production (China is now Russia's largest trade partner and (which is changing) is also geographically positioned as a bridge between China's industrialised northeastern provinces and the relatively less developed northwestern provinces.

Of course, at the moment, Mongolia lacks the necessary funds to modernise and expand transportation and energy infrastructure. However, in the end, it leads to the conclusion that only regional integration will create significant real economic and political opportunities in the future of Mongolia.

Keywords: Free Trade Agreement (FTA); Trans-Pacific Partnership (TPP), Regional Comprehensive Economic Partnership (RCEP); Association of Southeast Asian Nations (ASEAN)



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