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SCIENTIFIC PAPER

GENETIC-BASED PERSONALIZED NUTRITION IN HUNGARY – IS THERE A VIABLE BUSINESS MODEL?

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Abstract: *A move from population-based nutrition guidance toward personalized nutrition may offer a more effective strategy than before to improve dietary habits of citizens worldwide. However, a significant number of consumers are not willing to adopt the highest level of personalization, i.e., gene-based personalized nutrition. The purpose of this paper is to examine whether there is a viable business model for genetically based personalized nutrition services in Hungary, and what business model would promote a higher level of consumer acceptance of the new technology. As a first step, a systematic Internet search was conducted to gather personalized nutrition counselling services that meet four criteria: they are related to nutrition; show some level of personalization; offer a product or service; and use some kind of consumer information to personalize a product or service. The second step was an expert content analysis of the service providers' websites to identify the nine elements of the Business Model Canvas, based in which business model archetypes were identified. We can conclude that the vast majority of services available in the Hungarian market are based on phenotypic information; gene-based personalized nutrition is only rarely found. Our results suggest that business models of the Hungarian market differ significantly from the models identified by previous research. Of the eight identified business model archetypes, the "All in one place" model would promote a higher level of consumer acceptance of nutrigenomics-based services.*

Keywords: *personalized nutrition, nutrigenomics, genetic-based nutrition, business model*
JEL Code: I12, M31

INTRODUCTION

Efforts to improve eating habits in recent decades have not been very effective, resulting in an increase in the incidence of nutrition-related diseases worldwide. Chronic diseases such as obesity, diabetes, cardiovascular diseases and cancers are currently responsible for 71% of all deaths (WHO, 2018), while improving diet and lifestyle could prevent 80% of them (FALLAIZE et al. 2013). This raises the question of developing new, more effective strategies to change eating habits (FALLAIZE et al. 2013; BOUWMAN et al. 2005) to move individuals toward healthier eating. Part of this may be a shift from dietary recommendations for the entire population to personalized nutrition (FALLAIZE et al. 2013).

Personalized nutrition includes three levels (FISCHER et al. 2016; GIBNEY and WALSCH 2013; RIMBACH and MINIHANE, 2009): the first, least person-dependent level is personalized nutrition counselling based on individual lifestyle (including nutrition information). The second level is based on phenotypic information (e.g., anthropometric, clinical parameters, and biochemical markers of nutritional status); and only the third level is personalized counselling using genetic information (RONTELTAP et al. 2013), providing the most accurate results.

In the early 2000s, some claimed that nutrigenomics had already reached the commercialization phase (MULLER and KERSTEN, 2003), and more than a decade ago several researchers had predicted that nutrigenomics would find its place in mainstream healthy eating within a few (i.e. 10-15) years. According to them we would have a list not only of what is healthy and what is not based on our specific genetic profile, but also of how much and at what intervals nutrients should be consumed (BOLAND, 2008; VAN EST and HANSSEN, 2003). At the same time, experts in various disciplines in nutrigenomics (e.g., molecular biologists, food scientists, bioethicists, government agencies, food

and biotechnology companies, NGOs, including primarily patient rights advocates) expected the market introduction of genetically based nutrition advice or food products between 2010 and 2050; their average forecast was 2020 (RONTELTAP et al. 2007). According to RONTELTAP et al. (2013), the vast majority of personalized services available on the market belong to the first level; a significant part of them relies on phenotypic information, while although the third level of personalized nutrition has already appeared on the market, gene-based personalized nutrition is still not a mainstream activity in the market. This is partly due to consumer ignorance or even fear of the risks and costs of the new technology, which has been supported by a number of studies (BEREZOWSKA et al. 2015; BEREZOWSKA et al. 2014a; BEREZOWSKA et al. 2014b; STEWART-KNOX et al. 2013; WENDEL et al. 2013; MORIN, 2009). Although a significant proportion of consumers worldwide would be willing to follow a genetic test-based personalized diet (among European consumers, the willingness varies between about 13 and 39% (STEWART-KNOX et al. 2009), in some countries it may reach 45 (ROOSEN et al. 2008) and even 70% (AHLGREN et al. 2013), but not nearly everyone. According to Hungarian research studies, openness of domestic consumers to genetic-based personalized nutrition is lower than that of most foreign consumers: 27% in 2014 and 23.5% in 2019 would have been willing to try the new technology (SZAKÁLY et al. 2021; SZAKÁLY et al. 2014). Thus, despite the greater benefits of personalization than in case of the lower two levels based on more accurate information, consumers do not seem to be willing to take full advantage of the potential of genetically based personalized nutrition en masse; consumer acceptance of nutrigenomics-based personalized nutrition is much lower compared to personalized nutrition based on lifestyle and phenotypic information (RONTELTAP et al. 2013).

Based on these, the question arises as to whether there is a viable business model for genetically based personalized nutrition services at all, and what business model would promote a higher level of consumer acceptance of the new technology. To the best of the authors' knowledge, the issue has so far been investigated by a single study (RONTELTAP et al. 2013) in the case of services available in English and Dutch, so not specifically in the Hungarian market. To answer our research questions, we identified business models of personalized nutrition services that have been operated for years or even decades, some of which can be followed by gene-based personalized nutrition service providers.

MATERIALS AND METHODS

The starting point of the research methodology was the study by RONTELTAP et al. (2013), which was modified to take into account Hungarian specifics.

As a first step, we conducted an Internet search using the Google search engine in September 2020 to gather personalized nutrition counselling services that meet four criteria: they are related to nutrition; show some level of personalization; offer a product or service; and use some kind of consumer information to personalize a product or service. In our searches the Hungarian synonyms of these criteria were systematically combined, two-word expressions without quotation marks and also with quotation marks (Table 1). We conducted a total of 400 searches, and compiled an inventory of websites providing personalized nutrition services that met the four criteria. The results of a given search term were examined to the saturation point, i.e., we stopped at the result page where no new inventory hit appeared. Only pages that are (also) available in Hungarian were examined, as the research focused on services targeting Hungarian consumers.

The second step was to analyse the content of the websites in the inventory (expert content analysis). For each website, both authors individually recorded the nine elements of the "Business Model Canvas" developed by OSTERWALDER and PIGNEUR (2010), which are the building blocks of business models: 1. consumer segments (the company's target group), 2. value proposition (how consumer problems are solved, needs are satisfied), 3. channels (communication and distribution channels), 4. customer relations (way of communicating with segments), 5. revenue sources (in exchange of the value proposition), 6. key resources (these are needed to implement the previous elements), 7. key activities (in order for the company to provide the previous elements), 8. key partners (who perform outsourced activities and provide resources), 9. cost structure (cost aspects of the other elements). In addition, we recorded the type of personal information collected from customers and the prices of the service. After the compilation of the inventory with the business model elements by both authors, possible differences were discussed and consensus was developed, thus, the business model elements were finalized.

We then explored the similarities and differences between the items in the inventory in terms of the business model, again individually. Among the canvas elements, first we reviewed the key value proposition for each business model, followed by key activities, resources, and channels, consumer

Table 1: Criteria and search terms considered using the Google search engine.

Criteria	Search terms (Hungarian)	Search terms (English)
1. nutrition	táplálkozás, étkezés	nutrition, eating
2. personalization	személyre szabott, „személyre szabott", egyéni, személyes	personalized, individual, personal
3. product	diéta, tanácsadás, ajánlás, terv, étrend	diet, advice, recommendation, plan, menu
4. consumer information	nutrigenomika, genomika, nutrigenetika, genetika, fenotípus, genotípus, fenotipikus, genotipikus, metabolikus egyensúly, „metabolikus egyensúly"	nutrigenomics, genomics, nutrigenetics, genetics, phenotype, genotype, phenotypic, genotypic, metabolic balance, „metabolic balance"

Source: Authors own construction

segments, and finally customer relationships, revenue sources, key partnerships, and cost structure. Based on this review both authors individually identified archetypical approaches to personalized nutrition. Archetypes with their items identified by each of the authors then were compared and differences were discussed. After a consensus was achieved, final archetypes were set.

Besides the identification of business model archetypes for personalized service providers, the providers' key features are also described, primarily by basic descriptive statistics (frequencies, mean, standard deviation); average prices of providers of services at different personalization levels, however, are compared by independent samples t tests.

RESULTS AND DISCUSSION

Our web searches based on the described methodology resulted in a total of 114 service providers that met all four of our predefined criteria, so these were analysed further. It is worth noting that compared to the study of RONTELTAP et al. (2013), this number of providers found with the same search methodology is significantly higher in a much smaller market than the one targeting English- and Dutch-speaking consumers (76 service providers were found by RONTELTAP et al. 2013), which suggests an increasing interest in personalized nutrition in Hungary in the last decade.

Key features of personalized nutrition service providers

The vast majority (67 or 58.8%) of the 106 providers offering clear information on personalization level provide personalized nutrition services based on lifestyle-nutritional information (supplemented by some basic personal background variables such as gender, age, and BMI) as well as phenotypic information (e.g., metabolic type, body composition, body fat, waist-to-hip ratio, blood pressure, nutritional status, blood sugar and cholesterol levels). 30 providers (26.3%) personalize their nutrition advice based on basic lifestyle-nutrition information only, and only a few (9 or 7.9%) build on nutrigenomic information. These results differ significantly from those of RONTELTAP et al. (2013), where the majority of providers (52.6%) personalized their services at the first level, while 35.5% at the second level, and 11.8% used nutrigenomics.

The prices of personalized nutrition counselling were examined on the basis of the price information available on the websites (92 cases), by considering the largest package of services available, and if the possibility was explicitly referred to, one health check-up/control was considered. Prices show large differences, ranging from free to HUF 381,000 or EUR 1,066 (mean: HUF 66,405 or EUR 186, standard deviation: HUF 62,851 or EUR 176). Significant differences can be found in the average prices for the three levels of personalization; similar to the findings of RONTELTAP et al. (2013), the more personal information the service provider requests, the higher the price. The cheapest service is counselling based on nutritional-lifestyle information only (mean: HUF 46,411 or EUR 130, st. dev.: HUF 32,064 or 90 EUR), followed by advice based on phenotypic information (mean: HUF 60,229 or EUR 168, st. dev.: HUF 49,390 or EUR 138), average prices of which, however, do not differ significantly from those of the previous level ($p=0,212$). The highest average price can be found at those providing genetically based personalized services (mean: HUF 205,500 or EUR 575, st. dev.: HUF 115,591 or EUR 323), which is significantly higher than the average prices of the other two types ($p=0.019$ and $p=0.027$, respectively).

Based on the results, it is likely that Hungarian consumers are more willing to choose a service based on phenotypic information, which is not significantly more expensive, but allows for a more precise personalization compared to purely lifestyle-based personalization, resulting in a higher level of demand for the former services. From the service provider's point of view, the fact that a number of new measurement tools providing phenotypic information have appeared on the market or become cheaper in recent years helps to adjust to demand. These factors explain the higher level of supply for phenotypic information-based services in the Hungarian market compared to the supply level found by RONTELTAP et al. (2013). There is, however, a difference in magnitude of average prices between levels 2 and 3, which can be stepped over by only a small proportion of Hungarian consumers, generating a much lower demand for gene-based personalized nutrition compared to the lower two levels of personalization.

Among the key activities, we first considered the requested personal information (see the level personalization above) and the service elements that are part of the offer. Regarding the type of personalized offers, it can be stated that most (i.e., 102) service providers offer personalized nutrition counselling and 61 of them supplement this with diet planning and sample diet compilation; 9 pursues the latter activities independently, without advice. In addition, 55 providers offer lifestyle advice in a broader sense (in some cases, including a personalized workout plan), and 8 provide shopping lists. Finally, 32 companies also offer other products and services, including food supplements (14 cases), books (7), e-books (6), online community (7), food delivery (5), helping coach/mentor (4), menu designer (2), diet cooking course (2), and mobile application (1). Beside these, 42 providers offer their own machine measurements, too. It should be noted that the sum of the values is higher than the 114 cases in the inventory, as many service providers offer multi-item offers.

For the vast majority of companies providing personalized nutrition services (93 providers), human resources are the most important resource (most often dietary expertise (72), medical expertise (17), coaching expertise (8), and international expert background (4) and experience (4)), a significant proportion of them (21) also rely on infrastructural resources (including working with or having access to some special equipment, laboratory, testing, or kitchen), and some build on high brand value and recognition (4). Again, the sum of the values is higher than the 114 cases in the inventory, as many providers rely on a variety of key resources.

The vast majority (86 cases) of service providers use a personal channel to reach customers. In addition to or instead of this, they also consult via e-mail (28), webcam (26), telephone (17), website (13), and Facebook-page or text message (1). Physical products (sampling kits, books, food) are delivered by post or courier (17). Through these channels, customer relationships are managed individually by all service providers, however, in three cases the use of the service begins in groups. Out of all service providers in the inventory 30 (26.3%) come into contact with customers only once, whereas 43 (37.7%) promise one health check-up after the first consultation, and 41 (36.0%) multiple check-ups or continuous follow-ups for a few weeks/months. The sum of the values is higher than the 114 cases in the inventory, as many service providers use multiple channels to reach customers.

Seven target groups have been identified in the case of the examined service providers. These often did not appear as separate segments but as a combination, and such combined segments were considered for each related target group. Most providers target the segments of health-conscious (those who wish to maintain or improve health or prevent diseases; who follow reform diets – e.g., vegetarians and vegans; and who want a more energetic life) (78 cases) and those who want to achieve their ideal weight and appearance (who wish to lose or gain weight, or to build lean muscles) (77). It is worth noting that of those wishing to achieve the ideal weight, the majority of providers focus at least on those who wish to lose weight (72). In addition, people with various health problems (such as hormonal and thyroid problems, PCO, insulin resistance, digestive problems, diabetes, food allergies and intolerances, high blood pressure, eating disorders, skin problems) is also a popular target group (70). The other four target groups are much less targeted; women (in general; those wishing to have a baby; pregnant and breastfeeding mothers; those in menopausal transition) were targeted by 26 service providers; athletes and sport nutritionists by 22; infants, children, and adolescents by 9; and B2B customers by 5. The share of service providers targeting B2B customers, i.e., employers who purchase the service for their employees, is slightly lower in the Hungarian market than in the research of RONTELTAP et al. (2013) (6 out of 76); the low ratio indicates that the vast majority of Hungarian employers do not yet feel that it is important to provide this type of employer benefit. In addition to these segments, in 1-1 cases there could be identified other target groups (busy, wealthy individuals, those looking for premium service, and those around 30 years of age).

Based on our results, it can also be stated that the majority of service providers target 2 or 3 segments (27 or 23.7% and 33 or 28.9%, respectively), although the number of those pursuing a one-segment strategy is also significant (31 or 27.2%). Four segments are targeted by 20 (17.5%), while the most, i.e., 5 segments are targeted by only 6 providers (4.4%). The most popular target segment combination (for 20 providers, 17.5%) includes the segments of those who want an ideal weight and those who are health-conscious and have health problems.

The revenues of personalized nutrition providers come predominantly from nutrition and lifestyle counselling. A significant part of the service providers (55, 48.2%) also provide other services with counselling in one package (e.g., control, measurements, diet planning). 55 service providers (48.2%), on the other hand, do not sell the elements of their offer (control, measurements, diet planning, food supplements, books, food delivery) in packages, but separately; some combine two items at a time (in 2-2 cases, counselling and control, and counselling and diet planning (1.8-1.8%)), while charging a separate price for the others.

Of the examined providers of personalized nutrition services, the largest number cooperate with health care funds (22 providers, 19.3%), in addition, some providers partner with nutrition- and health-related actors (8, 7.0%), genetic and other testing laboratories (8 7.0%), hospitals, clinics, and health professionals (6, 5.3%), food companies and sports equipment manufacturers (2-2, 1.8-1.8%), the National Public Health and Medical Officer Service (2, 1.8%), and pharmaceutical companies (1, 0.9%).

BUSINESS MODEL ARCHETYPES OF PERSONALIZED NUTRITION

Using the nine elements of the business model canvas (OSTERWALDER and PIGNEUR, 2010), based on expert judgement, the following eight business model archetypes have been identified (see Appendix).

"Standing strong together": The most important part of its value proposition is to address weight loss with community support. Community support (or a certain degree of community pressure) contributes to a higher level of self-control and following advice. In all cases, the key activities include specific diet planning (sample diets) offered together with food recipes, and in several cases the sale of food supplements and healthy food. The vast majority of providers belonging to this type base their advices on dietary-lifestyle information, while a minority on phenotypic information.

"Health club": The value proposition of this type typically builds on a broader lifestyle change that addresses weight management, appearance, and fitness. It also includes different types of workouts as well as sales of food supplements.

"Do-it-yourself-healthy-diets": The main value proposition in this case is some kind of diagnostic tool (e.g., questionnaire, machine measurement), with which providers collect nutritional-lifestyle and phenotypic information (in most cases metabolic type). The channel for requesting dietary-lifestyle information is usually the Internet, and personal in case of machine measurement. There are few follow-up options, which is usually initiated by the customer. The target group consists mostly of those who want to eat healthier.

"Innovative do-it-yourself-diets": This archetype can be seen as an extension of the previous one in two ways. First, providers offer personalized advice based on genetic and novel phenotypic information (e.g., microbiome, hair tissue analysis), and second, in most cases the counselling includes broader lifestyle advice in addition to nutrition recommendations. The channel is personal for most service providers and the Internet for a smaller number of them, in addition to which genetic tests

themselves are delivered through physical distribution channels (post office, courier services). Similarly to the previous type, there is limited, mostly customer-initiated follow-up in this type. The main target group typically consists of health-conscious consumers here as well.

"All the way with you": The main feature of this type is that the service provider holds the customer's hand all the way by providing long-time assistance and intensive communication for a successful, sustainable lifestyle change. Most of the time, this means using personal channels, but there are also a significant number of services provided over the Internet. Similarly to the previous archetype, a wide range of lifestyle advice (mostly on exercise) is offered together with nutritional recommendations. In addition to the health-conscious customers, these providers also target those who want the ideal body weight.

"Heal with nutrition": The most important distinguishing feature of its value proposition is the promise of healing as well as treatment for different health problems. The vast majority of providers offer nutritional advice based on phenotypic information, and some also offer diet planning. With one exception, they reach customers through a personal channel.

"All in one place": As with the previous type, the most important part of the value proposition here is the promise of healing, but with the support of a professional health care background. The majority of service providers collect phenotypic information, while some collect only lifestyle information from customers. This information is then used as the basis for dietary advice and/or sample diets, but there is no other part of the offer. Without exception, customer relationship management is established through a personal channel; health check-up can be initiated by the customer. The majority also provide access to financing through health care funds.

"Convenient diet": This type elevates healthy eating and lifestyle changes to the most comfortable level possible, as the providers offer food delivery, so the customer only has to eat what is prepared exactly for him/her. In addition, in half of the cases belonging to this type, part of the revenue comes from the sale of nutrition-related books. The target group consists primarily of those who wish to lose weight, and they are asked for phenotypic information.

Comparing our results to those of RONTELTAP et al. (2013), it can be noticed that only some of the business models identified here ("Standing strong together", "Health club", "Do-it-yourself-healthy-diets") appeared in the previous research, therefore the Hungarian market significantly differs from the international market of eight years ago. Of the types identified in the present research, most providers fall into the "All the way with you" and "All in one place" archetypes, of which the latter business model may be the best analogy for nutrigenomics-based personalized service providers to follow, for more than one reason. First, the professional health care background needed to interpret genetic tests is available here. Second, there are only limited opportunities for follow-ups in this type, which does not increase the already high cost of gene-based nutrition services. Finally, financing through health care funds can help alleviate these high service costs. Due to the reasons above, the use of the "All in one place" business model could increase consumer acceptance of nutrigenomics-based personalized nutrition.

CONCLUSIONS

The aim of our research was to identify a viable business model for genetically based personalized nutrition in the Hungarian market. According to our results, the vast majority of services available in the Hungarian market are based on phenotypic information; gene-based personalized nutrition is only rarely found. Eight archetypical business models of personalized nutrition have been identified, of which the "All in one place" model could be the best one to follow for providers of genetically based personalized nutrition services.

The current research is unique in its kind; no such study has been conducted in Hungary so far. To the best of the authors' knowledge there is only one similar research (RONTELTAP et al. 2013) aimed to reveal business models for personalized nutrition services; however, it was conducted in English and Dutch, therefore service providers targeting international rather than Hungarian customers were addressed. An interesting future research direction is to examine business models of personalized nutrition in other markets and to compare the results with the results of the present and the previous research studies.

One of the limitations of the current research is that the full range of companies providing personalized nutrition services have not been examined; moreover, the sample composition is influenced by the methodology used for the Internet search. Therefore, generalizability of the results is somewhat limited; however, our results can draw attention to prevailing trends. Besides, the identification of business model archetypes relies on expert judgment and is therefore subjective to a certain degree.

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APPENDIX

Table A1: Business model archetypes of personalized nutrition

"Standing strong together"	
1. Dietetikusod	https://dietetikusod.hu/
2. Egészség és Diéta	https://egeszsegesdieta.eu/
3. Fitmeal	https://fitmeal.hu/
4. Formami	https://formami.hu/
5. Kolly fitness blogja	https://www.kolly.hu/etrendtervezes/
6. Krámli Anita	http://kramlianita.hu/eletmod/
7. Medifat	http://medifat.hu/genek_es_az_egeszseges_fogyas
"Health club"	
1. Biotech USA	https://biotechusa.hu/lifestyle/
2. Elite Stúdió	http://elitestudio.hu/SZOLGaLTATaSOK/GENETIKAI_TaPLaLKOZaS.html
3. Quintess Egészségközpont	http://www.quintess.hu/
4. Teljesítményfokozó Team	http://teljesitmenyfokozo.hu/
5. Testszerviz	https://testszerviz.hu/
"Do-it-yourself-healthy-diets"	
1. Anya és Gyermek Természetgyógyászat	http://www.anyagyermek.hu/szolgaltatasaink/taplalkozasi-tanacsadas
2. Babalesz	https://www.babalesz.hu/termekenyseg-tamogato-termekek/hormonegyensuly-tanacsadas/
3. Benyovszky Orvosi Központ	https://www.orvosikozpont.hu/dietetika/
4. Dr. Kriston Ildikó	https://kristonildiko.hu/taplalkozasi-es-eletmod-tanacsadas/
5. Genetikai Táplálkozás	http://genetikaitaplalkozas.hu/
6. Mitevő	https://mitevo.com/
7. New Day Apartments	http://www.newdayhotel.eu/orvosaink
8. Preventissimo	http://www.preventissimo.hu/a-preventissimorol
9. Profitt Diéta	https://profitt-dieta.hu/
10. Répási Eszter	http://www.repasieszter.hu/
11. Rofe	https://rofe.hu/kezelesek/dietetika-eletmod-taplalkozasi-tanacsadas/
12. Táplálkozásbeállítás	https://taplalkozasbeallitas.hu/
13. Tóth Boglárka	https://tothbogi.cafeblog.hu/
14. Tudatos Egészség Centrum	https://tudatosegeszseg.hu/szolgaltatasok/funkcionalis-taplalkozas-tanacsadas-szemelyre-szabva/
15. Vércsoportteszt	https://vercsoportteszt.hu/miert-fontos/szemelyre-szabott-eletmod/
16. Wáberer Medical Center	https://wmc.hu/dietetika/
17. Wellbalance	http://wellbalance.hu/genetikai_taplalkozas
"Innovative do-it-yourself-diets"	
1. Amway - Bodykey Nutrilite	https://bodykey.hu/public/
2. Arcfiatalitás Pécs	https://www.arcfiatalitaspecs.hu/gentesztek/
3. Atlas Biomed	https://atlasbiomed.com/hu/microbiome/nutrition
4. DNAnutryControl	https://taplalkozasgenetika.hu/
5. Exom	http://www.exom.hu/szolgaltatas.php?p=szszo
6. Fittgének	https://fittgenek.hu/termek/body/
7. Gellért Medical	https://www.gellertlabor.hu/hirek/2019-01-14_taplalkozasi-genterkep
8. Hajszövetelemzés	https://hajszovetelemzes.hu/2015/04/11/testsuly-kontroll-es-tartos-fogyas-hajszovet-analizis-segitsegevel/
9. Medifitness	https://www.medicalfitness.hu/gen-elemzes/
10. New Era Genetics	http://work.gfx.hu/newera_work/nutrigenetikai.html
11. Sportgenetika	http://sportgenetika.hu/
"All the way with you"	
1. Alfa Egészségközpont	https://www.alfaegeszsegkozpont.hu/Szakterulet/Dietetika
2. Anyagcseretípus-mérés	https://anyagcseretipusmeres.hu/programok.html
3. Bence Mária	http://www.adietetikus.hu/egyeni-tanacsadas/
4. Bezzeg Ramóna	https://www.bezzegramona.hu/etrendtervezes
5. Bodywakes	https://bodywakes.hu/taplalkozasi-tanacsadas
6. Derma-Art Klinika	https://www.dermaart.hu/szolgaltatasok/esztetikai-borgyogyaszat/orvosi-fogyokura
7. DiaVitas Életmód Program	https://www.diavitas.hu/programunk/
8. Dietaktika	http://dietaktika.hu/insumed-rendszer
9. Diétás étrend.hu	https://dietasetrend.hu/

10.	Dietetika	https://dietoterapia.hu/
11.	Egészséges táplálkozás	https://www.egeszsegestaplalkozas.com/
12.	Életmód Orvosi Központ	https://www.eletmodorvosikozpont.hu/taplalkozasi_tanacsadas
13.	Életmód-Navigátor	https://eletmod-navigator.hu/dietas-etrend-vagy-szemelyre-szabott-taplalkozas/
14.	Fannizero	https://www.fannizero.hu/main.php
15.	Feelgoodsmart	https://feelgoodsmart.com/okos-taplalkozas.html
16.	Fitlife – HB	https://fitlife-hb.hu/programok/
17.	Fittdiéta	https://fittdieta.hu/
18.	Fittétrend	https://fittetrend.hu/
19.	Freya Szalon	https://freyaszalon.hu/szolgaltatasok/kategoria/taplalkozas-tipus-meghatarozas
20.	Genetikai Alapú Táplálkozás	https://taplalkozas-eletmod.hu/
21.	Kiss Virág	https://kissvirag.com/szemelyre-szabott-etrendek/
22.	Laser Dental	http://www.laserdental.hu/dietetika/
23.	LifeLike Egészségügyi és Mozgásdiagnosztikai Központ	https://life-like.hu/rekreacio/
24.	Málnárium	https://malnarium-vac.hu/genetikai-anyagcsere-tipus-meresrol-roviden-es-tomoren
25.	Mozdulj Anyu	http://mozduljanyu.hu/
26.	Naturhouse	https://naturhouse.hu/
27.	Nutriexpert	https://nutriexpert.hu/
28.	Nutrifit by Sophie	https://www.nutrifitbysophie.com/
29.	Oxygen Wellness-Fitness	https://oxygenwellness.hu/taplalkozasi-tanacsadas/
30.	Perjes Kinga	https://www.perjeskinga.com/tanacsadas.html
31.	Shape Bakery	https://shapebakery.hu/szemelyre-szabott-etrend-tervezes/
32.	Sportkontroll	https://sportkontroll.hu/etrendbeallitas/
"Heal with nutrition"		
1.	Aranytű rendelő, Szabó Richárd dietetikus	http://aranytu.hu/?cat=11
2.	Greff Brigitta	https://greffbrigitta.hu/
3.	Hormontanácsadás	https://www.hormontanacsadas.hu/tanacsadas/arak
4.	Madách11 Magánrendelő	http://www.madach11.hu/
5.	MeDoc	https://medocklinika.hu/szolgaltatasaink/dietetika
6.	Modiet	https://moderndietetika.com/tanacsadas/
7.	Paleo Medicina	https://paleomedicina.com/hu/blog/2015/10/letezike-egyeni-anyagcsere-tipus-szemelyre-szabott-etrend-taplalkozasbeallitas
8.	Physio Timi	https://www.gerinctorna-reflexologia.hu/hormonegyensuly-taplalkozasi-tanacsadas/
9.	Tenuitas Egészség Stúdió	http://tenuitas.hu/arlista/
10.	Vastagbél.hu	http://vastagbel.hu/index.php/szolgaltatas/taplalkozas
11.	Your Health Academy	https://yourhealth.store/taplalkozasiprofil/
"All in one place"		
1.	Aranyklinika	https://aranyklinika.hu/szakrendelesek/dietetika/
2.	Árvai-Barta MED Magánklinika	https://arvai-barta.hu/dietetika
3.	Budai Corvin Orvosi Magánrendelő	http://www.corvinorvosirendelo.hu/dietetika_/
4.	Budai Egészségközpont	https://bhc.hu/szolgaltatasaink/szakrendelesek/dietetika/
5.	Budai Endokrinközpont	https://www.endokrinkozpont.hu/dietetikai-tanacsadas
6.	CMC Déli Klinika	https://deliklinika.hu/szakrendeleseink/dietetika/
7.	Da Vinci Magánklinika	https://davincimaganklinika.hu/hu/szolgaltatasaink/dietetika
8.	Duna Medical Center	https://www.dunamedicalcenter.org/hu/szakterulet/dietetika
9.	Endocare	https://endocare.hu/dietetikai-tanacsadas/
10.	Endomedix	https://gasztroenterologia-kozpontok.hu/vizsgalatok/dietetikai-tanacsadas
11.	Erzsébet Fürdő Gyógyászati és Szűrőközpont	https://www.erzsebetfurdo.hu/rendeleseink/dietetika/
12.	FirstMed	https://firstmedcenters.com/hu/szakrendelesek/
13.	For Life Medical Center	https://forlifemedical.hu/hu/szolgaltatasok/dietetika-szakrendeles
14.	Geomedical Egészségügyi Központ	https://geomedical.hu/service/dietetika/
15.	IGD klinika	https://igdklinika.hu/dietetikai-szaktanacsadas/
16.	Kelen Kórház	https://kelen.hu/szakorvosi-konzultacio-es-szeklet-genomikai-vizsgalat/
17.	Maternity Szülészeti és Nőgyógyászati Magánklinika	https://maternity.hu/maternity-rendelo/tovabbi-szakrendelesek/dietetika/
18.	Medicover	https://medicover.hu/szakrendelesek/dietetika/
19.	Mentaház	https://mentahaz.hu/szakrendelesek/felnott-szakrendelesek/dietetika
20.	Oktogon Medical Center	https://www.oktogonmedical.hu/dietetika
21.	Oliva Med Magánklinika	https://olivamed.eu/szakrendelesek/dietetikai-taplalkozasi-szaktanacsadas
22.	PrevMed	https://prevmed.hu/home/
23.	Rózsadomb Medical Center	https://r-medical.hu/ir-ambulancia-az-inzulinrezisztencia-korszeru-es-komplex-kezelese

24.	Sanitas Corporis	http://www.sanitascorporis.hu/eletmod-terapia/
25.	Sportorvosi Központ	https://www.sportorvosikozpont.hu/teljesitmeny-optimalizalas/sporttaplalkozasi-tanacsadas
26.	Versys Clinics	https://versysclinics.com/szakteruleteink/dietetika
27.	Vitalorg	http://vitalorg.hu/project/dietetika/
"Convenient diet"		
1.	Bocsi Viki	https://bocsiviki.hu/hu
2.	Energiakonyha	https://energiakonyha.hu/rolunk/
3.	Metodic	https://metodic.hu/szolgaltatasok/
4.	Naturwell	http://www.naturwell.hu/index.php?page=20

Source: Authors' own compilation

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SCIENTIFIC PAPER

GASSESSMENT OF WOMEN FARMERS' CREDIT NEEDS IN IMBULPE DS DIVISION IN SRI LANKA

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Abstract: *The study was conducted to identify the role of women farmers' credit needs, using Imbulpe (Divisional Secretariat) DS Division in Sri Lanka. As the sample size of study 238 women farmers were selected from seven selected (Grama Niladhari) GN divisions of the study area. This study was conducted to identify the areas and level of credit needed by women farmers. And also, the agricultural credit sources of was identified. Women farmers were selected by using the simple random sampling method. Questionnaire Survey was used as the data collection method from March to July 2019. Descriptive statistics was used for the data analyzing process and the result showed that, 59.7 % of the women farmers were observed within the middle ages (40-59 years), most of them were married, and 4-5 members within their family. 64.3 % of women farmers were studied up to secondary level education. Majority of the women farmers were noted that they need credit facilities for the application of agrochemicals and fertilizers. In Addition to that, utilization of modern farming technologies, transportation & marketing of agricultural products and purchasing improved seeds & livestock related credit neediness most important for them. And also, they were showed a less interest regarding the credit neediness for pre-planting activities, irrigation facilities and harvesting activities. Most of the respondents were indicated high level of credit neediness for the application of agrochemicals and fertilizers and utilization of modern farming technologies while moderate and low level of agricultural credit neediness regarding the pre-planting activities, irrigation facilities and harvesting activities within the study area. Majority of the respondents were showed savings from the previous agricultural earnings and other family member or fellow women as their major credit sources of agricultural activities. Private money lenders act as the least important credit source for agricultural activities in the study area.*

Keywords: *Agricultural information, Imbulpe, Credit needs, Sri Lanka, Women farmers.*
JEL Code: Q1, Q12

INTRODUCTION

Gender equity is act as the major force to achieve the sustainable development of a country in the globe (UNITED NATIONS-UN., 2020; UNDP, 2017; KHAN et al., 2017). Researchers provide evidences from their previous studies, about the invisibility of women contribution to the social development of the particular country. That is the root cause for assess the contribution of farm women for the development of country through identifying their credit needs on food production activities (GLAZEBROOK et al., 2020; FAO., 2011).

In developing countries, majority of women farmers are engaging with the traditional farming practices of planting, weeding, harvesting and post-harvest management related activities. Therefore rural women dominate within the subsistence farming operations rather than the commercial farming. When considering about the developed nations in the world, their agricultural operations are mechanized and considerably low level of women involvement is more conspicuous (RATHNACHANDRA and MALKANTHI.,2020; IBHARHOKANRHOWA., 2016; MALKANTHI., 2016).

Men upgrade their capabilities related to their education level, modern farming accessibility, agricultural information access and also the credit neediness (FAO, 2018). Credit neediness of the agricultural sector is act as a key component in improving small-scale agricultural production and linking them to the agricultural markets, thus upgrading the status of the rural livelihoods, more quality yield and food security of the global population (FAO., 2020).

The demand for agricultural credit facilities are prevalent by the economic and social factors in most of the rural areas of developing countries. Access to credit facilities are allow for low income farmers to afford to use fertilizer on food crops is a major problem in virtually all of the developing countries (MUSEMBI., 2019).

Women empowerment can be achieve by allowing them to take decisions within the household, having proper social networks, having proper access to financial and economic resources, more bargaining power with their husbands

within the family and having considerable freedom of mobility (RATHNACHANDRA and MALKANTHI.,2020; IBHARHOKANRHOWA.,2016). However, women still suffering from various difficulties for the access of such kind of credit facilities. The major case of lower accessibility of credit facilities, the rural women has low level of literacy and dependent on their husbands for the agricultural inputs (UN., 2018; IBHARHOKANRHOWA., 2016). Agricultural credit obtain with the several credit vehicles for financing the agricultural transactions, including loans, notes, bills of exchange and bankers acceptances etc. These types of financing methods are adapted to the specific financial needs of farmers, which are determined by planting, harvesting and marketing operations. In other words credit is regarded as a major factor for both agricultural development and rural development (UKWUABA et al., 2020; IJIOMA and OSONDU., 2015). Therefore, proper agricultural credit system is an essential requirement to obtain a significant improvement in food production (ASGHAR and SALMAN., 2018). The government is motivating to bloom the overall development through a viable and sustainable financial system for the agricultural sector. This situation cause to build-up an improvement in the accessibility of credit and other financial services (including banking) to the rural farmers (WORLD BANK., 2020; ASIAN DEVELOPMENT BANK., 2017).

In Sri Lanka, about 14.4% of the economically active women is represent from the rural sector. (MADURAWALA., 2018; ANNUAL LABOR FORCE REPORTS, 2017).

Women contribution in farming activities is gradually uplift the national economy of Sri Lanka. Rural women are contributed their effort for the agricultural sector rather than service sector (ANNUAL LABOR FORCE REPORTS, 2017).

Imbulpe DS Division consists with the agriculture sector rather than service sector and women support for the farming activities behind with men (CENSUS AND STATISTICS OF AGRICULTURE BASE REPORT –RATHNAPURA DISTRICT, 2013/14). Therefore, most of the women are engaged in farming activities within the study area. Based on the statistics of the Imbulpe divisional secretariat office, average monthly income of the household is about LKR 20, 000- 30,000 and also agricultural related activities are support to fulfill their financial requirements.

But there is no proper identification of the agricultural credit needs of women farmers in the study area. Sources of agricultural credit facilities is involve to build up higher women farmer capacity and directed to empower them. This study conducted to identify the rural women farmer's agricultural credit needs and level of agricultural credit needs of women farmers in the study area. In addition to that, to identify the sources of agricultural credit sources in Imbulpe area.

MATERIALS AND METHODS

Imbulpe DS Division is situated in Rathnapura district in Sabaragamuwa province of Sri Lanka. Agricultural activities are more prominent within the study area. And also, considerable share of men are working in urban areas. Therefore, majority of women are contributing their effort in farming activities.

Imbulpe area consists with fifty GN divisions and only seven representing GN divisions of the study area namely Halpe, Seelogama, Kinchigune, Puwakgahawela and Muttettuwegama, Imbulpe and Karagastalawa were used to select the respondents of the study. These GN divisions represent the large amount of women farmers who registered under the Agrarian Service Center of the study area than the other GN divisions. 238 women farmers were selected through the simple random sampling method as the sample and a pilot study was conducted to make sure the requirement of enough amount of primary data for the further analyzing process of the study. Pre-tested, interviewer-administered questionnaire survey was used as the primary data collection method from March to July 2019 and the data analysis was done by using descriptive statistics. A list of selected areas of agricultural credit needs were presented to the women farmers in the study area. They determined their required level of credit neediness by ranking their credit needs as very high (5), high (4), moderate (3), low (2) and very low (1). Weighted mean was calculated to identify the areas of credit needs for the agricultural activities and level of credit needed by women farmers in the study area. In addition to that, to identify the sources of credit for the agricultural activities was analyzed through the ranking of provided list of selected agricultural credit sources based on the findings of the pilot study

RESULTS AND DISCUSSION

Socio-economic factors of the respondents

Socio-economic factors of women farmers were demonstrated in Table 1.

Table 1: Socio-economic factors of respondents (n=238)

Factor	Category	Frequency	Percentage(%)
Age	20-39 Years	40	16.8
	40-59 Years	149	62.6
	> 60 Years	49	20.6
Marital status	Single	09	3.8
	Married	215	90.3
	Widowed	14	5.9
Educational level	No Primary education	08	3.4
	Primary education	68	28.6
	Junior secondary education (O/L)	153	64.3
	Senior secondary education (A/L)	09	3.8
Monthly income (LKR)	Less than 20,000	61	25.6
	20,001 – 40,000	156	65.5
	40,001 – 60,000	21	8.8
Number of family members	less than 4	79	33.2
	4 - 5	128	53.8
	more than 5	31	13.0

Source: Field survey March to July 2019

As per the results of the table 1, 62.6% of respondents were showed that in between 40 -59 years as their age. It conclude that most of the women farmers are represent the economically active population and there is a considerable potential to enhance their credit accessibility to upgrade the level of food production of them. 90.3% of respondents were married and 64.3% of them were showed Junior Secondary education as their level of education (GCE Ordinary level). A significant level of education has created a proper guidance to access and adopt new technologies that can improve their agricultural production, credit facilities and also the agricultural information accessibility. Majority of the respondents were reported that they have 4-5 members within their families. 0.84 acre was showed as their average farm land size and they were showed about 15 years as their farming experience. While 65.5% of women farmers were showed LKR 20,001 – 40,000 as the monthly income, 25.6% of them were reported their monthly income is below LKR 20,000. Low level of monthly income express the importance of agricultural credit neediness within the study area.

Agricultural credit neediness of women farmers in the study area

The areas of agricultural credit neediness were presented in table 2.

Table 2: Areas of agricultural credit neediness of the respondents (n = 238).

Areas of credit neediness	Frequency	Percentage (%)
Purchasing improved seeds & livestock	114	45.1
Labor requirements	080	33.6
Utilization of modern farming technologies	140	55.3
Pre-planting activities	044	18.6
Irrigation facilities	054	22.5
Transportation & marketing of agricultural products	112	47.0
Application of agrochemicals & fertilizers	146	57.7
Harvesting activities	030	12.7

Source: Field survey March to July 2019

Based on the findings of the table 2, majority of the women farmers (57.7%) were showed that they need credit facilities for the application of agrochemicals and fertilizers. In Addition to that respondents were noted utilization of modern farming technologies (55.3%), transportation & marketing of agricultural products (47%) and purchasing improved seeds & livestock (45.1%) related credit neediness more necessary for them.

But they were showed a less interest regarding the credit neediness for pre-planting activities (18.6%), irrigation facilities (22.5%) and harvesting activities (12.7%). Most of the women farmers were spent largest amount of credit for application of agrochemicals and fertilizers. Therefore, majority of the respondents were engaged chemical farming rather than the organic farming and conspicuous level of modern farming technology utilization observed. And also, transportation and marketing of agricultural products was showed conspicuous level of credit neediness. Because, Imbulpe area is a rural farming area and they have to transport their agricultural products into the market places of the urban areas.

Level of agricultural credit needs of women farmers

Table 3 showed about the level of agricultural credit needs of women farmers in the study area.

Table 3: Level of agricultural credit needs of the respondents.

Level of need	Frequency	Percentage (%)
Very high	42	17.6
High	102	42.9
Moderate	71	29.8
Low	17	07.1
Very low	6	02.5
Total	238	100

Source: Field survey March to July 2019

According to the results of the table 3, 42.9% of the respondents were indicated high level of credit neediness for the application of agrochemicals and fertilizers and utilization of modern farming technologies while 29.8% and 7.1% had moderate and low level of agricultural credit neediness regarding the pre-planting activities, irrigation facilities and harvesting activities within the study area.

Agricultural credit sources of women farmers

The agricultural credit sources were presented in table 4.

Table 4: Agricultural credit sources of women farmers (n = 238).

Credit source	Frequency	Percentage (%)
Savings from the previous agricultural earnings	114	47.9
Bank loans & loan providing institutions	12	05.1
Funds from the farming societies	37	15.5
Other family member or fellow women	69	29.0
Private money lenders	6	02.5

Source: Field survey March to July 2019

As per the results of the table 4, majority of the respondents were showed savings from the previous agricultural earnings (47.9%) and other family member or fellow women (29%) as their major credit sources of agricultural activities. In addition to that, funds from the farming societies were reported by the 15.5% of the respondents and private money lenders act as the least important credit source for agricultural activities in the study area.

CONCLUSION

Majority of the women farmers were showed that they need credit facilities for the application of agrochemicals and fertilizers. In Addition to that respondents were noted utilization of modern farming technologies, transportation &

marketing of agricultural products and purchasing improved seeds & livestock related credit neediness more necessary for them.

And also, they were showed a less interest regarding the credit neediness for pre-planting activities, irrigation facilities and harvesting activities. Most of the women farmers were spent largest amount of credit for application of agrochemicals and fertilizers. Therefore, majority of the respondents were engaged chemical farming rather than the organic farming and conspicuous level of modern farming technology utilization observed. And also, transportation and marketing of agricultural products was showed conspicuous level of credit neediness. Because, Imbulpe area is a rural farming area and they have to transport their agricultural products into the market places of the urban areas.

Most of the respondents were indicated high level of credit neediness for the application of agrochemicals and fertilizers and utilization of modern farming technologies while moderate and low level of agricultural credit neediness regarding the pre-planting activities, irrigation facilities and harvesting activities within the study area.

Majority of the respondents were showed savings from the previous agricultural earnings and other family member or fellow women as their major credit sources of agricultural activities. Private money lenders act as the least important credit source for agricultural activities in the study area.

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SCIENTIFIC PAPER

ANALYSIS OF HOUSEHOLD CROP COMMERCIALIZATION IN NIGERIA

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Abstract: *nigeria is experiencing a gradual shift from subsistence to commercialized agriculture, thereby increasing involvement and activities at different nodes of agribusiness. Participation of farmers in markets is an important determinant of well-being and development, and one of the pathways towards economic growth. This study analysed household crop commercialization in Nigeria. The secondary data used were the General Household Survey (GHS, 2018) Wave 4. Data were analysed using descriptive statistics, household crop commercialization index (HCCI) and ordered probit regression model.*

Mean age of Nigerian farmers was 50.04 years (±15.22), majority (85.68%) were male, married (82.51%), and 72.14% had formal education. Farming is viable in all the geopolitical zones and majority (87.64%) of the farmers were from the rural sector, holding a mean total plot size of 12.61(±15.63) hectares, and planted 3 crops on the average. The most produced crop categories are cereals (46.75%), tubers (20.70%) and legumes (19.00%); legumes and cereals are highest in the North, and tubers in the South. Subsistence households were 32.81% (HCCI=0), only 1.71% of the households were fully commercial (HCCI=100), while semi-subsistence households (0≤HCCI≤100) constitute 65.48%. Years of education ($p<0.05$) and crop production in North East and North West zones ($p<0.01$) constrain commercialization, while at $p<0.01$, crop production in the rural sector and the South zones, and increased land holding are the drivers of household crop commercialization in Nigeria.

Nigerian farming households are mainly semi-subsistence and are diversified in crop production. Nigeria relies more on market participation of the semi-subsistence households, through their marketable surplus, to feed her teeming population and for exports. Further attention on rural infrastructure development in all geopolitical zones and awareness creation on producing market oriented products will increase agribusiness activities. This will generate green decent jobs that will take unemployed youths off the streets of urban centres. This is in tune with the economy diversification bid and the new Nigeria Economic Sustainability Plan of the Federal Government of Nigeria.

Keywords: *Crop commercialization, Cereals, Tubers, Legumes, Semi-subsistence*
JEL Code – Q13

1 INTRODUCTION

Crop commercialization occurs when farming households move away from subsistence crop production to increased market orientation; transformation from production for household subsistence to production for the market. Ochieng et al. (2015) explained that crop commercialization is all about market orientation and participation. Farming households participate in crop market through their marketable surplus. In the context of crop commercialization, marketable surplus are quantities of products available for consumption by the non-farming population, and as raw materials for manufacturing and processing industries (Rohana and Bandara, 2010).

The non-farming population gets the marketable surplus through different markets, and linkages with industries for supply of produce as raw materials. This helps to measure the extent of commercialization of the production activities of a particular crop; while high proportions of marketable surpluses indicate greater market orientation of the producers (crop farmers), lesser proportions of surpluses mean that the producers are more subsistence-oriented or non-commercial. Crop commercialization can be addressed from two perspectives; first, as an increase in the marketed output, which is measured as the ratio of output sold to the production output, and secondly, as the amount of inputs purchased per unit of output (Gebremedhin and Jaleta, 2009).

Smallholder crop commercialization could be seen as the strength of the linkage between farm households and markets at a given point in time. Inability to sell irregular bumper harvests depress prices, undermining the income

of small farmers who manage to produce a surplus. Crop commercialization promotes agribusiness as it allows increased participation of individuals and poor households in domestic, national and international exchange economy and results in higher average farm incomes and lower farm inequality (Oteh and Nwachukwu, 2014). Poole (2017) explained that the participation of crop farmers in markets is an important determinant of well-being and development.

Gani and Adeoti (2011) stressed that market access plays a remarkable role in ensuring better income and welfare for smallholder farmers through diverse channels. By raising income, markets increase purchasing power, which, in turn, creates demand for consumer goods, thereby enhancing farmers' welfare. Market participation of smallholder crop farmers leads to gradual decline in real food prices due to increased competition and lower costs in food marketing and processing. These changes improve the welfare of smallholder farmers in two ways; low food prices increase the purchasing power for food for consumers while, to producers, a decline in food prices enables reallocation of limited household incomes to high value non-food agribusiness sectors and off-farm enterprises.

At household level, commercialization is mainly influenced by agro climatic conditions and access to infrastructure and market; factor and import markets, demographic and population change, availability of new technologies, market creation, and infrastructure. In addition, commodity price, availability of family labour, and geographic location of the household influence commercialization. According to Fischer and Qaim (2012), factors that influence crop commercialization can be grouped into long term and short term, and can either facilitate or hamper commercialization process. Some examples of the long term factors are population growth and rural infrastructure; population growth can increase the quantity of marketable surplus by increasing its demand, while rural infrastructure affects crop commercialization through its impact on prices, and diffusion of technology, thus affecting combination of inputs and outputs (Barrett, 2008).

Examples of short term factors that influence crop commercialization are consumption effects and income effects (Kirui and Njiraini, 2013). Kirui and Njiraini (2013) reported that lower level of crop commercialization is explained by many factors such as remoteness of many villages, low productivity, low farm gate prices, high market margins, lack of information and lack of market accessibility as many crop farmers walk approximately 18 kilometres to the closest market away from the village centre and more often, there is no public services to reach the market. All these factors hinder smallholder farmers from exploiting the benefits of participation in crop market.

Smallholders' decision to enter and participate in crop market is influenced by many household and environmental factors. It is constrained by crop pests and diseases, unreliable rainfall, access to irrigation and socioeconomic factors (size of farmland, draught power and family labour). Agricultural input and output markets are among the major constraints of crop commercialization. In this regard, low quality and quantity of produce, absence of market for the produce, transportation problems, price fluctuation and rising prices of inputs like labour, fertilizer and associated inputs are mentioned as bottlenecks for crop commercialization. Household size, lack of price information, distance to local market and expensive farm inputs reduce the intensity of crop marketing (Ugwu and Alimba, 2018).

Despite all these challenges and constraints, participating in crop commercialization helps to improve livelihoods of smallholder farmers. Hence, crop commercialization is one of the pathways towards economic growth by increasing agricultural productivity in Nigeria who relies on agricultural production. Factors such as age, the number of household members who assist in farm work, vocational training and farmers being landlords are factors that affect market participation positively.

Although there are streams of benefits that are inherent in market participation, studies show that participation in market by smallholder crop farmers in developing countries such as Nigeria is very low and has slowed down agriculture driven economic growth (Barrett, 2008). Low levels of commercialization reduce involvement of smallholder farmers in agribusiness due to lack of market orientation in the course of production. There is need to analyse market orientation of crop farming households in Nigeria, measured by the levels of commercialization or market participation, which is an indicator of the involvement of the farming households in agribusiness. This study analysed household crop commercialization in Nigeria.

Broadly, this study analysed household crop commercialization in Nigeria. Specifically, the study

i. Profiled crops grown by farming households (by zone and sector)
ii. Determined the level of household crop commercialization in Nigeria
iii. Analysed the determinants of household crop commercialization in Nigeria

Nigeria is experiencing a gradual shift from subsistence to commercialized agriculture. Nigeria economy has been known to depend mostly on oil revenue. Diversification into agricultural sector has been the major focus of the government as it seems like the main push needed from the overdependence on oil, especially as the prices of brent crude has been unstable at the international markets. Agribusiness is one of the ways of diversifying the economy. To be able to take advantage of the agricultural sector, there is need for restructuring of the sector from the subsistence production practices by the major drivers, that is, the rural producer of this sector into a market-oriented production. Commercializing smallholder agriculture cannot be neglected in achieving economic development especially for a country like Nigeria that still depend on agricultural sector for proper growth in the economy.

Also, emerging evidence across the world on the impact of Covid-19 suggests that economic and productive lives are affected. Generally, households earn less and have reduced livelihood opportunities due to Covid-19 related restrictions on movement which hamper households' ability to cultivate land

and engage in other activities. The results of this study on crop commercialization will shed light into agribusiness potentials of farming households. This will provide a way to induce greater levels of commercialization and increase volumes of agribusiness activities among farming households. These will help in executing the economy diversification bid and the new Nigeria Economic Sustainability Plan of the Federal Government of Nigeria during and after post covid-19 periods.

1.1 Conceptual Framework

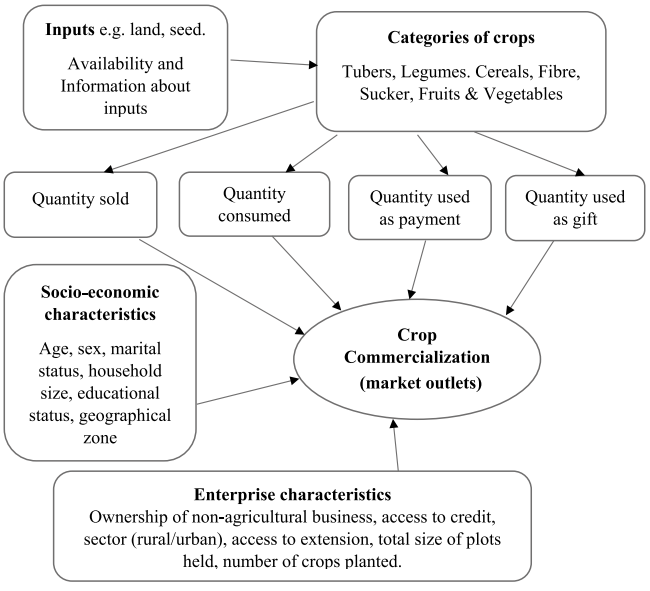
The conceptual framework on household crop commercialization in Nigeria is shown in Figure 1. The figure shows the relationship between crop commercialization and its various determinants, as well as the effect of crop commercialization on farmers and the economy as a whole. Various factors determine the types of crops farmers cultivate; soil type, availability of different inputs, information about the crop, and etcetera. Farmers make decision on whether to plant legumes, tubers, cereals, or others, based on those factors. The uses of each crop to farmers however differ, the quantity consumed for some is higher than what is sold and used as gift or payment, while for some, quantity sold will be the highest. Crops that are the major food source will only be sold after enough quantity for the household in a year has been removed.

The quantities of crops sold will therefore depend on the extent of other uses of that crop, and this affects the extent of crop commercialization. The quantity of crops that will be sold after removing other uses determine the level of market participation and commercialization of farmers. Socio-economic characteristics of farmers also affect their levels of commercialization. A farmer with large household size, for example, might have to keep larger quantities of grains for household consumption, which will reduce the quantity to be sold. Farmers that are leaving their active age may find it difficult to produce in large quantities, and may also find it difficult to get their produce to the market, compared to young and active farmers. This can discourage them from selling large quantities.

The figure also shows that enterprise characteristics affect commercialization. A farmer that has other non-agricultural business that already settles his bills may decide to consume all of his farm produce and probably give excess out as gifts, thereby reducing commercialization. Farmers with large hectares of land will probably practice commercialization more than a farmer with small land size. Producing crops in large quantities will make it possible for the farmer to keep portions for other uses and still have enough to market.

Commercialization is a key for restructuring the economy. Farmers that practiced commercialization will have increased income, which will help to cater for other basic needs. It can also help to improve the nutrient intake of farmers, since they will be able to purchase other nutritional food items aside from what they produce on the farm, and have higher living standards. According to Alawode et al. (2018), commercialization is characterized by expansion in output sales which raises cash earnings of rural farmers. Crop commercialization will also help the country to achieve self-sufficiency in food production and increase the volume of activities at all agribusiness nodes. This will be achieved if majority of Nigerian farming households produce for the market. It means there will be food in our local/domestic markets and farmers can also be oriented to produce quality crops for international market which will help to boost the foreign exchange of the country.

Figure 1: Conceptual framework on Household Crop Commercialization in Nigeria



Source: Alawode and Makinde, 2021.

1.2 Empirical Review

Ahmed and Murtala (2013) examined the impact of agricultural commercialization on food security in Nigeria using OLS regression method. The results showed that commercialization enhances food security in the country. Other variables they found to significantly contribute to food security were domestic food production and food import. Per capita income showed a very weak relationship with food security. They concluded that commercialization of agriculture is important for ensuring food security and land reforms, and provision of credits to smallholder farmers are needed to encourage commercialization. They therefore recommended that policies to improve food security in the country should be geared towards increasing domestic food production and improving the distribution of income.

In their study, Ele et al. (2013) determined the household commercialization index. They identified the variation in the level of commercialization among households in the three agricultural zones, and identified the micro-level factors determining the level of commercialization in Cross River State, Nigeria. The degree of commercialization in the study area was found to be moderately high (about 60.40%). On the average, households sold about 56.10%, 66.60% and 58.50% of their total production (in grain equivalent terms)

for the Southern, Central and Northern zones respectively. Tobit regression analysis showed that total quantity of food crops produced, farming experience, access to agricultural extension service, size of land used for cultivation, membership in cooperatives and household size are important factors determining the level of commercialization of smallholder farms.

Kabiti *et al*. (2016) determined factors that affect smallholder commercialization of farming enterprises. Input and output commercialization indices were derived for all the participating farmers. Tobit model was used to regress the indices and farmer specific variables. The study showed that the farmers are fairly commercialized for both input and output sides. In addition, factors that determined input and output commercialization are varied. The paper recommended increased public and private sector contribution towards commercialization through training and financial support and increased remittances by family members outside farming. The study concluded that smallholder farmers had a great potential for commercialization if necessary conditions were met.

Falola *et al*. (2017) carried out a study on the determinants of commercial production of wheat in Nigeria: A case study of Bakura Local Government Area, Zamfara State. They analyzed data using descriptive statistics, household commercialization index (HCI) and tobit regression. They found that the average HCI was 54.7%, implying that there was a gap of 45.3% for the farmers to attain full commercialization level. Farm size, fertilizer, credit, access to improved varieties, age of household head, using man-power as the only source of labour for cultivation and non-farm income were found to significantly influence household commercialization of wheat production.

Alawode *et al*. (2018) examined the relationship between rural land market and commercialization among crop farming households in Southwestern Nigeria. Descriptive statistics, land market index, crop commercialization index and tobit regression model were used for data analysis. They found that majority (74%) of the farmers acquired their farm plots through inheritance. The crop driving commercialization in the study area was maize, with crop commercialization index of 72%. They also found that participation in land market had positive effect on crop commercialization, the crop commercialization index for farming households participating in land market is expected to be 0.05 higher than that of the farming households which are not participating. They concluded that crop commercialization increases with participation in land market and recommended formulation of policies which will give room for flexibility in land redistribution that will make farmers have better access to land.

Ugwu and Alimba (2018) analysed the determinants of commercialization of staple crops among smallholder farmers in South East Nigeria. They analysed data using descriptive statistics, household commercialization index and multiple regression analysis. The commercialization indices indicated that the extent of commercialization was highest in cassava (57%) and rice (49%). The variables found to be the determinants of commercialization include sex, household size, processing cost and market distance. Favourable indices for commercialization are high sales of products, improvement in crop farming and processing, and relevant policy formulations. They also found that even though the crops have potentials of being transformed into different products, they were limited to mainly gari (a processed form of cassava) and milled rice for paddy rice. Major challenges identified include inadequate processing and storage facilities and poor access to credit facilities. They recommended that government should refurbish old facilities, assist farmers in putting new ones in place, and set up strategies to facilitate farmers' access to credit. Also, farmers should participate actively in farm associations.

2 MATERIALS AND METHODS

2.1 Study Area

The study area for this research is Nigeria. Nigeria is a country located in West Africa, on the Gulf of Guinea. It is located between latitudes 400N and 140S of the Equator; and between longitudes 300E and 150W of Greenwich Meridian. Nigeria is made up of 36 states and a Federal Capital Territory, and grouped into six geopolitical zones: North Central, North East, North West, South East, South South, and South West. The population of Nigeria is predominantly rural; approximately one-third live in urban areas. The vast arable land in Nigeria makes it suitable to plant many food and cash crops. Nigeria produces tradeable agricultural commodities in which it has comparative advantage. For example, Nigeria is the sixth largest producer of cocoa beans and the fifth largest producer of plantain in the world in 2017 (FAO, 2019).

2.2 Sources of Data

Secondary data were used for this study. The secondary data were the General Household Survey (GHS, 2018). The Nigeria General Household Survey panel component (GHS-Panel) is part of a larger regional project in sub-Saharan Africa to improve agricultural statistics. The GHS-Panel is a nationally representative survey of approximately 5,000 households. The 2018/19 GHS-Panel is the fourth round (wave 4) of the survey with prior rounds conducted in 2010/11, 2012/13, and 2015/16. The data consist of post-planting and post-harvest data. The post-harvest and household data were merged together to obtain the required data for the study. The cleaned data gave 2,807 households. The required data are on crop commercialization, socio-economics and enterprise characteristics of the households. The data on commercialization include different crops produced, quantities of crops produced, quantities of crops sold, quantities given out in kind for labour, quantities paid as rent, quantities consumed, quantities given out as gift, and quantities kept or saved for the following season. Also, the socio-economic characteristics include age, sex, marital status, household size, educational level, geopolitical zone, and enterprise characteristics include ownership of non-agricultural business, access to credit, sector (rural/urban), access to extension, total size of plots held, number of crops planted

2.3 Analytical methods

Data were analysed using descriptive statistics, household crop commercialization index (HCCI) and ordered probit regression model

Descriptive statistics

Descriptive statistics were used to profile the socio-economic and enterprise characteristics of the farmers. They include percentages and mean. Results are presented in frequency distribution tables. Also, descriptive statistics were used to profile the crops grown by farming households by zone (North Central, North East, North West, South East, South South, and South West), and sector (rural and urban) (Objective 1). Various crops grown by farmers were grouped into 7 categories: Legumes, Tubers, Cereals, Sucker, Fibre, Fruits & Vegetables, and Tree crops.

Household Crop Commercialization Index (HCCI)

The extent of crop commercialization was assessed using Household Crop Commercialization Index (HCCI) (Objective 2). Gross quantity of crops produced was obtained from adding together the quantities of crops sold, quantities given out in kind for labour, quantities paid as rent, quantities consumed, quantities given out as gift, and quantities kept or saved for the following season. HCCI measures the ratio of the gross quantities of crop sales in year i to the gross quantities of all crops produced by the household in the same year i expressed as a percentage.

HCCI is given as:

$$HCCI_h \frac{\text{Gross quantity of all crops sold in year i}}{\text{Gross quantity of all crops produced in year i}} = x\ 100$$

$HCCI_h$=Household crop commercialization index for all crop sales

HCCI ranges between 0 and 100

Where HCCI = 100 if household sells all its output - Pure subsistence

HCCI = 0 if household consumes all its output - Full commercial

0%<HCCI<100% = household sells different proportions of its output - Semi-subsistence

The commercialization indices of households were further categorised into 3; low, medium and high levels of commercialization.

Low - 0-33%, Medium - 33-66%, High - 66-100%

Households' level of crop commercialization (low, medium and high) were profiled by significant socio-economic and enterprise characteristics.

Ordered Probit Regression Model

Ordered probit regression was used to analyse the determinants of household crop commercialization (Objective 3). The dependent variable Y* (commercialization level of household) has 3 categories; high, medium and low.

Model specification for the ordered probit regression model is given as:

$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5+\beta_6X_6+\beta_7X_7+\beta_8 X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+\beta_{12}X_{12}+\varepsilon$

Y=Level of crop commercialization by households; 1=high, 2=medium, 3=low

The independent variables are the socio-economic and enterprise characteristics of the head of households:

X_1=Age (years)

X_2=Sex (male, female)

X_3=Marital status (never married, married, not married)

X_4=Household size (number of persons)

X_5=Years of education

X_6=Ownership of non-agricultural activities

X_7=Sector (rural, urban)

X_8=Zone (North Central, North East, North West, South East, South South, South West)

X_9=Credit access (yes, no)

X_{10}=Extension access (yes, no)

X_{11}=Number of crops planted

X_{12}=Total size of plot held (3-5 hectares, 5-10 hectares, > 10 hectares)

β_0=Constant term

β_1-β_{12}=Regression coefficients to be estimated;

ε= error term

3 RESULTS AND DISCUSSIONS

3.1 Socio-economic and Enterprise Characteristics of Farming Households' Heads

The Socio-economic characteristics of farming households' heads are presented in Table 1. The mean age of 50.04 years (±15.22) indicates that the farming population in Nigeria are ageing and majority (85.68%) of the farmers were male, implying that farming activities in Nigeria are dominated by men. Those that were married either monogamous or polygamous were (82.51%) and a mean household size of 6.69(±3.72) means that, on the average, there are 7 persons in farmers' households. More than one-quarter (27.86%) of the farmers had no formal education, 37.26% and 24.37% had primary and secondary education, respectively. Meanwhile, only about one-tenth (10.51%) of the farmers had tertiary education. Transition of subsistence to commercial agriculture is enhanced by the level of education of farmers. Involvement of more educated farmers in crop production will increase the activities of farmers at the different nodes of agribusiness. Therefore, low level of education of Nigerian farmers has implications on achieving high level of commercialization in Nigeria. However, farming is viable in all the geopolitical zones of the country. Different crops thrive in different zones of the country, which account for high contribution of agriculture to GDP.

The enterprise characteristics of the farming households' heads are presented in Table 2. About half (50.34%) of the farmers owned non-agricultural business. This implies that Nigerian farmers engaged in non-agricultural businesses, signifying livelihood/income diversification, not only within different nodes of agribusiness, but also into non-agricultural

related businesses. Access to credit by Nigerian farmers is very low as only 15.43% of the farmers were able to source for formal credit. Expectedly, majority (87.64%) of farmers were from the rural sector. Nevertheless, the results underscores the fact that there is urban farming in Nigeria as more than one-tenth (12.36%) of the farmers were from the urban sector. Most (40.33%) of the farmers held total plot size greater than 10 hectares. Higher sizes of land held can translate to higher levels of crop production if farmers put them into productive and efficient use, with appropriate and improved inputs, thereby leading to higher levels of commercialization. Meanwhile, more than one-quarter (29.28%) of the farmers held less than 3 hectares of land, and some held as low as 0.005 hectare. Less than one-quarter (20.24%) of the farmers practiced specialization (planting one crop. Specialization is expected to increase greater experience and expertise in doing, thereby increasing the production of the crops concerned. However, Nigerian farmers planted 3 crops on the average as the highest proportion (68.50%) planted 2 to 4 crops. Crop diversification has been identified to reduce the vulnerability of farming households to harvesting shocks, especially households that depend on rain-fed agriculture. Higher levels of crop production is expected to increase the level of commercialization of crops by households.

Table 1: Socio-economic characteristics of farming households' heads in Nigeria

Socio-economic characteristics	Frequency (n=2,807)	Percentage
Age		
≤ 30		
31-60	285	10.15
>60	1,865	66.44
Min 17, Max 130	657	23.41
Mean 50.04(±15.22)		
Sex		
Male	2,405	85.68
Female	402	14.32
Marital status		
Married	2,316	82.51
Not married	414	14.75
Never Married	77	2.74
Household size		
1-5		
6-10	1,197	42.64
>10	1,215	43.28
Min 1, Max 33	395	14.08
Mean 6.69(±3.72)		
Level of education		
No formal education	782	27.86
Primary education	1,046	37.26
Secondary education	684	24.37
Tertiary education	295	10.51
Geopolitical zone		
North Central	493	17.56
North East	646	23.02
North West	606	21.59
South East	516	18.38
South South	358	12.75
South West	188	6.70

Source: Computed from Nigeria GHS Data, 2021

Table 2: Enterprise characteristics of farming households' heads in Nigeria

Enterprise characteristics	Frequency n=2,807	Percentage
Ownership of non-agricultural business	1,413	50.34
Access to credit	433	15.43
Access to extension service	460	16.39
Sector		
Urban	347	12.36
Rural	2,460	87.64
Total plot held (hectares)		
≤ 3		
3.01-5.0	822	29.28
5.01-10.0	316	11.26
>10.0	537	19.13
Min 0.005, Max 175.49	1,132	40.33
Mean 12.61(±15.63)		
Number of crops planted		
1		
2-4	568	20.24
5-8	1,923	68.50
>8	308	10.97
Min 1, Max 12	8	0.29
Mean 2.76 (±1.46)		

Source: Computed from Nigeria GHS Data, 2021

3.2 Crops grown by farming households (by zone and sector)

The vast arable land in Nigeria makes it suitable to plant many food and cash crops. Table 3 shows the various categories of crops grown in Nigeria (by zone and sector). The most produced crop category is cereals (46.75%), followed by tubers (20.70%) a*nd legumes (19.00%). Other categories of crops; sucker, fibre, fruits & vegetables and trees, are produced in smaller proportions (less than 10%). The major categories of crops grown in Nigeria are cereals, tubers and legumes; these crops are consumed by humans and also of great use in the livestock subsector. Greater levels of production of all the crop categories, especially with specialization, are expected to enhance crop commercialization in Nigeria.

From these 3 main categories of crops, the highest proportions of crops produced in the North (North Central, North East and North West) are legumes and cereals, while the highest proportions of crops produced in the South (South East, South South and South West) are tubers. Sanusi and Salimonu (2006) confirmed the high production of yam in Oyo state, Southwest Nigeria. Also, greater proportions of tree crops, and fruits & vegetables are produced in the South while the least category of crops produced in Nigeria is fibre (0.38%). Before the advent of oil, cereals and legumes (groundnut) were found in the North while tree crops such as cocoa were found in the South for exports. Also, all the crops, except fibre, are produced both in the rural and urban sectors though cereals and legumes are more produced in the rural sector.

According to Olayide et al. (2011), Nigeria used to boast of high surplus in agricultural trade and food self-sufficiency, especially in the 1960s. Today, Nigeria has lost the leading position it once occupied as it is now a major importer of food

Table 3: Categories of crops grown in Nigeria

Variable	Crop Categories (%)						
	Legumes	**Tubers**	**Cereals**	**Sucker**	**Fibre**	**Fruit &Veg**	**Tree**
Zone							
North Central	15.85	27.60	47.92	1.04	0.24	6.18	1.16
North East	33.79	1.17	63.20	0.19	0.24	1.22	0.19
North West	22.91	2.37	67.88	0.00	0.95	5.85	0.05
South East	12.06	34.00	28.86	4.20	0.06	13.90	6.92
South South	9.47	51.75	16.46	8.79	0.68	10.03	2.82
South West	0.30	41.13	18.78	6.56	0.00	9.84	23.40
Total	19.00	20.70	46.75	2.42	0.38	7.09	3.65
Pearson chi2(30) = 4.1e+03 Pr = 0.000							
Sector							
Urban	11.22	31.16	37.69	3.18	0.00	8.88	7.87
Rural	20.21	19.07	48.16	2.30	0.44	6.81	3.00
Total	19.00	20.70	46.75	2.42	0.38	7.09	3.65
Pearson chi2(6) = 223.0187 Pr = 0.000							

Source: Computed from Nigeria GHS Data, 2021

Examples of crops in different categories:

Legumes: *Beans, Melon, Groundnut/Peanuts;* ***Tubers:*** *Sweet Potato, Cassava, Cocoyam, Yam* ***Cereals:*** *Wheat, Rice, Sorghum, Maize, Millet, Soya beans;* ***Sucker:*** *Plantain, Banana;* ***Fibre:*** *Cotton;* ***Fruits & Vegetables:*** *Agbono, Pumpkin Leave, Pineapple, Water Melon, Pepper;* ***Tree:*** *Rubber, Oil Palm, Tangerine, Coconut, Cocoa, Cashew, Orange, Kolanut, Mango*

and agricultural commodities. Nigeria now spends billions of naira on importation of food and agricultural products. This situation is paradoxical as Nigeria is well-endowed with the requisite natural and human resources needed to be food self-sufficient. Besides, most governments are adjudged as successful or failed on the basis of meeting the basic needs of their citizens in terms of food.

3.3 Level of Crop Commercialization by Households in Nigeria

The extent of crop commercialization by Nigerian farming households are presented in Table 4. Household commercialization index (HCCI) ranges between 0 and 100%. The households are grouped into 3 categories on the basis of the results.

Subsistence: The subsistence households are those with HCCI of 0. They are non-commercial. This implies that they did not sell any part of the crop produce. They produce mainly for household consumption. This group can include those that go into crop production to augment household food provision. Production at this level will not boost agribusiness in Nigeria. This group makes 32.81% of the households. This is quite high, considering the efforts of the Federal Government of Nigeria in making agribusiness one of the means of diversification of the economy.

Commercial: The households that are fully commercial (HCCI =100). This is perfect market orientation where all the crop production is meant for the market. Profit is very important to the commercial farming households as they use improved inputs on the farm. Only 1.71% of the households are fully commercial. More commercial farming activities are necessary to make more crop produce available for local consumption, as well as for exports. The goals of Nigeria's agricultural development policy is to ensure that the nation produces enough food and becomes less dependent on importation so as to ensure adequate and affordable food for all.

Semi-subsistence: Households within the continuum of subsistence and full commercial crop production ($0 \leq HCCI \leq 100$). They can also be called semi-commercial. They produce for households and put the rest to the market; marketable surplus. This group of households, that is, the semi-subsistence constitutes 65.48%. Semi-subsistence farmers aim at food self-sufficiency, crop diversification and monetary income. The category of semi-subsistence farmers emphasized agricultural commercialization as agricultural transformation process whereby farmers graduate from mainly consumption-oriented subsistence production towards market and profit oriented production systems. Rohana and Bandara (2010) explained that high proportions of marketable surpluses indicate greater market orientation of the producers; lesser proportions of surpluses mean that the producers are more subsistence-oriented.

The results imply that Nigeria depends more on the marketable surplus of the semi-subsistence households to feed her teeming population. This stresses the fact that increase in food availability will be achieved by the greater orientation of the households towards market. This will also increase the activities of the households at all agribusiness nodes. Martey et al. (2012) emphasized that smallholder agriculture contributes greatly to national income, employment, foods and nutrition in Nigeria. According to Alawode et al. (2018), commercialization is characterized by expansion in sales of output (marketable surplus) which raises cash earnings of farming households in their small-scale agricultural enterprises (agribusiness).

The proportion of the semi-subsistence households show why Nigerian farmers diversify in crop production. This

reduces their vulnerability to risks and shocks. Nigeria has the potentials to be food self-sufficient by the re-orientation of the agricultural sector and proper repositioning of the semi-subsistence farmers who are the providers of food for the non-farming population in Nigeria. Ahmed and Murtala (2013) emphasized that higher levels of commercialization enhances food security in Nigeria.

Table 4: Extent of Crop commercialization by farming households in Nigeria

HCCI (0≤HCCI≤100)	Frequency n=2,807	Percentage
0		
≤ 25.0	921	32.81
24.01-50.0	541	19.27
50.01-75.0	676	24.08
75.01-99.9	402	14.32
100	219	7.81
Min 0, Max 100	48	1.71
Mean 29.9(±29.3)		

Source: Computed from Nigeria GHS Data, 2021

Household crop commercialization was further categorised into low (<33%), medium (33-66%) and high (66-100%). The results are presented in Table 5. More than half (58.25%) of the households were in the low category, about one-quarter (26.26%) were in the medium category while 15.50% were in the high level. Going by FAO (1989) grouping of farmers into three different categories based on the marketable surplus as a percentage of total production, those in the low commercialization category can be classified as subsistence households, those in the medium commercialization category as transition households and those in the high commercialization category as commercial households.

Table 5: Level of crop commercialization by farming households in Nigeria

28,712 mm	Frequency n=2,807	Percentage
Low	1,635	58.25
Medium	737	26.26
High	435	15.50

Source: Computed from Nigeria GHS Data, 2021

Socio-economic characteristics and level of crop commercialization

The results of the significant relationships between Socio-economic characteristics and levels of commercialization are presented in Table 6.

The relationship between age and level of commercialization was significant at 1%. The highest proportion of farmers (60.64%) within the age of 31-60 years were found in the low commercialization category. This could be due to the fact they are the group in the active family years, implying they produced more for households consumption.

Significant at 5%, the relationship between marital status shows that the highest percentage (59.46%) of those that were married were in the low commercialization category. This could be based on the responsibility of providing food for the household members, especially in the polygamous setting with large household sizes and high number of dependents. Those that were never married (57.14%), found in the low commercialization category, could have dependents that they catered for.

The relationship between household size and level of crop commercialization was significant at 1%. The highest proportion of households (19.80%) of 1-5 members were found in the high commercialization category while the highest proportion (67.85%) of those with household members greater than 10 were found in the commercialization category. Larger household sizes, especially with more dependents, translate to lower levels of commercialization.

Geopolitical zones in Nigeria and level of crop commercialization had significant relationship at 1%. The highest proportion of households in the low commercialization category (75.85%) were in the North East, followed by North West (68.32%) and North Central (54.16%). This implies that there is low level of crop commercialization in the North than South. In essence, legumes and cereals, which are most produced in the North (Table 3) are used more to provide for households.

This implies that Nigeria can pay greater attention to the North to improve the production of legumes and cereals for higher levels of commercialization. Also, medium and high levels of commercialization in tubers (Table 3) and other categories of crops in the South can be improved to enhance overall crop commercialization in Nigeria.

Table 6: Socio-economic characteristics and level of crop commercialization

Socio-economic Variable	Commercialization Level		
	Low	Medium	High
Age			
≤ 30	156 (54.74)	82 (28.77)	47 (16.49)
31-60	1,131 (60.64)	462 (24.77)	272 (14.58)
>60	348 (52.97)	193 (29.38)	116 (17.66)
Pearson chi2(4) = 13.4321 Pr = 0.009			
Marital status			
Married	1,377 (59.46)	602 (25.99)	337 (14.55)
Not married	214 (51.69)	117 (28.26)	83 (20.05)
Never Married	44 (57.14)	18 (23.38)	15 (19.48)
Pearson chi2(4) = 12.2502 Pr = 0.016			
Household size			
1-5	629 (52.55)	331 (27.65)	237 (19.80)
6-10	738 (60.74)	317 (26.09)	160 (13.17)
>10	268 (67.85)	89 (22.53)	38 (9.62)
Pearson chi2(4) = 44.5627 Pr = 0.000			
Zone			
North Central	267 (54.16)	162 (32.86)	64 (12.98)
North East	490 (75.85)	127 (19.66)	29 (4.49)
North West	414 (68.32)	151 (24.92)	41(6.77)
South East	261 (50.58)	162 (31.40)	93 (18.02)
South South	160 (44.69)	87 (24.30)	111 (31.01)
South West	43 (22.87)	48 (25.53)	97 (51.60)
Pearson chi2(10) = 426.3909 Pr = 0.000			

Source: Computed from Nigeria GHS Data, 2021

Figures in parentheses are percentages

Enterprise characteristics and level of crop commercialization

The results on enterprise characteristics and their significant relationship with levels of commercialization are presented in Table 7

Ownership of non-agricultural business and level of crop commercialization had significant relationship at 10%, higher proportion (16.86%) of households without non-agricultural business were found in the high commercialization category than those with non-agricultural business (14.15%). Also, at 1% level of significance, farmers that had access to credit has higher proportion in high (20.09%) and medium (29.79%) commercialization categories, while those without access to credit had higher proportion (59.73%) in the low commercialization category. These imply that access to credit improves commercialization.

At 1% level of significance, those in the rural sector had higher proportion (59.11%) in the low commercialization category, while those in the urban sector had higher proportion (24.78%) in the high commercialization category. Also, at 1%, households that held more than 10 hectares had the highest proportion (63.34%) in the low commercialization category, those that held 3-5 hectares (24.05%) had the highest proportion in the high commercialization category. The means of acquisition of land could be paramount here as those that acquired land through transaction to pay rent, often utilise land better to yield more income than those without obligation to pay rent on their land.

The number of crops planted had significant relationship with level of commercialization at 1%. From the results, the households that practiced specialization, that is, planting of 1 crop had the highest proportion (28.87%) under the high commercialization category while those that planted between 5-8 crops had the highest proportion under the low commercialization category. Surprisingly, those that planted more than 8 crops had the highest proportion under the medium commercialization level.

3.4 Determinants of Household Crop Commercialization

The results of the ordered probit regression on the determinants of household crop commercialization are presented in Table 8. The model is significant at 1%. The socio-economic and enterprise characteristics that were found to significantly affect household crop commercialization are discussed in this section. The factors are categorised into two; the constraints and drivers of household crop commercialization in Nigeria.

Constraints to Household Crop Commercialization

Age was found to negatively affect household commercialization level at 5% level of significance. This implies that as the age of the farmer increases, his commercialization level becomes lower. Increase in farmer's age by 1 year reduces the probability of high commercialization by 0.17%. Older farmers may not be able to cope with rigours of farming, thereby reducing their levels of crop production and their levels of commercialization.

Table 7: Enterprise characteristics and level of crop commercialization

Enterprise characteristics	Commercialization Level		
	Low	Medium	High
Ownership of non-agricultural business			
Yes	822 (58.17)	391 (27.67)	200 (14.15)
No	813 (58.32)	346 (24.82)	235 (16.86)
Pearson chi2(2) = 5.4849 Pr = 0.064			
Access to credit			
Yes	217 (50.12)	129 (29.79)	87 (20.09)
No	1,418 (59.73)	608 (25.61)	348 (14.66)
Pearson chi2(2) = 15.2275 Pr = 0.000			
Sector			
Urban	181 (52.16)	80 (23.05)	86 (24.78)
Rural	1,454 (59.11)	657 (26.71)	349 (14.19)
Pearson chi2(2) = 26.0988 Pr = 0.000			
Total plot held (hectares)			
< 3	454 (55.23)	215 (26.16)	153 (18.61)
3.01-5.0	154 (48.73)	86 (27.22)	76 (24.05)
5.01-10.0	310 (57.73)	148 (27.56)	79 (14.71)
>10.0	717 (63.34)	288 (25.44)	127 (11.22)
Pearson chi2(6) = 45.6566 Pr = 0.000			
Number of crops planted			
1	332 (58.45)	72 (12.68)	164(28.87)
2-4	1,117 (58.09)	559 (29.07)	247 (12.84)
5-8	185 (60.06)	101 (32.79)	22 (7.14)
>8	1 (12.50)	5 (62.50)	2 (25.00)
Pearson chi2(6) = 146.4145 Pr = 0.000			

Source: Computed from Nigeria GHS Data, 2021

Figures in parentheses are percentages

Significant at 10%, household size was found to influence commercialization level negatively. The higher the household size, the lower the probability of household being in the high commercialization level. Increase in household size by 1 person reduces the probability of household being at high commercialization level by 0.53%. Increase in household size, especially of dependents, increases the quantity of produce consumed by the household members, making the household to tend more towards subsistence, rather than commercial agriculture.

The number of years spent in school reduces the level of commercialization. From Table 1, only 10.51% of the farmers had tertiary education. This means that young elites in Nigeria are not much attracted to farming. Those involved are probably part of those that are into farming to augment family income, so they are part of those who owned non-agricultural businesses. From Table 8, 1 more year of education translated to 0.54% reduction in probability of commercialization at 5% level of significance. This is in line with the findings of Aderemi et al. (2014), who found that as the level of education increased, there was a significant decrease in the level of commercialization.

The North East and North West zones in Nigeria have negative effects on crop commercialization, at 1% level of significance. Crop production in the North East and North West zones reduce the probability of commercialization by 18.4% and 12.8% respectively. From Table 3, legumes and cereals are produced more from the North and they are also more subsistent. This could be explained by the security crisis

in the North, leading to disruption of farming activities so that households feed from whatever they are able to produce or source from others, while some households could not produce at all, having fled their homes, for fear of attacks and untimely death by kidnappers and bandits.

Age, household size, years of education, and North zones are the constraints to household crop commercialization in Nigeria.

Drivers of Household Crop Commercialization

Although crop production takes place in the rural and urban sector in Nigeria (Table 3), the rural sector showed a significant positive effect on crop commercialization at 5%, when compared with the urban sector. Although, according to Table 7, higher proportion of farming households in the urban sector are in the high commercialization level, the results that rural sector significantly and positively influence commercialization in Table 8 could be so because more Nigerian farmers (87.64%) are found in the rural sector (Table 2). Greater involvement of farming households in crop production in the rural sector will increase the probability of commercialization by 5.9%. This implies that promoting crop production among farming households in the rural sector will increase the level of marketable surplus, thereby increasing commercialization.

All the South geopolitical zones in Nigeria positively affect crop commercialization in Nigeria at 1% level of significance. Crop production in the South West, South South and South East increase the probability of commercialization by 31.8%, 12.5% and 11.4%, respectively. This could be explained by the relative peace enjoyed in the South. This implies that the South, especially, the South West drives commercialization in Nigeria. Findings of Alawode et al. (2018) showed that the zone driving commercialization in Nigeria is the South West. Since tubers, fruits & vegetables, suckers and tree crops are found more in the South (Table 3), commercialization of these categories of crops can be greatly increased. FAO, (2019) pointed out that Nigeria is the sixth largest producer of cocoa beans and the fifth largest producer of plantain in the world in 2017.

The different categories of plot sizes held had positive effect on the level of commercialization by households. This shows that increased landholding increases the level of crop commercialization significantly at 1%. Whatever the category of land held, high level of commercialization is enhanced. This can be explained by the fact that most (65.48%) of the farming households in Nigeria are semi-subsistence (Table 4). More responsive use of land with improved inputs will increase crop production and enhance commercialization. Holding more land for cultivation translates to about 15% increase in the probability of commercialization by households. The result is in line with the findings of Aderemi et al. (2014) that increased landholding significantly increases the level of commercialization.

The rural sector, the South zones (especially the South West), and the total size of plots held, are the drivers of crop commercialization in Nigeria.

3.5 Conclusions

Nigerian farmers are mainly semi-subsistence, diversified in crop production, and producing different categories of crops. Nigeria relies more on market participation of the semi-subsistence households through their marketable surplus to feed her teeming population and for exports. There is low

Table 8: Determinants of Household Crop Commercialization in Nigeria

HCCI	Marginal effect	Coefficient	Standard error	z	P>|z|
Age	-0.001660**	-0.001660	0.0006969	-2.38	0.017
Sex (female)	-0.072164	-0.072164	0.0467887	-1.54	0.123
Marital status					
Not married	0.059804	0.059804	0.0474920	1.26	0.208
Never married	0.003444	0.003444	0.0496137	0.07	0.945
Household size	-0.005348*	-0.005348	0.0027811	-1.92	0.055
Years of education	-0.005451**	-0.005451	0.0024623	-2.21	0.027
Ownership of non-agric. activities	0.012227	0.012227	0.0184414	0.66	0.507
Sector (rural)	0.059121**	0.059121	0.0273824	2.16	0.031
Zone					
North East	-0.184448***	-0.184448	0.0296504	-6.22	0.000
North West	-0.127543***	-0.127543	0.0310659	-4.11	0.000
South East	0.113844***	0.113844	0.0349513	3.26	0.001
South South	0.124644***	0.124644	0.0345320	3.61	0.000
South West	0.318023***	0.318023	0.0414338	7.68	0.000
Credit access (yes)	0.057146**	0.057146	0.0230412	2.48	0.013
Extension access (yes)	0.016578	0.016580	0.0234913	0.71	0.480
Number of crops planted	0.033288	0.033288	0.0255091	1.30	0.192
Total size of plot held (ha)					
3-5 hectares	0.126217***	0.126217	0.0306009	4.12	0.000
5-10 hectares	0.099969***	0.099969	0.0288228	3.47	0.001
> 10 hectares	0.154861***	0.154861	0.0274848	5.63	0.000
Constant		0.196318	0.0659695	2.98	0.003

Source: Computed from Nigeria GHS Data, 2021

*LR chi2(19) = 255.79, Prob > chi2 = 0.0000, Log likelihood = -1176.5277, Pseudo R2 = 0.0980 ***, **, * significant at 1%, 5% and 10% respectively*

level of crop commercialization in the North than South. Age, household size, years of education, and crop production in North zones constrain household crop commercialization in Nigeria. This means that young elites in Nigeria are not much attracted to farming. The rural sector, crop production in the South zones (especially, the South West), and the total size of plots held, are the drivers of crop commercialization in Nigeria.

Further attention should be given to rural infrastructure development in all geopolitical zones; rural institution capacities building and awareness creation on producing market oriented products, thereby encouraging crop commercialization and increasing agribusiness activities. This will generate green decent jobs that will take unemployed youths off the streets of urban centres. This is in tune with the economy diversification bid and the new Nigeria Economic Sustainability Plan of the Federal Government of Nigeria. Also, increasing the landholding of households with small holdings requires land reforms that will allocate land to more efficient crop producing households. However, monitoring the production activities of the farming households towards market orientation will increase crop production and commercialization by improving the level of marketable surplus of the many semi-subsistence farmers in Nigeria.

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SCIENTIFIC PAPER

HUNGARIAN TRADITIONAL CLOTHING, AS ON- AND OFFLINE MARKETING

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Abstract: *Several experts have already formulated the fact, that this time is the fourth industrial revolution, which affects our lives and it results in a change affecting all areas of life. It is not an exaggeration, that the new procedures and tools change as well – establishing working methods and consumption habits but also affecting our mentality greatly too. We can get the information in different way than a few decades ago, and we can also process more easily information. The development of technology, internet and marketing is getting faster and faster, and many effects of these changes can be felt in all areas of our lives.*

There are new trends, which can give new marketing related solutions for companies. These companies have to recognize the fact, that the marketing activity has to be integrated, most importantly, well thought out and also well versed in the case of traditional marketing tools and also online and social media tools. People spend most of their time online whit checking their social media sites.

How important is Hungarian tradition and the preservation of these traditions in the 21th century? Do traditions have any role in the life of the modern man today? What is the social, cultural and economic importance of tradition? This study presents the research result of the company, which started before the pandemic in 2019, furthermore it introduces with the help of the products of the company, and assists people in getting to know the Hungarian tradition and folk costumes too.

Can a company work without online presence nowadays? The internet and the social media sites give new possibilities, which can help to build the reputation, but they also contain risks.

How can a company work effectively on social media? The consistency and the definition of the targeted groups are important in online marketing. What is needed for excellent communication? The company has to know the purpose of the communication: whether it would like to keep contact with the existing partners or would like to make new connections?

Keywords: *consumption of Hungarian traditional customs, marketing, online marketing, social – media, consumer behavior*
JEL Code: M31

INTRODUCTION

The reason for this study is a business, which started in 2019 before the Covid – 19. The business has a Hungarian name: Ládafiám Kincsei, and it functionates online. One of the authors, as the pres. of a Hungarian folk dance group, met the interest of artisanship products. She recognized that there is demand for a company, which will promote tradition, heritage preservation and making of Hungarian folk dresses. Trends are changing in commerce, and there are some viewpoints in the foreground which did not get any attention before. Searches can prove, that the consumers privilege the local products in contrast to the cheap and low – class products from Far East. The trustfulness, permanency and sustainable products and short supply chain are more important nowadays (Digital Hungary, 2020). We can find out that consumers want handmade and individual products, which consumers can get closer to Hungarian traditions, folk costumes, and they can look unique while doing so. The market of culturally specific products is blooming, and this trend will most likely raise in the future as well. The consumers have expectations in connection with the products. These expectations could be for example that the products must be unique and personalize adle. Besides the products should also reflect Hungarian traditions. The problem identification of this study was, that a company can or cannot work without an online presence. The internet and social media gives new opportunities for the companies and also for consumers, which can build the reputation but these opportunities hide some risks as well.

How can a company operate on social media? There are important factors: the consistency or defining the target groups.

What is wanted for excellent communication? The company has to know the purpose of the communication: the company wants to keep in contact with the customers or it wants to reach new partners.

There was an online questionnaire research to get to know the customers of Ládafiám Kincsei better. What do the visitors

of the social media platforms think about the social media site? What do the visitors think about Ládafiám Kincsei according to their experience? Can Ládafiám Kincsei compare to the competitors? What is their opinion about the expansion of the service? What would they like to have too on the social media? What do they miss from the online platforms?

The supposition of the study, that the older people, especially above fifty years old consumers would like to buy the products of the Ládafiám Kincsei brand, because there is the Hungarian tradition in focus. Therefore, the study presents the result of the questionnaire research, regarding to the above fifty years old consumers.

Our tradition - what develops in the course of our history - and our values - what are evolving constantly – can connect to the renewal. When we talk about the cultural identity, we also talk about our traditions: our social, economical and cultural tradition, which mean the historical continuity and national culture.

There is no national culture without the local and small communities, furthermore there is no communities without culture. Here is the local culture especially important in Hungary, that the local values and traditions could get back their roles. After all, a healthy society and local communities are the basis of a functional country.

The countryside development idea lives since the discovery of the folklore in 19th century, that the tradition and folk crafts have the retaining power in a countryside, where the local traditions are outstanding.

The folk handicraft, as an economic factor has significant factor in the provincial tourism, in the local economy. These due to the revaluation of the handmade products.

How can a company take advantage of online presence? What is needed to use the social media effectively? How can the online communication be appropriate?

LITERATURE REVIEW

The marketing defined by Zoltán Veres and Zoltán Szilágyi: "The marketing is born, where the need appear; we would like to satisfy it with the help of marketing, for which we need a product (or service), for which we can get the consideration, for which we need a Sales Channel between the customer and seller and for which we have to influence the sales" (Veres – Szilágyi, 2007).

There are a lot of changes since 2007, when Veres and Szilágyi described the concept of the marketing. When we check the on – and offline marketing tools on the World Wide Web, we can experience this, there the change is constant and we cannot make a final list about the tools. Those who meet marketing tools every day, they can know ATL and BTL tools. There is TTL tools more widespread, which means marketing crossing the line. "As a result of market developments, there is an all – embracing category for customers looking for efficient and cost – effective communication and integrated marketing communication tools or specialized technical interpretation of inter – agency coordination" (Bauer – Horváth, 2013). It contains both ATL and BTL tools, which should be applied in a coordinated way, that they can strengthen each other and they can work well together. In order to successfully transfer the message, it is deductible from the coordinated use that it corresponds to the integrated marketing communication (IMC). At the same time the TTL tools can prove, that the traditional ATL and BTL tools cannot be isolated. As a result of the digitalization and the development of modern technology, the appearance on the internet is playing an even more important role. Therefore, the ensuring an online presence is essential for a new brand or for keeping the market leading position.

The appearance of the internet has created great opportunities for both consumers and businesses. The companies have to achieve the traditional marketing point of view: if they not only would like to use it to increase the commerce, also they would like to use to assess and meet new customer's need.

"We mean the form of the marketing activity related to interactive business work under notion of online marketing, which communicates individuals and groups in a specific way in network information systems and electronic media, and it supports global sales through online and offline tools. The E – marketing or electronic marketing is alternative concept, it is wider and it includes the application of the internet, the interactive digital TV, the mobile communication and other technologies, for example database marketing and electronic CRM (customer relationship management) for purpose of marketing" (Veres-Szilágyi, 2007). „The key question is not whether internet technology needs to be developed – companies have no choice, if they would like to stay competitive – but how can to do it" (Porter, 2001).

The internet is popularity and full of opportunities for online marketing thank to the fact, that they are the least expensive tools, furthermore there are minimal geographical constraint. The communication is more and more unimpeded and faster because anyone becomes available anywhere and anytime due to the internet and the globalization. To name a few: social media, website, affiliate marketing.

The drafting of social media by Andreas Kaplan and Michael Haenlein "Social media, defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content" (Kaplan - Haenlein, 2010.) According to another source: a form of online media, where the contents are primarily uploaded by users. The internet users are not just consumer of content, they can and are producing most content. There are several kinds of social media, for example forums and blogs, but there are "wikis" (digiatal encyclopedias), podcasts, furthermore photo and video sharing sites too. (Máté B.,2020) According to a digital encyclopedia it can be summarized as follows: a set of media which users fill with content. Anyone can use social media because this is a community where everybody can have a dialogue with each other without control. The purpose of these communications are connections and keeping in touch. A social media site is an online space, which can evolve dynamically, and it is

extremely diverse. The social media could be social site, blog, forum, etc. (Eszes, 2013).

The technical and the technological progress develop at a very fast pace, and there is no place in our life which would not be affected. It is particularly important for Ládafiám Kincsei to keep up with technical innovations, because it would help the operations.

The development of the internet and the smart phones is almost untraceable at this point, but it could ensure opportunities for online presence, communication, furthermore the development can make these faster. The company can communicate flexibly whit the customers and with the suppliers by the internet, without geographical constraints.

SUBSTANCE AND METHODS

The customers of Ládafiám Kincsei and the visitors of the Facebook page of Ládafiám Kincsei answered the online research, furthermore the questionnaire has been shared on thematic groups on Facebook. So the research could also reach people who did not know about this company and the products before. As a result, 261 people filled out the questionnaire, which is not accurately representative, but the research continues for the development of the company.

The website of Ládafiám Kincsei was made on 26th July 2019., there can be found the basic information about the company and the products. The website was made with an online, easy to use and free site, by www.webnode.hu. The "Webnode" is a great help for beginners, because they can use available templates, therefore they can create an easily and user friendly website. However, each item can be customized, so the website becomes unique instead of a mass product. This is the easiest way to make a website right now. The "Webnode" is a very simple and easy to handle site. It was created in 2008, since then it helped more than 40 million users launch their own websites. (Webnode, 2020)

Hungary is a world – renowned country in the field of preservation of traditions, despite this it can be said, that the craft creators have livelihood problems and their handmade works do not have enough prestige, social recognition. Furthermore, the teaching of aftergrowth is a huge problem.

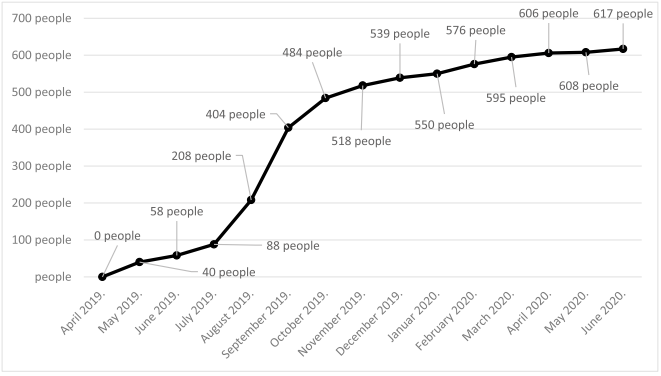
However, the lack of cooperation and dialogue causes quarrels, so people and organizations who are professionals and dedicated to folk art, and people in economic and social sectors voices echo in vain, that there is value, strength and reserve in this activity. (Beszprémy, 2013)

RESULT

The direct sales method was chosen, so products of Ládafiám Kincsei can go directly to the customers without the involvement of distributor or retailer.

The Facebook page has become available to everyone as of 24th April 2019. at the same time, an Instagram profile was created. The page has been shared in thematic groups on Facebook, for example folk costumes groups, where people can buy and sell the products, therefore the number of followers rose rapidly. The page had 637 followers in June of 2020, and 617 people just clicked the like button. The increase of the number of page fans of Ládafiám Kincsei is shown on the 1. diagram.

1. diagram: Increase of the number of page fans of Ládafiám Kincsei



Source: own editing

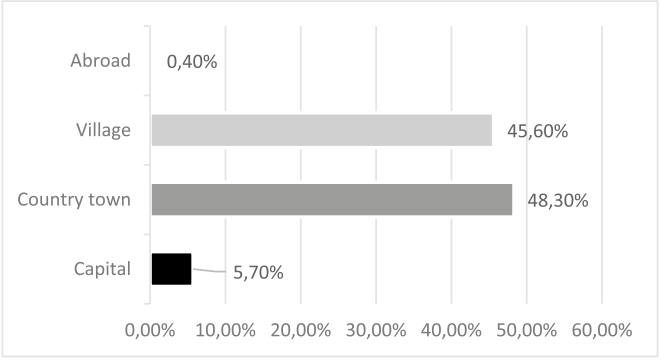
It can be seen from the 1. diagram, that the number of the page fans continued to grow in the first months. There were no likes on the page in April 2019., because the page was not available, it became public in the end of April 2019. The page achieved significant growth in May 2019., as it rose by followers. The number of the fans show continuous increase till June 2020. The most of new followers joined the page in August 2019.: 196 people clicked the like button. This rise is most likely due to the beginning of school and folk events, because people search thematic sites, where they can buy new elegant clothes or folk customs for theses school and folk events. The least people joined to the Facebook page om April 2020.: only 2 followers clicked the like button. This minimal growth effect of the COVID – 19: all events have been cancelled, the institutions (for example community centers) have been closed, therefore people had to stay at home and had to live in quarantine. The consequence of this is that people did not order new customs and clothes, and more attention was paid to the online world.

Ládafiám Kincsei could not appear on any events or festivals as a result of the pandemic in 2020., hopefully this will be possible in 2021 or 2022. There are more thematic festivals in Jász – Nagykun – Szolnok County, where Ládafiám Kincsei, where a folk costume maker can introduce itself and make itself known. For example, there is the "Hungarian Market" in Jászberény, which is a farmers market and a craft fair. The vendors offer Hungarian products from Hungarian grower and craftsman/craftswoman. (Programturizmus, 2020) There is another festival from the county, which fits to the profile: for the fifth time organized in 2019 the Jam cooking Festival in Kétpó. This festival is not just about the jam, besides that it also aims to cultivate traditions. (Fesztiválportál, 2020) The Túri Fair is known nationwide, because fables have been written about the greatness and significance, and folk song was written about its tents. The festival pays attention to the Hungarian traditions, it presents forgotten crafts, and more thanks to 300 vendors who offer their handcrafted products. (Irány Mezőtúr, 2020)

Furthermore, it should be mentioned the shepherd festivals in Túrkeve or in Karcag, but there is also a gulyás – and Crêpe festival in Szolnok. The appearance of Ládafiám Kincsei harmonizes with the festivals and it fits into the line of craft vendors.

261 people filled out the online questionnaire, of which 242 women and 19 men answered the questions. It can be concluded from these numbers, that women like to answer questionnaires and share their views. 37,7% of the participating people, i.e. 99 person have already bought a product from Ládafiám Kincsei, and 162 person (62,1%) did not order any. The most people, 74 people (28,3%) answered to the questionnaire from age group of 36 – 45 years. 19,9% of respondents, 52 – 52 people answered from age groups of 18 – 25 years and 26 – 35 years. There are 32 participating people (12,3%) from the age group of 46 – 65 years and 56 – 65 years, who answered the questions of the research. As expected people under 18 years gave answers to the questionnaire, the research could reach 19 young people (7,3%). Unfortunately, people over 65 years old did not take part on this research. it follows, that online presence is not typical in this age group. The habitation is important in terms of preserving traditions. The distribution by place of residence is on the 2. diagram.

2. diagram: Distribution by place of residence



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It can be read from the figure, that the most responders, 126 people (48,3%) live in a country town somewhere in Hungary. The second category is a village, which 119 people marked, i.e. 45,6%, as their place of residence. 15 people answered, i.e. 5,7%, from the capital, and 1 person marked the place of residence abroad. The expectation was not met in case of place of residence, according to which the most of participating people live in a village, where people pay more attention to the Hungarian traditions and folk dance, as a result they could meet with people or products of Ládafiám Kincsei in an on – or offline area.

One of the assumptions of the research was, that people over 50 years old prefer to order the products of Ládafiám Kincsei. Of the 261 people, 54 came out in total from this age group: 32 people are in group 46 – 65 years, and also 32 people in group of 56 – 65 years old, and people over 65 years of age did not participate in this research. The most people, 74 head, i.e. 28,3% of respondents are from group of 36 – 45 years, furthermore 52 – 52 people filled out the online questionnaire from groups of 18 – 25 years and 26 – 35 years. Important to highlight it, that under 18 years old could the research accost and it is a good result, that 19 young people send their own respond. They are very active online, especially on the social media platforms, but the tradition is not so simple topic for this age group. It can be established, that the suggestion is incorrect, because based on the demographic data, the products are not bought by the age group over 50 years.

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SCIENTIFIC PAPER

COMPARISON OF CONSUMPTION AND PURCHASE HABITS FOR UNIVERSITY STUDENTS FOR INDUSTRIALLY KEPT PIGS AND MANGALICA PIGS

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Abstract: *The aim of the study is to compare the preferences for the purchase and consumption of industrially kept pigs and mangalica pigs. The research was conducted among the students of the Faculty of Economics and Business of University of Debrecen in October 2019, in the form of an online questionnaire. Descriptive statistical methods, chi-square tests, Spearman rank correlation indexes, factor analysis and two-step cluster analysis were used to analyze the data obtained from the survey. Based on the results, it can be said that there are differences in consumer perceptions of industrially kept pigs and mangalica pigs among a number of sociodemographic factors. Factor analysis was used to delimit three factors in the case of industrially kept pigs ("Hungarian-brand-fresh product" aspects, factors related to health awareness, aspects of a marketing nature), while in the case of mangalica pigs one factor was identified. Next, I used a two-step cluster analysis using the isolated factors, where several sociodemographic variables were tested. The best fit was shown by the combination of gender and highest educational level. Based on these, it can be concluded that in the case of industrially kept pigs, the factors considered in the purchase were the most important for women and men with higher education in the case of two factors ("Hungarian-brand-fresh product" aspect and marketing aspects) and for mangalica pigs. While in the case of industrially kept pigs, the third factor (factors related to health awareness) that were taken into account in the purchase proved to be the most important for men with a secondary education.*

Keywords: *industrially kept pigs, mangalica pigs, buying habits, consumption habits, preferences*
JEL Code: I12, M31

INTRODUCTION

The importance of animal husbandry in Hungary has started to decline in recent years. The pig sector is characterized by a steady decline in livestock. While in 2004 4.06 million pigs were kept in the country, by 2019 the number of pigs decreased to 2.63 million individuals (CSO, 2021a). This is due to the fact that competition has greatly increased, producers have to comply with increasingly strict animal welfare and environmental standards, and a number of new procurement opportunities have opened up for slaughterhouses, for which domestic producers are not sufficiently prepared (Csonka, 2012). According to the latest data from the Central Statistical Office, poultry meat accounts for the largest share of per capita meat consumption, followed by pork (HCSO, 2021b; HCSO, 2021c). Thus, pork is one of the most consumed types of meat in Hungary.

The mangalica pig, which is a native and traditional pig breed, plays an outstanding role in Hungarian agriculture. Consequently, its preservation is of paramount importance (Balogh et al., 2016). Hungary has a history of nearly two hundred years, which, however, cannot be said to be entirely successful, as its stock has declined significantly over the years (HNAMB, 2020). However, it is important to highlight that the number of registered sows has started to increase in recent years (MM, 2020). Mangalica is a typical fatty pig that can produce up to 70% fat in terms of body weight (Tóth, 2012). Mangalica pork meat contains special nutrients therefore can be classified as a functional food (Cordiş et al., 2015), as well as tasty, soft, and juicy, and therefore suitable to produce high-quality, traditional meat products (Szente et al., 2011; Balogh et al., 2013).

Several similar research have been conducted on this topic at the domestic and international level.

Domestic research has focused on mangalica pigs and their products, and international research has focused on industrially kept pigs and other meats and meat products. Szente et al. (2011) examined consumer behavior in the market for mangalica products with the participation of 1,200 domestic consumers. Among their results, they highlighted that consumer with a high level of education, mostly in intellectual work, living in a big city, regularly buy some

product made from mangalica pigs. Their motivation for this is based on Hungarian origin, the value of enjoyment and the maintenance of health. In addition, it was pointed out that among the processed products, the consumption of bacon, fat, salami and various types of sausages is quite common among the respondents. Szigeti and co-researchers (2015) surveyed consumer perceptions of traditional mangalica products through a national sample of 1,000 people. Both quantitative and qualitative methods were used for the analysis. Among their conclusions, they pointed out that more than half of the domestic consumers are characterized by the consumption of traditional mangalica pork and products made from it, which are mainly obtained from a butcher shop and producer. Balogh et al. (2016) examined consumer preferences related to a traditional mangalica product (mangalica salami) involving 309 individuals using a discrete choice experiment. Among their results, they pointed out that the indication of origin (certificate of the Hungarian National Association of Mangalica Breeders (HNAMB)) is a decisive aspect in decision-making and has a positive effect on consumers' sense of usefulness. The aim of the study by Czine et al. (2020) was to identify the most important product characteristics that influence consumer decisions about a traditional product (mangalica sausage). In their study, they used a discrete choice experiment in which they estimated three models (multinomial logit, mixed logit, latent class). Based on their latent class model estimates, they identified three classes with different preferences (price sensitive, loyal to label, label neutral). Their price sensitive group included significantly older lower-income male consumers, who are extremely price-sensitive and prefer the origin-marked product from the producer market with 75% mangalica meat.

The article by Verbeke and Viaene (1999) focuses on the evaluation of consumer beliefs, attitudes, and behaviors related to fresh beef, pork, and poultry. The survey was conducted through quantitative marketing research involving 320 Belgian fresh meat consumers. In their research, they used factor analysis, the aim of which was to determine the factors that form freshness for different types of meat. As a result, in the case of beef, pigmeat and poultrymeat, the first factor was defined as the „safety factor", the second as the „comfort factor" and the third as the „additional factor". The interpretation of the factors differs from the type of fresh meat considered. Article by Glitsch (2000) summarizes the results of a consumer survey conducted in six European countries in order to obtain comparable information on consumer behavior and assessment of the quality of fresh meat. The assessment of meat quality consisted of two stages, a stage before the actual purchase and a stage after the purchase during meat eating. In the first stage, price was considered the least important factor in assessing quality in all countries except the United Kingdom; in the case of beef and pigmeat, the place of purchase has become one of the most important factors in all countries except Sweden and the United Kingdom; and among the internal characteristics, color proved to be the most important factor in the case of beef, pork and chicken. In the second stage, flavor was one of the most significant quality characteristics and freshness became the most important factor in terms of safety for all three types of meat. Based on their results, the authors concluded that it would be worthwhile to use appropriate indications for manufacturers and retailers to inform consumers about the freshness of the product. A study by Bryhni et al. (2002) focuses on how the consumer perceives the eating quality of pork. The questionnaire survey was conducted among pork consumers (N = 526) in Denmark, Norway and Sweden. Multivariate statistical methods were used to examine differences between consumers. Consumers considered the taste of pork to be the most defining trait. Among the aspects considered in its purchase, the most important was the fact that pork can be used in the preparation of many dishes, and the least important factor was the fact that pork could be served at social events. The biggest differences between consumers were by country, while smaller differences were by age and gender. Swedish consumers reported a higher frequency of consumption and were more satisfied with the quality of pork than Norwegian and Danish consumers. In terms of age, 16-35-year-olds are less likely to consume pork than those older than 35 years. The aim of the article by Shi et al. (2005) was to identify differences in eating habits and preferences among adolescents along sociodemographic characteristics. To this end, 824 students from eight Chinese high schools were interviewed in a questionnaire survey. The questions were related to food, frequency of meals, food preferences, and sociodemographic characteristics. Socio-economic conditions and urban location were positively associated with higher consumption of high-energy foods such as food of animal origin and dairy products. Boys consumed food of animal origin more often, and fruits and vegetables less often than girls. Urban students and students in high socio-economic status were more likely to consume animal foods, fruits, yogurt, milk, and soft drinks. The aim of the study by Guenther et al. (2005) was to provide information on meat consumption and factors explaining differences between certain subgroups, and to assess how knowledge and attitudes about nutrition, healthy diet, and health awareness affect meat consumption. The survey involved 4,802 children and 9,460 adults. The study focused on chicken, beef, pork and pork products. Relationships between types of meat intake, dietary characteristics, and demographic factors were examined using a two-step, multivariate regression model. The results suggest that individuals in higher-income households consume relatively more chickens, while those in low-income households consume more pig products. Those who did not consume beef and only consume smaller amounts of chicken thought their fat intake was low. Beef and pork consumers were more likely to think that their diet was too high in fat, but considered it less important to consume low in fat foods. The region of residence of the respondents also influenced the probability of consuming meat, and high education was associated with lower consumption of beef and pork. Overall, therefore, the likelihood of selecting certain types of meat and the amounts consumed are largely determined by sociodemographic factors, and are also influenced by knowledge and attitudes about diet and meat products. The aim of the review by Kiefer et al. (2005) was to describe eating and dieting habits by gender. As a result of the studies, it can be said that women consume more food and have

more nutritional knowledge than men. Women consume more fruits, vegetables, cereals, milk, dairy products, and whole grains, while red meat, especially pork, sausages, eggs, alcohol, and foods high in sucrose, are more common in men. Women eat sparingly and diet more often. Men prefer to control their body weight with exercise and implement diets only for health reasons. Eating disorders are more common in women, while the likelihood of obesity is similar between the sexes, but overweight is more common in men. The research by Caine-Bish and Scheule (2009) aimed to identify dietary preferences for school-age children and adolescents in terms of gender and age. The survey is conducted in 3-12. grade students in schools in the northeast Ohio. Students completed an anonymous questionnaire about 80 different food preferences. They had to answer the questions on a 5-point likert-scale. Caine-Bish and Scheule used exploratory factor analysis to identify the factors of the main course and garnish, and used analysis of variance to determine differences by gender and school grade. As a result of the research, it can be said that boys preferred meat consumption and girls preferred fruits and vegetables. In addition, gender differences in preferences were also shown for school departments. Eating preferences thus differ between the sexes, and these gender differences appear between lower primary school students, upper primary school students, and high school students. A study by Papanagiotou et al. (2012) sought to explore the concept of quality expected in relation to pork and compare it with consumers 'intentions to purchase pork. The data collection took place in Greece. As a result of their Conjoint analysis, they have shown that quality expectations are often reflected in pork purchases. For respondents, the marble of origin and the meat are important, while price is a less determining factor. They also pointed out that gender, education, place of purchase, and consumption habits also greatly influence people's willingness to buy. And Kayser et al. (2013) examined attitudes and conducted a consumer survey aimed at gaining detailed insights into the wide variety of attitudes and social environments that may affect the amount of meat consumed. In their study, "low", "average" and "heavy" consumer groups were distinguished. Their study focused on the factors that, based on the literature and information received from experts, have the most influential influence on consumer decisions. In addition, sociodemographic factors such as age or income were considered. Based on their results, the so-called "low meat consumers" group placed the greatest emphasis on ethical issues related to meat consumption. Escriba-Perez et al (2017) analyzed the consumer profile of each meat type. To this end, the average frequency of consumption of different types of meat was examined from two directions. Consumer segmentation was first performed using the food-related lifestyle (FRL) framework, during which 4 segments were identified, followed by analysis along sociodemographic factors. The variables used included gender, age, education, social class, number of people living in the household, number of children under 18 years of age living in the household, and place of residence. In the case of beef, significant results were obtained in both analyses, and in the case of turkey only in the analysis of FRL. In the case of other meats (chicken, pork, rabbit and lamb), there were significant differences only in the analysis of sociodemographic factors. Based on the results, it was concluded that there is no unique consumer profile tailored to each type of meat.

Based on the above, the aim of my research was to find out whether there is a difference in consumer preferences for industrially kept pigs and mangalica pigs along different sociodemographic characteristics. Furthermore, if there is a discrepancy along what factors it manifests itself.

My hypotheses were as follows:

H1: There is a significant difference in consumer preferences for industrially kept pigs and mangalica pigs along certain sociodemographic factors.

H2: The criteria considered for the purchase of industrial pigs and mangalica pigs can be separated into distinct factors.

MATERIALS AND METHODS

My study was based on a questionnaire survey conducted among students of the Faculty of Economics of the University of Debrecen in the autumn of 2019. Completion was voluntary and anonymous. Because I used a convenience sampling procedure, the sample is not representative, so the results cannot be generalized.

The questionnaire consisted of three parts. In the first part, I asked questions about pigs kept industrially. These questions focused on the consumption of pork and pork products and the factors considered in the purchase. In the second part, questions related to mangalica pigs were formulated. Here, it was asked whether the respondents consume mangalica pork and a product made from mangalica, and how important each of the factors listed is when purchasing. In the third part, demographic questions are listed, the descriptive statistics of which are given in Table 1.

The analysis was performed with IBM SPSS Statistics 25. During data processing, I performed descriptive statistical methods, Chi-square tests, Spearman rank correlation studies, factor analysis (Principal Component Analysis – PCA), and two-step cluster analysis.

Factor analysis is a multivariate statistical method that models the correlations of variables. For factor analysis, independent variables are known. The method can only be performed on a dataset if it is properly correlated (Tóthné, 2011). Factor analysis can be used to find common factors that characterize preferences and are related to several variables examined. These latent variables are the factors. The aim of the analysis is to reduce the number of variables, therefore the number of factors obtained during the study should be less than the number of initial variables (Varga and Szilágyi, 2011).

Cluster analysis is a multivariate method that aims to explore structures and create a relatively homogeneous subset by simultaneously considering the characteristics of a relatively heterogeneous population (Simon, 2006). Cluster analysis does not differentiate between dependent and independent variables, but examines the interrelationships within a set of variables (Malhotra and Simon, 2009). Two-step cluster analysis is

Table 1. Demographic characteristics of the respondents

Demographic variable (N=324)		Mean (S.d.)	Frequency	Percent (%)
Gender	Male		100	30.86
	Female		224	69.14
Age (years)		21.07 (3.53)		
Highest level of education	Secondary education		268	82.72
	Higher education		56	17.28
Place of residence	Rural		60	18.52
	Town		131	40.43
	County town		35	10.80
	Capital		98	30.25
Number of people living in the household (persons)		3.72 (1.02)		
Monthly net income (per capita) of the household	I don't want to answer		65	20.06
	Less than 100 thousand HUF		35	10.80
	100-200 thousand HUF		106	32.72
	200-300 thousand HUF		71	21.91
	More than 300 thousand HUF		47	14.51

Source: Own construction

used to analyze large number of databases when hierarchical and K-means clustering are less efficient. The method can be applied to both categorical and continuous variables. The number of clusters is usually determined based on some information criterion (e.g., Bayesian information criterion (BIC)) (McIntyre and Blashfield, 1980; Hadi et al., 1992).

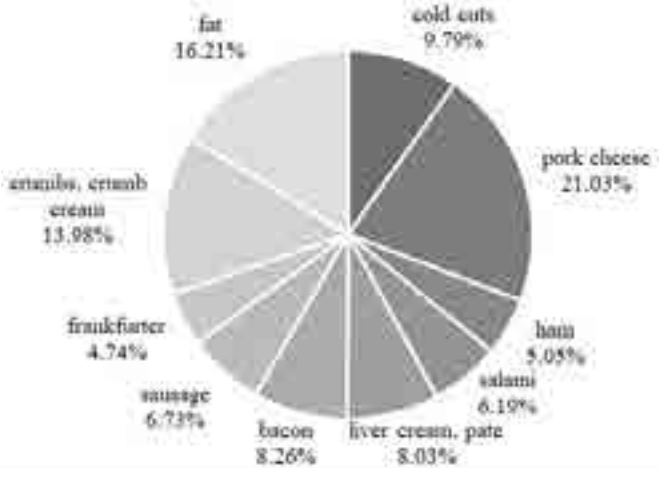
RESULTS AND DISCUSSION

Results

Based on the answers to the questions related to the consumption and purchase of industrially kept pigs and mangalica pigs, the following findings were made.

All the respondents used to consume pork with some regularity, however, only 37.3% of the respondents also consume mangalica pork. I also asked about the consumption of various products made from pork and mangalica in the questionnaire. The following figures show the proportion of respondents consumed from industrially kept pigs and mangalica pigs.

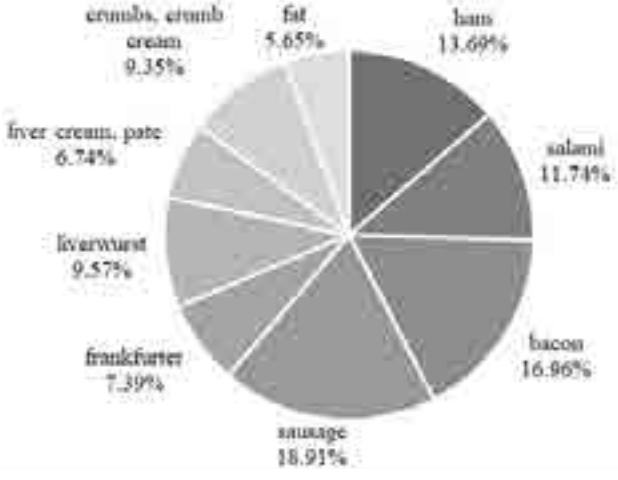
Figure 1: Distribution of consumption of industrially kept pig products



Source: Own construction

Figure 1. shows that the largest proportions of pork cheese, fat and crumbs, crumb cream made from pork are consumed by the respondents, while salami, ham and frankfurter are consumed the least.

Figure 2: Distribution of consumption of mangalica products



Source: Own construction

Figure 2 shows that the highest proportions of sausage, bacon and ham made from mangalica are consumed by university students, while frankfurter, liver cream, pate and fat are the least consumed.

I was also curious about the importance of certain factors when it comes to shopping. These factors were price, product ingredients, fat content, healthy nutrition, freshness, Hungarian product, manufacturer/brand and packaging in the case of industrial pigs, while price, product ingredients, fat content, healthy nutrition, freshness, Hungarian product, certified product of origin and packaging in the case of mangalica. Assessing importance, it was done on a scale from 1 to 5, where 1 – represented: not at all important, while 5 – represented: a very important opinion. This question also had to be answered by those respondents who do not consume mangalica pork because

Table 2. Descriptive statistics of factors considered during the purchase

Viewpoints	Industrially kept pig							Mangalica pig						
	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	S.d.	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	S.d.
Price	2.5	7.7	29.9	38.6	21.3	3.7	1.0	31.2	6.5	19.7	24.4	18.2	2.9	1.5
Product ingredients	0.6	2.8	16.7	32.4	47.5	4.2	0.9	25.9	5.6	15.1	22.8	30.6	3.3	1.6
Fat content	2.8	8.6	33.7	32.4	22.5	3.6	1.0	27.2	7.4	25.9	24.7	14.8	2.9	1.4
Healthy nutrition	2.8	8.0	31.2	29.3	28.7	3.7	1.1	26.8	5.6	21.0	21.3	25.3	3.1	1.5
Freshness	0.0	0.3	3.4	13.6	82.7	4.8	0.5	25.6	3.7	8.7	12.0	50.0	3.6	1.7
Hungarian product	2.5	5.2	21.3	32.7	38.3	4.0	1.0	26.9	7.7	15.4	22.8	27.2	3.2	1.6
Manu-facturer/ Brand	2.8	9.0	24.4	37.6	26.2	3.8	1.0	-						
Certified product of origin	-							26.5	4.6	19.2	20.1	29.6	3.2	1.6
Packing	3.7	9.6	30.5	31.2	25.0	3.6	1.1	29.0	8.3	24.7	21.9	16.1	2.9	1.5

Source: Own calculation

I was curious as to which factors they would consider relevant in the event of a possible subsequent purchase. The distributions, mean, and standard deviation values for each aspect are shown in Table 2.

Consumers considered the freshness, the ingredients of the product and the Hungarian product to be the most important in case the two type of pigs, and in the case of mangalica, even the origin of the product proved to be decisive.

In the following, I examined whether there is some level of relationship between gender, residence, education, and income, and the purchase and consumption of products from industrially kept pigs and mangalica pigs. Significant results are shown in Table 3.

Table 3. Results of Chi-square tests

Industrially kept pig	χ^2	Phi/Cramer
Gender - salami	7.714 **	0.154**
Gender - liver cream, pate	4.875**	0.123**
Residence - where to buy	27.635**	0.169**
Residence - liver cream, pate	9.677**	0.173**
Mangalica pig	χ^2	**Phi/Cramer**
Gender - sausage	10.868**	-0.183**
Gender - where to buy	11.260**	0.186**
Residence - mangalica pork	11.092**	0.185**
Residence - bacon	10.571**	0.181**
Residence - sausage	12.019**	0.193**
Residence - where to buy	26.230**	0.164**
Education - crumbs	3.914**	0.110**
Income - mangalica pork	11.971**	0.192**
Income - sausage	10.780**	0.182**

*Note: ** Phi value was determined at 5% level, significant for 2x2 contingency tables, and Cramer's association coefficient for larger tables.*

Source: Own calculation

Based on the results of Table 3, it can be clearly seen that there is a significant relationship between gender and the consumption of various industrially kept pork and processed mangalica pork products (e.g. salami, liver cream, pate). Based on the results of the Chi-square tests, it can be statistically confirmed that more men consume pork salami and mangalica sausage, and more women consume pork liver cream and pate. In terms of the place of purchase, there are justifiably more people in small towns who buy pork products than those living in the county seat. In a supermarket / hypermarket, there are justifiably more pig products in the county than in the village, and in a supermarket / hypermarket, more men buy mangalica products than women. There are statistically more people in the village than those who buy pork products elsewhere than in the county seat. In terms of residence, it can be justified that more people living in county seats consume pork liver cream than those living in small towns. Statistically, more people living in the county seat consume mangalica pork and sausage made from mangalica pork. Mangalica pork bacon is consumed or bought by several people living in the county seat at a producer / market, while fewer people living in the village consume bacon and buy less at a producer / market. In terms of educational attainment, mangalica pigs are demonstrably consumed by people with more tertiary education and less with secondary education. In terms of income categories, those with a monthly net income (per capita) of more than HUF 300,000 consume significantly more mangalica pork, while those with a net income of less than HUF 100,000 have statistically verifiably less. Verifiably more people with a net income of more than HUF 300,000 consume mangalica sausage. The value of the association coefficients was below 0.3 in all cases, therefore the relationships between the criterion categories can be considered weak.

In the next step, I used principal component analysis to find out if the number of aspects involved in the evaluation could be reduced. I did this from two directions. In terms of pigs kept industrially on the one hand and mangalica pigs on the other. Prior to principal component analyzes, I used Spearman's rank correlation test to find out if an overly strong correlation could be detected between certain factors. I did not find such a case. The PCA results are shown in Table 4 and Table 5.

Table 4. Results of principal component analysis on responses to statements on buying preferences related to industrially kept pigs

Statement	PC1 (α = 0.588)	PC2 (α = 0.713)	PC3 (α = 0.337)
Manufacturer/brand	0.796		
Hungarian product	0.769		
Freshness	0.569		
Healthy nutrition		0.813	
Fat content		0.798	
Product ingredients		0.715	
Price			0.801
Packaging			0.628

Note: Total explained variance: 64.095%; Bartlett's test of sphericity: $\chi 2 = 488.232$, $p < 0.001$; KMO = 0.665; Cronbach's α = 0.663.

Source: Own calculation

Table 5. Results of principal component analysis on responses to statements on buying preferences related to mangalica pork

Statement	PC1 (α = 0.971)
Product ingredients	0.943
Certified product of origin	0.939
Freshness	0.937
Fat content	0.922
Hungarian product	0.915
Healthy nutrition	0.910
Packaging	0.874
Price	0.861

Note: Total explained variance: 83.354%; Bartlett's test of sphericity: $\chi 2 = 3405.379$, $p < 0.001$; KMO = 0.939; Cronbach's α = 0.971.

Source: Own calculation

In the case of industrially kept pigs, I managed to separate three components, the first of which included the manufacturer/brand, the Hungarian product and the freshness, so I named this component the "Hungarian-brand-fresh product" aspect. The second component includes factors related to health awareness (healthy nutrition, fat content and product ingredients), while the third component includes aspects of a marketing nature (price and packaging). As a result of the PCA for mangalica pigs, I found that all factors can be classified into one component.

I subjected the results of the PCA to further analysis to see if there are groups that can be created along certain consumer characteristics for the components. For this, I used a two-stage cluster analysis, where I also tested several sociodemographic characteristics (gender, place of residence, highest educational attainment, income) and the combination formed from them as a grouping variable. The best explanatory result was achieved through the inclusion of gender and highest educational level, the results of which are shown in Table 6 and Table 8.

Table 6. Results of the two-step cluster analysis (industrially kept pigs)

	"Hungarian-brand-fresh product" aspect		Factors related to health awareness		Marketing aspects	
	Mean	S.d.	Mean	S.d.	Mean	S.d.
Cluster 1	0.192	0.909	-0.063	0.847	0.111	1.039
Cluster 2	0.029	1.001	0.004	1.073	0.041	0.982
Cluster 3	-0.183	1.035	0.031	0.941	-0.158	1.006

Source: Own calculation

As a result of the two-step cluster analysis, I was able to identify three subgroups (Table 6). Based on the results of Table 6, it can be clearly seen that the component related to the "Hungarian-brand-fresh product" factors takes on the highest value in the case of the first cluster, while it has the lowest value in the case of the third cluster. Based on these, I can say that in the case of the former members, the most important, while in the case of the latter, the aspects that are included in the component are the least important. Regarding the second component, it can be stated that the third cluster has the strongest effect, while the first cluster has the weakest effect. The effect of the component on marketing aspects is most pronounced in the first cluster and least in the third cluster.

Table 7. Distributions of clusters (industrially kept pigs)

	Gender (%)		Highest level of education (%)	
	Male	Female	Secondary education	Higher education
Cluster 1	13.0	19.2	0.0	100.0
Cluster 2	0.0	80.8	67.5	0.0
Cluster 3	87.0	0.0	32.5	0.0

Source: Own calculation

Based on Table 7, it can be concluded that the first cluster includes men and women with level of higher education. The second subgroup consists of women with secondary educational level. Finally, the third cluster included men with secondary education.

Table 8. Results of the two-step cluster analysis (mangalica pigs)

	Mangalica aspects	
	Mean	S.d.
Cluster 1	-0.084	0.859
Cluster 2	0.091	1.019
Cluster 3	0.012	1.058

Source: Own calculation

As a result of the two-step cluster analysis of mangalica pigs, I was able to identify three subgroup (Table 8). Based on the results of Table 8, it can be clearly seen that the component for mangalica aspects takes the highest value in the case of the second cluster and the smallest value in the case of the first cluster. Based on these, I can say that in the case of the former members, the most important, while in the case of the latter, the aspects that are included in the component are the least important.

Table 9. Distributions of clusters (mangalica pigs)

	Gender (%)		Highest level of education (%)	
	Male	Female	Secondary education	Higher education
Cluster 1	87.0	0.0	32.5	0.0
Cluster 2	13.0	19.2	0.0	100.0
Cluster 3	0.0	80.8	67.5	0.0

Source: Own calculation

Based on Table 9, it can be concluded that the first cluster includes only men with secondary educational level. The second subgroup consists of men and women with level of higher education. Finally, the third cluster included women with secondary education.

DISCUSSION

The aim of my research was to examine and compare consumer preferences related to industrially kept pigs and mangalica pigs. I conducted my survey in the autumn of 2019 among the students of the Faculty of Economics of the University of Debrecen. The first part of my questionnaire included questions related to the consumption and purchasing behavior of respondents and then I assessed demographic factors. In my analysis, I used descriptive statistics, chi-square test, and multivariate statistical methods. Based on my research, I was able to show several relationships. In addition, I identified three components in the case of industrially kept pigs based on the statements in the questionnaire, while in the case of mangalica pigs, all factors could be classified into one component. Based on my two-step cluster analysis, I established further correlations.

Compared to the basic concept of my research, a number of studies have been conducted both domestically and internationally. The authors discussed in the introductory section examined consumer preferences and attitudes about certain foods one by one, and several of them placed great emphasis on traditional mangalica pork, industrially kept pork, and other meats. Aspects of my study show similarities to the research of the following authors Verbeke - Viaene (1999) - freshness; Glitsch (2000) - price and freshness; Shi et al. (2005) - product ingredients; Szente et al. (2011) - healthy nutrition; Papanagiotou et al. (2012) - certified product of origin and price; Czine et al. (2020) - price, product ingredients and proven product of origin. However, differences can also be discovered in Glitsch (2000) - color and aroma; Bryhni et al. (2002) - taste; Papanagiotou et al., (2012) - marbling of meat. Regarding the composition of the examined sample, we can see a rather divided picture in the case of research on similar topics in the domestic and international literature. While Verbeke - Viaene et al. (1999), Glitsch (2000), Bryhni et al. (2002), Guenther et al. (2005), Szente et al. (2011), Papanagiotou et al. (2012), Kayser et al. (2013), Szigeti et al. (2015), Balogh et al. (2016), Escriba-Perez et al. (2017) and Czine et al. (2020) was not limited to a certain age group, whereas Shi et al. (2005) and Caine-Bish – Scheule (2009) targeted school-age youth in a similar way to me. The use of multivariable statistical methods can be observed in similar research studies. Verbeke - Viaene (1999) factor analysis; Guenther et al. (2005) and Kayser et al. (2013) multivariable regression analysis; Caine-Bish - Scheule (2009) factor and variance analysis; Szente et al. (2011) and Szigeti et al. (2015) analysis of variance; Papanagiotou et al. (2012), Balogh et al. (2016) and Czine et al. (2020) used a preference evaluation procedure (the former using conjoint analysis and the latter using discrete choice experiment). My results that socio-demographic variables affect preferences are consistent with Caine-Bish - Scheule (2009), who described difference by gender and Bryhni et al. (2002) who found a difference by age and gender (although age did not appear to be a relevant factor in my research). Similarity can also be found with Shi et al. (2005), who by gender and place of residence; Guenther et al. (2005) who, by place of residence and education (for beef and pork consumption); Szente et al. (2011) who have residency and education; Papanagiotou et al. (2012) who have gender and education; Kayser et al. (2013) who age and income level; and Czine et al. (2020) who found differences between gender, age and income level.

Based on the results obtained from my studies, I can maintain my first hypothesis that there is a significant difference in consumer preferences for industrially kept pigs and mangalica pigs, among certain sociodemographic factors. Regarding my second hypothesis, according to which different factors can be distinguished on the basis of the criteria taken into account in the purchase of industrially kept pigs and mangalica pigs, I cannot draw a clear conclusion. The reason for this is that although I managed to delimit different factors in the case of industrially kept pigs, in the case of mangalica pigs the examined factors move together in the perception of consumers.

Within the limits of my research, it is definitely necessary to mention that my analyzed sample was not representative, so my conclusions are not suitable for generalization. In addition, as in previous research, consumer preferences for industrially kept pigs and mangalica pigs could be approached in a number of ways. Several additional sociodemographic and other factors can be included in the studies in order to identify additional variables that form the basis of segmentation.

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SCIENTIFIC PAPER

FACTORS AFFECTING ACCEPTANCE OF SMART RETAIL SOLUTIONS IN HUNGARY: AN EMPIRICAL STUDY USING UTAUT2 MODEL

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Abstract: *In today's digitalisation process, retail is also undergoing a transformation, with the emergence of new smart solutions. Integrating intelligent solutions into a business model means new strategic challenges for retailing companies. The aim of the research is to examine the factors influencing the behavioural intention and use behaviour of smart retail solutions (SRS). The proposed model was based on the extended Unified Theory of Acceptance and Use of Technology (UTAUT2). Data was collected by conducting a questionnaire of 302 Hungarian respondents. Confirmatory factor analysis (CFA) and partial least squares (PLS-SEM) estimation were implemented. The results showed that behavioural intention is significantly and positively influenced by effort expectancy and it is significantly and negatively influenced by facilitating conditions. Most of the respondents are not yet regular users of SRS, and the market penetration of front-end intelligent solutions in retail is considered as rather low*

Keywords: *smart retail, UTAUT2, consumer survey, CFA, SEM-PLS, industry 4.0*
JEL Code: M10, M31, O14

1. INTRODUCTION

Digital solutions have become part of our everyday lives, fundamentally changing people's habits and behaviour. With the development of information and communication technology, online consumption is growing rapidly (Kim, 2021). Digitalisation is the defining process of our time, affecting business, including almost all areas of retail. New business models are emerging to which companies must respond in order to remain competitive (Demeter, 2020; Matyusz & Pistrui, 2020a; Molnár, 2018; Pantano & Vannucci, 2019; Rekettye, 2020; Satoglu et al., 2018; Sikos et al., 2019; Tushar & Sachi, 2017). The fourth industrial revolution is fundamentally changing the way companies operate and succeed in the marketplace. Corporate strategies need to be repositioned to keep pace with the ongoing digital transformation.

With the rapid evolution of technology and changing consumer habits, the retail industry worldwide is striving to develop new retail practices. Retail businesses are seeking new technologies and are dependent on technological advances. The UN's ninth Sustainable Development Goal "Industry, Innovation and Infrastructure" describes the goal of building resilient infrastructure, promoting inclusive and sustainable industrialisation and fostering innovation (Chen & Shang, 2021; United Nations, 2015)

Within the digital transformation retail sector has changed a lot in recent years, with physical and digital boundaries becoming increasingly blurred, which have also led to the emergence of new business models in this sector (Sikos et al., 2019). The emergence of e-commerce is a global phenomenon in developing countries (Yang et al., 2021). The share of all IoT (Internet of Things) devices grew by 73 percent between 2015 and 2019 and is expected to grow by nearly 183 percent globally by 2025 compared to 2019 (Louie, 2020).

Between 2020 and 2025, the global smart retailing market is estimated to grow at a CAGR of 23.6 percent, and is expected to be worth $62.5 billion (USD) worldwide by 2025. Of this USD 62.5 billion, Europe will account for a significant share of approximately 30 percent (MarketsAndMarkets, 2020).

Traditional linear retail supply chains have been replaced by Digital Supply Networks (DSNs), where the transparent and real-time flow of information allows for more effective strategic decision-making and value creation is no longer limited to products and services. The new retail strategies based on these new foundations can essentially be broken down into front-end and back-end processes, according to Deloitte (Tushar & Sachi, 2017). This division was also used to delimit the research area. The digital tools used in front-end retail processes include digital tools for customer experience, store design, pricing, payment and loyalty programs such as smart fitting rooms, digital shelf communication, scan&shop solutions, smart shopping carts, self-service checkouts, virtual walls, loyalty programs based on blockchain technology or online shopping applications (Tushar & Sachi, 2017). Back-end processes include the areas of background administration, HR, finance or warehouse and inventory management (Matyusz & Pistrui, 2020a; Tushar & Sachi, 2017).

2. THEORETICAL BACKGROUND

2.1 Smart retailing

Digitalization processes have given rise to the concept of smart retail, which has grown out of the smart city concept in recent years. The spread of smart retail can be attributed to several factors. On the one hand, advances in technology have led to innovations such as QR codes, RFID scanners, touch screens and smartphones; on the other hand, after the 2008 global crisis, many businesses have moved online (Droogenbroeck & Hove, 2021; Pantano, 2014; Sikos et al., 2019). The Covid-19 pandemic has facilitated the spread of these tools to a greater extent than expected (Dannenberg et al., 2020; Shankar et al., 2021). The pandemic-induced expansion has led/is leading to the emergence of consumer groups in markets who may not have shopped online (Stolp, 2020) or were less open to using smart devices in their purchases.

The emergence of continuous innovation is leading to a rethinking of commercial processes, in which the relationship between sellers and buyers and the purchasing process is being transformed (Pantano & Timmermans, 2014; Sikos, 2018). Pantano and Timmermans (Pantano & Timmermans, 2014) identified six main elements of smart retailing: (1) rapid responsiveness, (2) change in knowledge management, (3) smart partnering, (4) change in salesperson's job, (5) service access, (6) change in consumption.

Providing smart devices or solutions to customers is only one part of smart retailing, as it requires a whole strategic shift in approach to integrate these solutions into the business model. Pantano and Timmermans' (Pantano & Timmermans, 2014) smart retail model illustrates the areas that need to be addressed and strategically managed in order for a business to properly integrate these devices into its business model. This research is mostly related to the area of consumption change (6), contributing to the digitalisation and automation strategy of retail companies.

2.2 Technology Acceptance Models

The evolution of technology acceptance models has played a key role in testing the user acceptance of a technological innovation. In 1985, the first widely used model for the acceptance of new technologies (Technology Acceptance Model - TAM) was published, which was prompted by the spread of personal computers (F. Davis, 1985). It was at this time that the consumer acceptance of technological innovations became increasingly important and, consequently, the way in which the potential flaws of a technology could be filtered out. Although it is worth noting that the TRA (Theory of Reasoned Action) model, which is attributed to Fishbein and Azejn (1975), and the TPB (Theory of Planned Behaviour) (Ajzen, 1991) are considered to be the predecessors of the TAM model. Due to the fact that new technologies were born, and nowadays digital transformation gives us new devices and new digital solutions, these models and theories have been changing from the 70's. Following the emergence of the TAM model, the evolution of models of technology adoption has led to a number of theories (Table 1) (Keszey & Zsukk, 2017; Palau-Saumell et al., 2019; Taherdoost, 2018).

Table 1. Main theories and their authors of technology acceptance models

Models/theories	Cources
Perceived Characteristics of Innovating Theory (PCIT)	(Moore & Benbasat, 1991)
The Model of PC Utilization (MPCU)	(Thompson et al., 1991)
Motivational Model (MM)	(F. D. Davis et al., 1992)
Igbaria's Model (IM)	(IGBARIA et al., 1994)
Diffusion of Innovations Theory (DOI)	(E. M. Rogers, 1983; Everett M. Rogers, 1995)
Social Cognitive Theory (SCT)	(Bandura, 1986; Compeau & Higgins, 1995)
Extension of TAM (TAM2)	(Venkatesh & Davis, 2000)
Uses and Gratification Theory (U&G)	(Katz et al., 1973)
Unified Theory of Acceptance and Use of Technology (UTAUT)	(Venkatesh et al., 2003)
Technology Acceptance Model 3 (TAM3)	(Venkatesh & Bala, 2008)
Extension of Unified Theory of Acceptance and Use of Technology (UTAUT2)	(Venkatesh et al., 2012)

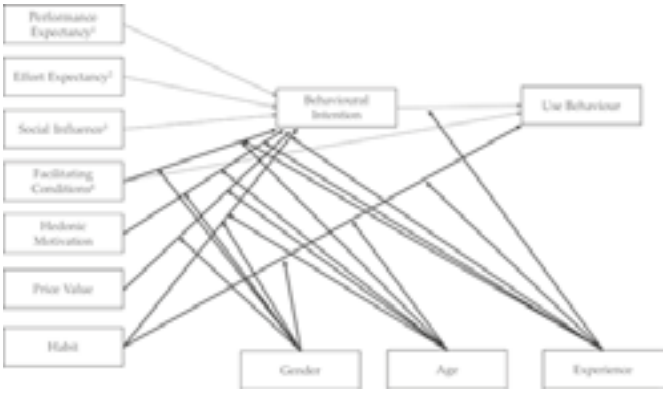
The research methodology presented in this paper is based on the extension of Unified Theory of Acceptance and Use of Technology (UTAUT2) by Venkatesh et al. (Venkatesh et al., 2012). The enhanced method is based on the UTAUT model, which analyses the acceptance of innovations, primarily in workplace settings (Venkatesh et al., 2003). The UTAUT2 model focuses on ordinary technological innovations used not only in workplace but in everyday life. International studies have examined the adoption of a number of smart devices and solutions using the UTAUT2 model (Table 2).

Table 2. Examining unified theory of technology adoption and use (UTAUT2) in some international research.

Investigated area	Cources
mobile Internet	(Venkatesh et al., 2012)
e-health individual adoption	(Goulão, 2014)
mobile app based shopping	(Tak & Panwar, 2017)
focus of age in healthcare	(Murugesh-Warren et al., 2015)
voice Assistants	(Kessler & Martin, 2017)
mobile banking	(Alalwan et al., 2017)
e-payment	(Indrawati & Putri, 2018), (Acharya et al., 2019)
mobile payment	(Wei et al., 2021)
mobile apps for restaurants	(Palau-Saumell et al., 2019; Yang et al., 2021)
e-money products	(Putra et al., 2019)
advanced driver assistance system	(Jun et al., 2019)

The original UTAUT2 model is structured with seven variables directly influencing behavioural intention, one variable indirectly and two variables directly influencing use behaviour, and it is contained three moderating variables (Figure 1).

Figure 1. Structure of the UTAUT2 model



Note: 1. moderating variable: gender and age; 2. moderating variable: gender, age and experience; 3. moderating variable: gender, age and experience; 4. moderating variable influencing use: age and experience

Source: (Venkatesh et al., 2012)

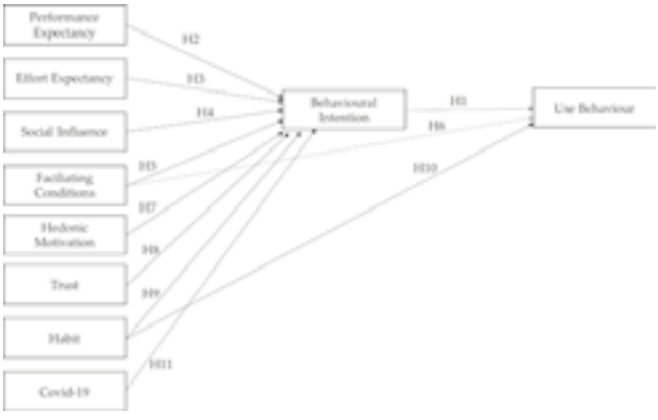
Performance expectancy variable express the extent to which the system or device under test contributes to the user's improved productivity in everyday life. Effort and energy investment required by the user to use it is measured by the effort expectancy variable. How important or unimportant they feel it is to use a device or system, what others think about it, is measured by the social influence variable. Facilitating conditions have a direct impact on both behavioural intention and use behavioural. The variable measures the extent to which users have the necessary technical tools and knowledge about the device under study. The hedonic motivation variable aims to measure the extent to which customers feel that using the devices is fun and how much pleasure they derive from using them. The price value variable measures the perceived usefulness of the user in using the devices under investigation in relation to the price of the device. The user's habits have a direct impact on both the intention to use and the actual use. The habit variable measures the user's established habits in relation to the analysed solutions (Alalwan et al., 2017; Keszey & Zsukk, 2017; Macedo, 2017; Raman & Don, 2013; Venkatesh et al., 2012).

The focus of the research was defined in terms of digital solutions for the front-end of retail. A key objective of the study is to examine consumers' perceptions of smart retailing solutions (SRS) in Hungary with the extended Unified Theory of Acceptance and Use of Technology Model (UTAUT2) (Venkatesh et al., 2012). Within the key objective the aim was to examine the affecting factors of SRSs' behavioural intention and use behaviour.

2.3 Research model and hypothesis development

Due to the specificities of the topic, it was necessary to modify the original UTAUT2 model. Price value variable were excluded from the proposed model because consumers do not have to pay directly for the use of the smart retail devices. The variable experience was also excluded due to the cross-sectional nature of the current research. Instead, trust, which is linked to smart retail solutions, was included as a test criterion. An additional set of statements was created on the effects of the Covid-19 pandemic (Covid-19). Such an adaptation of the UTAUT2 model has been previously reported in other studies (Acharya et al., 2019; Alalwan et al., 2017; Indrawati & Putri, 2018; Palau-Saumell et al., 2019; Putra et al., 2019; Raman & Don, 2013; Roy et al., 2018; Tak & Panwar, 2017).

Figure 2. Research model



So far this area has not been investigated using this method in Hungary. The hypothesis development was mostly based on the literature review; however, Covid-19 pandemic hypothesis is its own hypothesis (Table 3).

3. METHODOLOGY - MEASURES AND DATA COLLECTION

In order to test the hypothesises in this paper, a survey was applied. A pilot survey was conducted in February 2021 to filter out the possible inaccuracies. The final questionnaire

Table 3. Research hypothesises

Hypothesises	Sources
H1: The Behavioural Intention directly and positively influences the Use Behaviour of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H2: Performance Expectancy directly and positively influences the Behavioural Intention of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H3: Effort Expectancy directly and positively influences the Behavioural Intention of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H4: Social Influence directly and positively influences the Behavioural Intention of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H5: Facilitating Conditions directly and positively influences the Behavioural Intention of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H6: Facilitating Conditions directly and positively influences the Use Behaviour of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H7: Hedonic Motivation directly and positively influences the Behavioural Intention of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H8: Trust directly and positively influences the Behavioural Intention of SRSs.	(Acharya et al., 2019; Indrawati & Putri, 2018)
H9: Habit directly and positively influences the Behavioural Intention of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H10: Habit directly and positively influences the Use Behaviour of SRSs.	(Macedo, 2017; Palau-Saumell et al., 2019)
H11: Covid-19 pandemic directly and positively influences the Behavioural Intention of SRSs.	Own hypothesis

was available online between 1 March 2021 and 16 June 2021, and at the beginning of the questionnaire the research goal and definitions were introduced to the respondents with the aim of ensure competent responses. The survey was conducted using a non-probability sampling method (snowball sampling). The total number of respondents to be assessed was 302 of which all were assessable, so no exclusion was necessary. The statements were compiled based on the applied model (Annex A1). For each of the 9 constructs, respondents rated 34 statements on a scale of 1 to 7, where 1 was 'strongly disagree' and 7 was 'strongly agree'. For Use Behaviour also a 7-point Likert scale was available, where 1 was 'never use' and 7 was 'use daily'. Measurement scales are in line with the research of Venkatesh et al. (Venkatesh et al., 2012).

An analysis of demographic characteristics of respondents were performed. Amongst the respondents in terms of gender, 65.1% were female and 34.9% were male. 29.9% between age of 40-49 and the 18-29 and 30-39 age groups were almost equally represented (25.9% and 24.8%) indicating that the over-50s are less interested in the topic. 68.4% of the respondents own a diploma and 25.5% were studied on high school level. 53.2% said they live on their salary but have little to put aside, while 22.7% of the respondents said they can live on their salary and they can put aside well and almost the same number of respondents (21.6%) said their income is just enough to live on, but they can no longer save.

4. RESULTS

4.1. Measurement model

For data analysis IBM SPSS 25 and AMOS 26.0 software packages were used to validate the research model and test our hypothesises. Maximum likelihood estimation procedure was followed for evaluate the measurement model and the structural model. In the first step the measurement model was assessed by analysing the validity and reliability of the constructs. It is shown in Table 4 that all constructs have greater value than 0.7 in terms of Cronbach's Alpha, and concerning composite reliability all construct reached the adequate level (CR>0.7) (Hair et al., 2010) . AVE value of the latent constructs all but one above the limit value of 0.5 (Hair et al., 2010).

Table 4. Measurement model tests

Constructs	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Performance Expectancy (PE)	0.885	0.83	0.62
Effort Expectancy (EE)	0.884	0.89	0.66
Social Influence (SI)	0.914	0.91	0.78
Facilitating Conditions (FC)	0.739	0.70	0.44
Hedonic Motivation (HM)	0.926	0.93	0.80
Trust (TR)	0.902	0.88	0.65
Habit (HT)	0.870	0.86	0.57
Covid-19 (CV)	0.889	0.89	0.73
Behavioural Intention (BI)	0.903	0.84	0.73

To test for multicollinearity, VIFs (Variance Inflation Factors) were calculated, and values obtained between 1.942 and 4.710, which are below the threshold value of 5, indicate multicollinearity is not an issue in this study (Hair et al., 1995).

Confirmatory factor analysis (CFA) was implemented in which factor loadings were assessed. In order to improve the model fit and eliminate loadings below threshold, four items were dropped. In the final model all items had a greater factor loading than 0.5, which were found statistically significant and model fit indexes show appropriate fit (Table 5). Chi-square test have limitation and it is sensitive to sample size (West et al., 2012) therefore in line with Wheaton et al. (1977) and Kline (2015) CMIN/df, IFI, TLI, CFA, RMSEA were considered to report model fit.

Table 6 shows the discriminant validity of the analysed constructs, where heterotrait-monotrait ratio was applied. In this analysis the values obtained were compared to a threshold value of 0.9 (Henseler et al., 2016), where most of the values were under the criterion. Three values do not meet the criterion, however they do not exceed 1.0 (Henseler et al., 2016).

Table 5. Measurement model loadings

		Factor loadings	t-value
Performance Expectancy (Venkatesh et al., 2012)			
PE1	I find smart retail solutions useful in my daily life.	0.76	15.33***
PE3	Using smart retail solutions help me accomplish things more quickly.	0.80	16.34***
PE4	Using smart retail solutions increase my productivity.	0.80	
Effort Expectancy (Venkatesh et al., 2012)			
EE1	Learning how to use smart retail solutions is easy for me.	0.83	18.06***
EE2	My interaction with smart retail solutions is clear and understandable.	0.75	15.59***
EE3	I find smart retail solutions easy to use.	0.80	17.26***
EE4	It is easy for me to become skilful at using smart retail solutions.	0.86	
Social Influence (Venkatesh et al., 2012)			
SI1	People who are important to me think that I should use smart retail solutions.	0.87	21.33***
SI2	People who influence my behaviour think that I should use smart retail solutions.	0.88	21.65***
SI3	People whose opinions that I value prefer that I use smart retail solutions.	0.91	
Facilitating Conditions (Venkatesh et al., 2012)			
FC1	I have the resources necessary to use smart retail solutions.	0.58	7.52***
FC3	Smart retail solutions are compatible with other technologies I use.	0.71	9.74***
FC4	I can get help from others when I have difficulties using smart retail solutions.	0.70	
Hedonic Motivation (Venkatesh et al., 2012)			
HM1	Using smart retail solutions is fun.	0.88	21.65***
HM2	Using smart retail solutions is enjoyable.	0.93	24.20***
HM3	Using smart retail solutions is very entertaining.	0.88	
Trust (Acharya et al., 2019 and Indrawati & Putri, 2018)			
TR1	I believe that smart retail solutions are reliable.	0.84	14.02***
TR2	I rely on smart retail solutions.	0.96	15.55***
TR3	If I use smart retail solutions on my own device (e.g. smartphone, computer), I think my data will be kept confidential.	0.71	20.30***
TR4	I believe that when I use a smart retail tool, my data and activities do not fall into unauthorized hands.	0.71	
Covid-19 (own statements)			
CV1	Because of the Covid-19 pandemic, I currently use more smart retail solutions than I did before the epidemic.	0.82	16.92***
CV2	I feel that due to the Covid-19 pandemic, smart retail solutions are closer to me than they were before the epidemic.	0.90	19.13***
CV3	The Covid-19 pandemic has made it clear that there is a greater need for smart retail solutions than it used to be.	0.85	
Habit (Venkatesh et al., 2012)			
HB1	The use of smart retail solutions has become a habit for me.	0.93	16.48***
HB2	I am addicted to using smart retail solutions.	0.56	9.73***
HB3	I must use smart retail solutions.	0.51	8.84***
HB4	Using smart retail solutions has become natural to me.	0.94	16.80***
HB5	I'd rather shop in a store where I can use smart retail solutions. (Own statement)	0.73	
Behavioural Intention (Venkatesh et al., 2012 and Indrawati & Putri, 2018)			
BI2	I will always try to use smart retail solutions in my daily life.	0.82	
BI3	I plan to continue to use smart retail solutions frequently.	0.89	19.48***

*Notes. Model fit: Chi-square (χ2)=915.906, df=366, p=0.000; CMIN/df=2.502; IFI=0.934; TLI=930; CFI=0.929; RMSEA=0.071; **p<0.01*

Table 6. Discriminant validity – Heterotrait-Monotrait ratio (HTMT)

	PE	EE	SI	FC	HM	TR	HB	CV	BI
PE									
EE	0.791								
SI	0.678	0.365							
FC	0.720	0.931	0.409						
HM	0.883	0.687	0.583	0.585					
TR	0.838	0.658	0.498	0.674	0.696				
HB	0.882	0.724	0.774	0.601	0.728	0.682			
CV	0.754	0.522	0.623	0.545	0.594	0.525	0.709		
BI	0.956	0.774	0.630	0.675	0.844	0.737	0.993	0.686	

4.2. Structural model - Hypothesis Analysis

Relationships of the research model were analysed to test eleven hypothesises. Structural equation modelling (SEM) was performed by doing bootstrapping procedure where model fit indexes (Table 7) indicating appropriate fit. Results shows that effort expectancy and facilitating conditions significantly influenced behavioural intention. Based on the significant results H3 was supported since effort expectancy (=0.650, p<0.05) has a positive direct effect on behavioural intention. Regarding hypothesis H5, a significant result was obtained that facilitating conditions has direct effect on behavioural intention (=0.608, p<0.05), however this relationship is negative therefore this hypothesis is not supported while it is an interesting result. Other hypothesises (H1, H2, H4, H6, H7, H8, H9, H10, H11) of the model were rejected which means other variables have no effect on behavioural intention and use behaviour.

Table 7. Effects on endogenous variables

Hypothesis	Relationship	Standardized Coefficient (β)	Sig.	Hypothesis validation
H1	BI→UB	-0.444	0.593	Not supported
H2	PE→BI	0.243	0.481	Not supported
H3	EE→BI	0.65***	0.02	Supported
H4	SI→BI	0.107	0.165	Not supported
H5	FC→BI	-0.608***	0.009	Not supported
H6	FC→UB	-0.082	0.397	Not supported
H7	HM→BI	-0.08	0.402	Not supported
H8	TR→BI	0.121	0.563	Not supported
H9	HB→BI	0.569	0.567	Not supported
H10	HB→UB	0.974	0.266	Not supported
H11	CV→BI	0.057	0.414	Not supported

*Notes. Model fit: Chi-square (χ2)=967.361, df=393, p=0.000; CMIN/df=2.461; IFI=0.928; TLI=914; CFI=0.927; RMSEA=0.070; ***p<0.05*

5. DISCUSSION AND CONCLUSIONS

The main goal of this paper was to analyse among respondents what are the main influencing factors of SRS acceptance and how the analysed variables influence behavioural intention and use behaviour. The findings of this study can provide guidance for retailers in Hungary which can be the main drivers for consumers to try or use smart solutions. UTAUT2 model was used to answer the research hypothesises where 31 statements were adapted from international research and 3 statements (one construct) were created to investigate the influence of Covid-19 pandemic situation.

Based on the findings of the structural model the main influencing factor of behavioural intention are effort expectancy and facilitating conditions. Findings about effort expectancy are consistent with Venkatesh et al. (2012), Raman & Don (2013), Macedo (2017) and Acharya et al. (2019). Respondents seems to learn and use these technologies rather easily therefore the easier it is to use, the more likely customers are to want to use it.

In terms of facilitating conditions significant negative relationship was detected which indicate that the existence of facilitating conditions does not mean that the intention to use is positively influenced. Wei et al. (2021) also found negative relationship with behavioural intention, but their result was not significant.

In this research coronavirus had no significant impact on behavioural intention among Hungarian respondents.

Performance expectancy, social influence, hedonic motivation, trust, and habit have neither proven relationship with behavioural intention in this research. Behavioural intention also not considered as an influencing factor to use behaviour. Several studies (Macedo, 2017; Morosan & DeFranco, 2016; Putra et al., 2019; Raman & Don, 2013; Wei et al., 2021) rejected a few of these hypothesises, but it is important to note that not so many of the hypotheses tests are rejected at the same time. As validated statements were used in the proposed model (except statements about the pandemic situation) the results indicate to examine descriptive statistics.

The results of the descriptive statistics (Annex A1) show that high standard- and relative standard deviation values were observed, and that there are also notable differences (>2.0) between the mode and the mean values. Respondents' opinions can rather be described as heterogeneous. The responses on habit show an interesting result, as most respondents gave a score of 1.0 for each statement and the mean scores cannot be considered as high on the seven-point Likert scale. Most of the respondents are not yet regular users of smart retail solutions as confirmed by the fact that mean value for use behaviour was 1.99 on seven-point likers scale, which can be considered as low level use. Consequently, they did not necessarily respond based on numerous, but rather on little or no experience. This is also supported by the fact that at the time of the survey, the analysed smart solutions were not widely available in Hungary because Hungarian companies first focusing on improve the efficiency of back-end processes, and after these improvements they starting to focus on the digitisation of front-end activities (Matyusz & Pistrui, 2020b). Overall, the use of these devices is not yet established in Hungary, therefore the factors influencing the behavioural intention and use behaviour are not yet cleared.

From a managerial perspective, the findings have implications for retail store managers and operators. Based on the findings of this study in early adoption stage of the intelligent front-end retail solutions it is important to keep device handling simple and user friendly. As the introduction of SRS is still in its infancy in Hungary, therefore one of the most important tasks for retail companies is to build consumer confidence and incentives to use new technologies. Data security should be an important aspect of the market launch where data and activities do not fall into unauthorized hands.

6. Limitations and Future Research

This research was conducted among Hungarian respondents, and the results cannot be generalized due to the sampling method, therefore the results should be interpreted with caution. In Hungary, the market penetration of front-end intelligent solutions in retail was rather low during the survey

period therefore the findings may not be applied to countries that are more technologically advanced.

Markets are changing rapidly due to digital transformation, so the research should be repeated in a few years. This will allow us to see how the findings in this publication change over time. Furthermore, moderating effects (e.g. gender, age, income) should also be investigated in the future, although this was not the aim of this current paper.

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Appendix A

Table A1. Statements and descriptive statistics of Modified Extended Unified Theory of Acceptance and Use of Technology Model (UTAUT2)

Code	Constructs and items	Mean (N=302)	Mode	S.D.	Relative S.D. (%)
Performance Expectancy (Venkatesh et al., 2012)					
PE1	I find smart retail solutions useful in my daily life.	5.16	7.00	1.707	38.321
PE2	Using smart retail solutions increase my chances of achieving things that are important to me. (dropped)	4.60	7.00	1.875	33.751
PE3	Using smart retail solutions help me accomplish things more quickly.	4.88	6.00	1.518	36.064
PE4	Using smart retail solutions increase my productivity.	4.47	6.00	1.885	57.386
Effort Expectancy (Venkatesh et al., 2012)					
EE1	Learning how to use smart retail solutions is easy for me.	4.64	5.00	1.776	33.067
EE2	My interaction with smart retail solutions is clear and understandable.	5.20	7.00	1.753	40.773
EE3	I find smart retail solutions easy to use.	5.08	7.00	1.832	31.104
EE4	It is easy for me to become skilful at using smart retail solutions.	3.41	1.00	1.959	42.192
Social Influence (Venkatesh et al., 2012)					
SI1	People who are important to me think that I should use smart retail solutions.	3.11	1.00	1.931	62.178
SI2	People who influence my behaviour think that I should use smart retail solutions.	3.07	1.00	1.922	62.605
SI3	People whose opinions that I value prefer that I use smart retail solutions.	2.90	1.00	1.876	64.764
Facilitating Conditions (Venkatesh et al., 2012)					
FC1	I have the resources necessary to use smart retail solutions.	6.29	7.00	1.364	21.690
FC2	I have the knowledge necessary to use smart retail solutions. (dropped)	4.54	6.00	1.803	39.727
FC3	Smart retail solutions are compatible with other technologies I use.	4.60	6.00	1.836	39.916
FC4	I can get help from others when I have difficulties using smart retail solutions.	4.83	7.00	1.757	36.354
Hedonic Motivation (Venkatesh et al., 2012)					
HM1	Using smart retail solutions is fun.	4.68	7.00	1.873	40.065
HM2	Using smart retail solutions is enjoyable.	4.53	5.00	1.781	39.357
HM3	Using smart retail solutions is very entertaining.	3.87	1.00	1.955	50.495
Trust (Acharya et al., 2019; Indrawati & Putri, 2018)					
TR1	I believe that smart retail solutions are reliable.	4.64	5.00	1.698	36.630
TR2	I rely on smart retail solutions.	4.53	6.00	1.776	39.173
TR3	If I use smart retail solutions on my own device (e.g. smartphone, computer), I think my data will be kept confidential.	4.02	5.00	1.864	46.371
TR4	I believe that when I use a smart retail tool, my data and activities do not fall into unauthorized hands.	3.74	4.00	1.872	50.119
Covid-19 (own statements)					
CV1	Because of the Covid-19 pandemic, I currently use more smart retail solutions than I did before the epidemic.	3.78	1.00	2.252	59.598
CV2	I feel that due to the Covid-19 pandemic, smart retail solutions are closer to me than they were before the epidemic.	3.75	1.00	2.110	56.188
CV3	The Covid-19 pandemic has made it clear that there is a greater need for smart retail solutions than it used to be.	4.06	4.00	2.054	50.640
Habit (Venkatesh et al., 2012)					
HB1	The use of smart retail solutions has become a habit for me.	3.52	1.00	2.046	58.168
HB2	I am addicted to using smart retail solutions.	1.97	1.00	1.525	77.261
HB3	I must use smart retail solutions.	2.54	1.00	1.787	70.355
HB4	Using smart retail solutions has become natural to me.	3.70	1.00	2.037	55.029
HB5	I'd rather shop in a store where I can use smart retail solutions. (Own statement)	3.25	1.00	1.841	56.724
Behavioural Intention (Indrawati & Putri, 2018; Venkatesh et al., 2012)					
BI1	I intend to continue using smart retail solutions in the future. (dropped)	4.73	7.00	2.027	42.847
BI2	I will always try to use smart retail solutions in my daily life.	3.07	1.00	1.934	62.998
BI3	I plan to continue to use smart retail solutions frequently.	4.15	6.00	1.986	47.824
BI4	I highly recommend that others use smart retail solutions. (dropped)	3.83	4.00	1.911	49.849

Use Behaviour was measured on 7-point scale (1: "never use" and 7: "use daily").

Note: All other items based on 7-point scale (1: „strongly disagree" and 7: „strongly agree").

Applied Studies in Agribusiness and Commerce – APSTRACT
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SCIENTIFIC PAPER

THE SITUATION OF AGRICULTURAL SECTOR IN HUNGARY – TRENDS AND TERRITORIAL ASPECTS[1]

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Abstract:*Based on its geographical features, Hungary is basically an agricultural country. The proportion of the production area within the total area of the country is approximately 80% and the proportion of arable land is 60%. This makes our country one of the first in the European Union. In the EU, only Denmark and the United Kingdom have a higher proportion of agricultural land. Hungary accounts for only 3% of the total agricultural area of the EU-27 Member States, however, it plays a significant role in the production of certain products. (Harangi-Rákos, 2013)*
In addition, the climate is favorable for agricultural production, which also strengthens the country's agricultural character. Throughout history, we have rightly been given the honorable name "pantry" (Marosi, 2009), which was true both within the Monarchy and Europe. In the socialist system the agricultural country became a so-called "industrial-agrarian" country due to the violent industrializations.
Beyond industrial development, the service sector plays an important role in the national economy due to its technology-intensive nature. In addition, agricultural production is still significant in Hungary (Lakner et al. 2020). The agricultural sector is significantly involved in the production of the gross domestic product (Fróna-Kőmíves 2019) and in the positive development of the export-import balance. During the 2008 world crisis, it was thanks to this sector, among other factors, that the recession that affected our country did not deepen. The domestic consumption is largely covered by domestically produced commodities (Csatáriné, 2019)

OBJECTIVE, DATABASE, METHODOLOGY

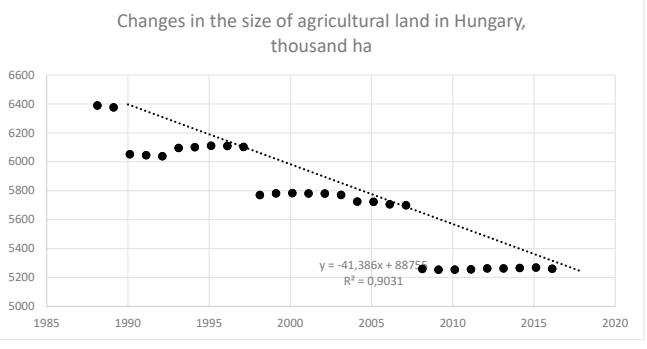
Based on some key aspects, the authors attempt, without wishing to be exhaustive, to summarize the changes that have taken place in the sector in the decades following the change of regime, based on key macroeconomic data, taking into account some regional differences as well. The authors mainly performed their analyzes by using the latest database of the KSH (Hungarian Central Statistical Office), and by relying on some simple, descriptive and inferential statistical methods.

RESULTS

Changes in agricultural land and in the production of major agricultural products in recent decades

The proportion of agricultural land is high compared to the total area of the country, but has been steadily declining in the years following the change of regime. According to the available data, it decreased from 6473.1 thousand hectares in 1990 to 5343.8 thousand hectares by 2018. This represents a decrease of nearly 1,130 thousand hectares (17.5%), (the annual average decrease was nearly 0.7%, ie slightly more than 41 thousand ha) (Figure 1).

Figure 1.



Source: Edited by the authors based on the KSH STADAT database

Despite the decrease in the agricultural area, we can still say that Hungary has remained self-sufficient in the production of agricultural products. The level of mechanization has increased significantly, and this has resulted in a much more efficient production, agrotechnics developed, and the quality of propagating materials influencing the production of commodities has improved. All this can be said despite the fact that since the 1990s, the amount of crop and livestock products produced in some cases has been steadily declining.

1 The research is supported by the Research Centre at Faculty of Business and Economics (No PE-GTK-GSKK A095000000-6) of University of Pannonia (Veszprém, Hungary).

In the last almost 30 years the wheat production has fallen from 6 million 200 tones to 5.26 million tones (15%), while maize production has increased by 78% and sugar beet production has fallen sharply to one-fifth since the change of regime. The latter data show an obvious correlation with the large-scale privatization of the Hungarian sugar industry (Bertalan, 2016; Molnár, 2016). Among the other crops, the change in the production of oilseeds stands out, with an increase of almost three and a half times. For the other crops (vegetables, grapes, fruits), production fell to almost two-thirds, with the exception of potato production, where the decline was similar to that of sugar beet (73% reduction).

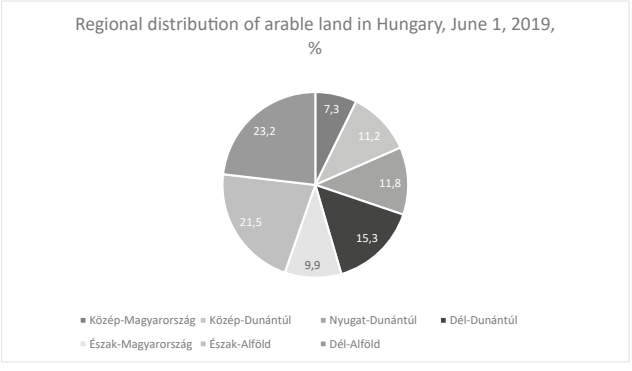
We can also see a decline in the livestock sectors. On one hand, the number of animals decreased for all major animal species: the number of cattle fell to 56%, the number of pigs to 35%, the number of sheep to 60% and the number of poultry to 80% compared to the 1990 base year.

At the same time, of course, the production of the livestock sectors (commodity stock) also decreased. In the case of cattle this decrease is 25%, in the case of slaughter pigs 55%, in the case of cow's milk 32%, in the case of egg production 45%, and in the case of wool production 50%.

The index of agricultural production (crop and livestock production combined) fell by 2.3% over 28 years, but the two sectors moved in opposite directions. While we see an increase of almost 25% in crop production, the value of livestock production decreased by 40% at current prices. (KSH, Stadat 2020.)

Based on the territorial distribution of cultivation sectors, there are big differences between the regions. Based on the national distribution of arable land, not surprisingly almost half of the total arable land of the country (44.7%) is concentrated in the two Great Plain regions (Northern Great Plain and Southern Great Plain). (Figure 2).

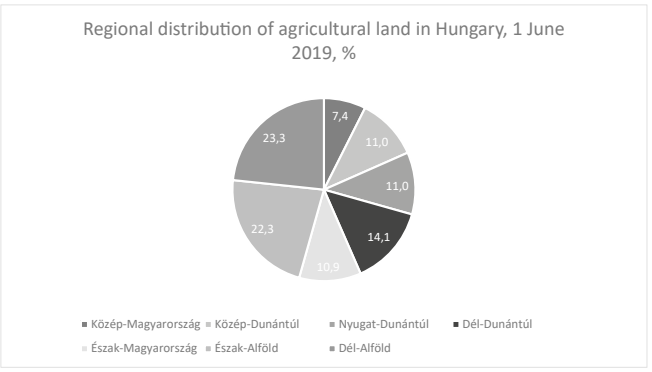
Figure 2.



Source: Calculated and edited by the authors based on the KSH STADAT database

In terms of agricultural area, we can actually observe very similar proportions as we saw in the distribution of arable land. In this respect, the Northern Great Plain and the Southern Great Plain regions represent almost half of the areas in question (45.6%) (Figure 3).

Figure 3.



Source: Calculated and edited by the authors based on the KSH STADAT database

Characteristics of the number of full time employees and total number of employees (full time employed and seasonal workers) in the agricultural sector

In the agricultural sector (by which we mean agriculture, forestry, fishing, and hunting together), the number and proportion of full time employees have changed since the change of regime. During the last ten years (2009 to 2019), the number of people living from the income received from this sector decreased by approximately 9,000 (Table 1).

The number and proportion of those employed full time in the agricultural sector in Hungary in the last decade Table 1.

year	*number of full time employees in the agricultural sector, thousand people*	*number of full time employees in the agricultural sector, %*
2009	*82.8*	*3.11*
2010	*76.7*	*2.84*
2011	*74.7*	*2.78*
2012	*77.8*	*2.91*
2013	*75.3*	*2.79*
2014	*78.2*	*2.77*
2015	*78.9*	*2.73*
2016	*77.7*	*2.61*
2017	*78.1*	*2.58*
2018	*74.7*	*2.40*
2019	*73.3*	*2.30*

Source: Edited by the authors based on the KSH STADAT database

In case of proportions, we can see similar trends. While in the early 1990s more than 20% of workers made a living from the agricultural sector, at present this proportion does not reach 3%. The decline in the number of employees was not entirely even (see the years starting from 2012), but we are still seeing a steady decline in its trend.

The total number of people employed in the sector is higher than this, as it also takes into account those who work here temporarily (eg working on a contract basis and seasonal). Thus, we can say that the situation in the sector is slightly better than if only full time employed are taken into account (Table 2).

The total number and proportion of people working in the agricultural sector in Hungary in the last decade Table 2.

year	*number of people working in the agricultural sector, thousand people*	*number of people working in the agricultural sector, %*
2009	*174.9*	*4.7*
2010	*172.8*	*4.6*
2011	*184.6*	*4.9*
2012	*192.7*	*5.0*
2013	*184.6*	*4.7*
2014	*189.6*	*4.6*
2015	*203.2*	*4.8*
2016	*217.0*	*5.0*
2017	*220.0*	*5.0*
2018	*214.9*	*4.8*
2019	*210.7*	*4.7*

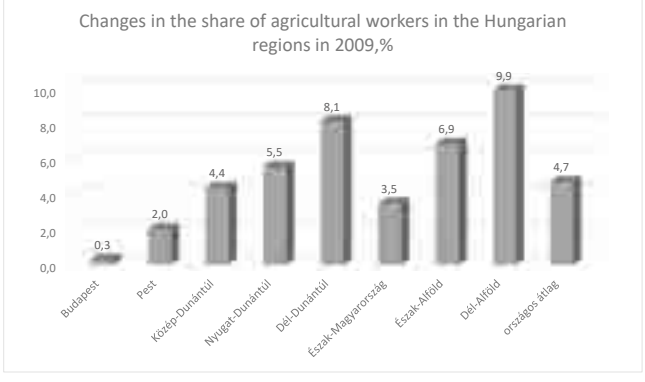
Source: Calculated and edited by the authors based on the KSH STADAT database

There are significant differences between different regions in terms of the number and proportion of agricultural workers. Based on these indicators (among others) conclusions can be drawn on the agricultural character of a region. In this respect the South Transdanubia and the Southern Great Plain regions stand out.

In the following, we show what ratios can be observed in this respect at the beginning (2009) and at the end (2019) of the study period.

At the beginning of the study period (2009), the national average for those working in agriculture was 4.7%. The regional data (Budapest was taken here separately from Pest County) differed significantly from this average. In addition to the above-mentioned regions (Southern Great Plain and Southern Transdanubia) (9.9 and 8.1%, respectively), the proportion of agricultural employees was significant in the Northern Great Plain region (6.9%). Budapest, Pest County and the Northern Hungary region are significantly below average (Figure 4).

Figure 4.

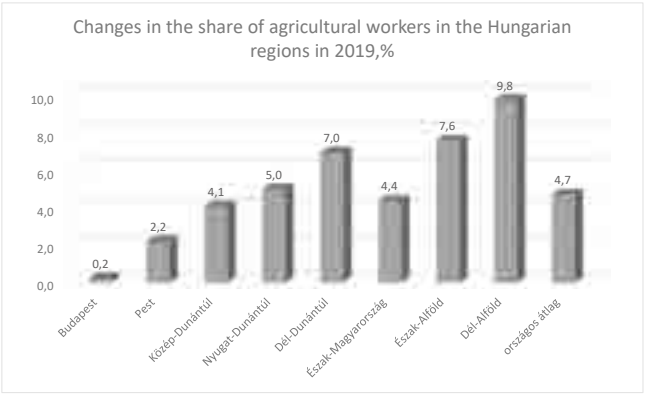


Source: Calculated and edited by the authors based on the KSH STADAT database

At the end of the study period (in 2019), the proportion of agricultural workers at the national level is the same as 10 years earlier. The proportions of the regions have been rearranged at some degree.

Thus, the share of Budapest and the Southern Great Plain region decreased slightly (by 0.1 percentage points), while the share of workers in Southern Transdanubia decreased significantly (by 1.2 percentage points). In contrast, we can observe a relatively significant increase in the regions of Northern Hungary and the Northern Great Plain (0.9 and 0.7 percentage points). In addition, there was a slight increase in Pest County, while a slight decrease was observed in Central Transdanubia and Western Transdanubia (Figure 5).

Figure 5.



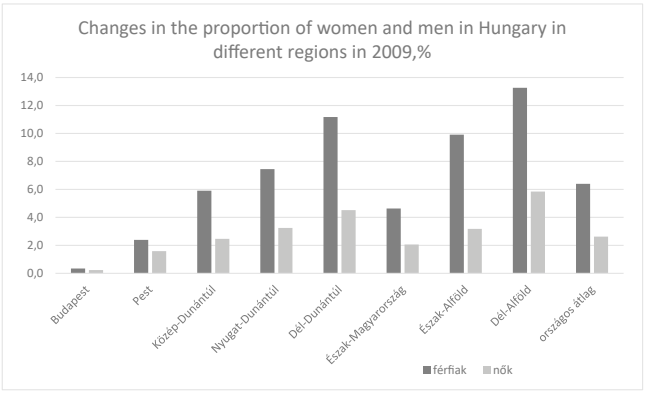
Source: Calculated and edited by the authors based on the KSH STADAT database

It is interesting to examine the gender differences for those working in agriculture. At the beginning of the study period, a much higher proportion of men worked in agriculture than women (see Figure 6). The difference is more than double in favor of the former (6.2% and 2.6%, respectively). This is obviously related to the fact that working in agriculture in general tends to require more physical power than in other sectors.

The above-average regions are the same as for the total number of workers, so the Southern Great Plain, the Northern Great Plain and the South Transdanubia regions stand out, and the Western Transdanubia data is just above the average. Thus, the average of women is lower than that of men, and in fact in all regions, the agricultural employment of women is lower than the national average of men (Figure 6).

Values of the women above its own average occur in the same regions as in the case of men (Southern Great Plain, Northern Great Plain, Southern Transdanubia and Western Transdanubia).

Figure 6.



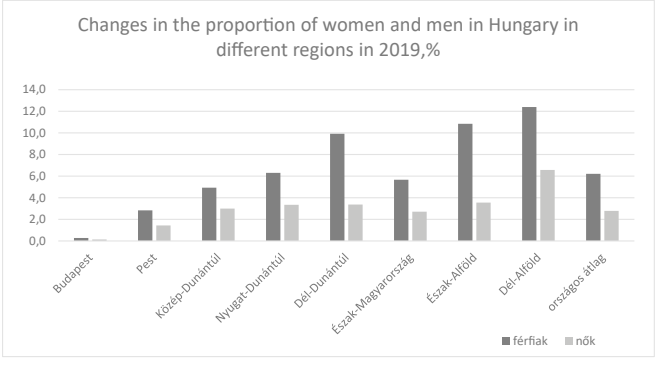
Source: Calculated and edited by the authors based on the KSH STADAT database

By the end of the period, national averages had changed very slightly, men's had decreased slightly, women's had increased slightly, but no significant change had taken place. There was some change in each region (Figure 7.).

For men, there was an increase in the regions of Northern Hungary Northern Great Plain, and in Pest County, while in the other regions we observed a decrease, the largest in Southern Transdanubia.

Women also had the largest decrease in the South Transdanubia region, but we can see an increase everywhere outside the central region (Budapest and Pest County). The highest rate was registered by the Southern Great Plain (0.7% percentage points).

Figure 7.



Source: Calculated and edited by the authors based on the KSH STADAT database

Development of wages for full time employees in theagricultural sector

It is widely believed that those working in agriculture have a gross wage below the national average, although there might be significant differences between wages and income. The following table (Table 3) shows the development of gross wages in the agricultural sector over the last 10 years and the deviations from the national average. It should be noted that the data in the table come from enterprises with more than 5 employees, so they are slightly skewed upwards.

Changes of wages in the agricultural sector in Hungary in the last decade Table 3.

year	*gross average wages in agriculture, Ft*	*national average, Ft*	*deviation from the national average, %*
2009	*137 101*	*199 837*	*-31.4*
2010	*143 861*	*202 525*	*-29.0*
2011	*153 301*	*213 094*	*-28.1*
2012	*164 136*	*223 060*	*-26.4*
2013	*171 679*	*230 714*	*-25.6*
2014	*180 251*	*237 695*	*-24.2*
2015	*189 136*	*247 924*	*-23.7*
2016	*204 385*	*263 171*	*-22.3*
2017	*230 638*	*297 017*	*-22.3*
2018	*255 664*	*329 943*	*-22.5*
2019	*293 207*	*367 833*	*-20.3*

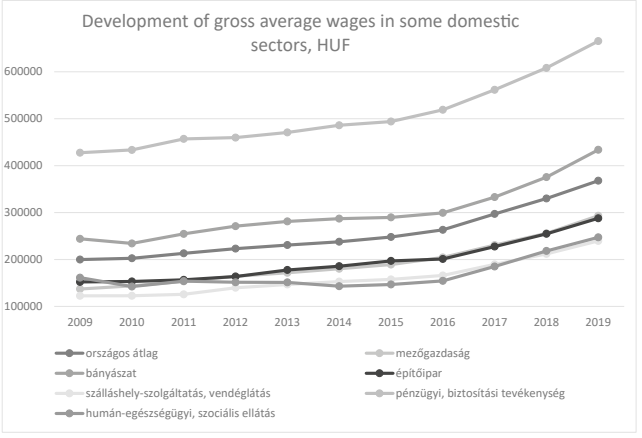
Source: Calculated and edited by the authors based on the KSH STADAT database

Wages observed in the sector remain significantly below the national average, although this gap has narrowed significantly since the beginning of the period, the gap of more than 30% by 2019 narrowing to just over 20%.

Taking into account all sectors, the 2019 data show that agriculture does not have the lowest gross wages. The lowest earnings were in the "human health and social care" sector, where the average wage did not reach HUF 250,000.

Within this, the "social care" sub-sector was the last with its average of HUF 175,000. Furthermore, the wages of those working in "construction" as well as in "accommodation and hospitality" activities also lagged behind in comparison with those working in the agricultural sector (Figure 8).

Figure 8.



Source: Calculated and edited by the authors based on the KSH STADAT database

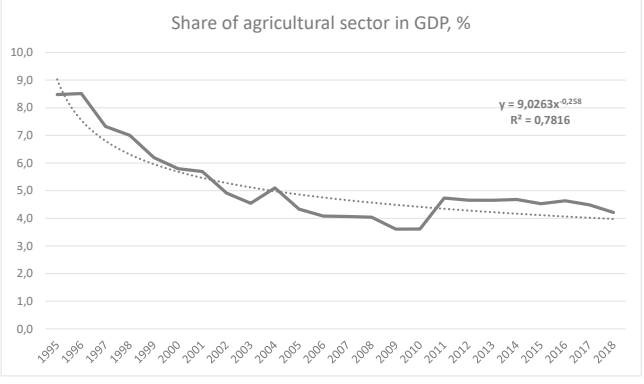
In each year of the period under review in terms of wages, the list-leading sector is "financial and insurance activity". The wages available here were almost double the national average in 2019 (exactly 1.8 times higher), and 2.3 times higher than the agricultural earnings. In addition to "agriculture", the data of

the other primary branch of the national economy, "mining and quarrying" also show values exceeding the national average.

Some characteristics and significance of the production in the agricultural sector

Although the importance of the agricultural sector in Hungary is great, its role in the production of gross value added (GVA) has been declining since the change of regime. While in 1995 its share in the GVA was 8.5%, by 2018 this rate was less than half (4.2%), dropping by 0.25% in average per year (Figure 9).

Figure 9.



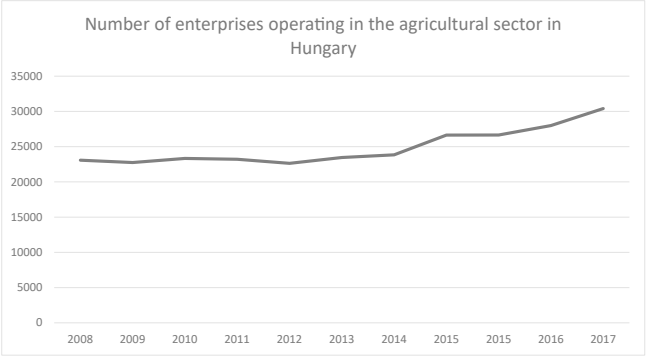
***Source: Calculated and edited by the authors based on the* KSH STADAT database**

At the end of the period (2018), it ranks only 11th in the distribution between sectors and also lags significantly behind the performance of the leading sectors. The manufacturing industry is on the first place, with a share of 22.1%, ahead of the trade and repair of motor vehicles and motorcycles activities (11.0%). Sectors in the same weight as the agricultural sector were construction, transport and storage, information and communication, administrative and support service activities, education, human health and social work activities.

Number of enterprises operating in the domestic agricultural sector, in the different regions

The number of enterprises operating in the domestic agricultural sector has been growing steadily since 2008, reaching a total increase of 30% in 10 years. From 23 thousand (23 081) at the beginning of the period, their number increased to more than 30 thousand (30 408). In this regard, especially since 2014, there has been a noticeable increase, which can be seen in Figure 10.

Figure 10.



Source: Calculated and edited by the authors based on the KSH STADAT database

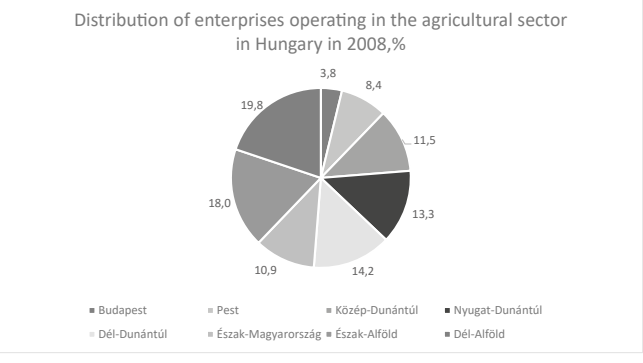
Share of different branches of the national economy in GDP, 2018 Table 4.

Code	*Economic activities*	*distribution,%*
A	Agriculture, forestry and fishing	*4.2*
B	Mining and quarrying	*0.3*
C	Manufacturing	*22.1*
D	Electricity, gas, steam and air conditioning supply	*1.5*
E	Water supply; sewerage, waste management and remediation activities	*0.9*
F	Construction	*5.3*
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	*11.0*
H	Transportation and storage	*6.1*
I	Accommodation and food service activities	*1.9*
J	Information and communication	*5.0*
K	Financial and insurance activities	*3.5*
L	Real estate activities	*7.9*
M	Professional, scientific and technical activities	*6.2*
N	Administrative and support service activities	*4.0*
O	Public administration and defence; compulsory social security	*8.0*
P	Education	*4.5*
Q	Human health and social work activities	*4.6*
R	Arts, entertainment and recreation	*1.5*
S	Other service activities	*1.4*
T	Activities of households	*0.0*
	Total gross value added	***100.0***

Source: Edited by the authors based on the KSH STADAT database

However, there are also big differences between the NUTS level 2 regions in Hungary in this respect. At the beginning of the period, in the eight regions (excepting Budapest and Pest county), the Southern and Northern Great Plain regions stood out with the highest share (19.8 and 18.0 per cent, respectively) (see Figure 11). These regions are followed by South Transdanubia (14.2%) and West Transdanubia (13.3%). Naturally, Budapest (3.8%) and Pest County (8.4%) had the smallest share of enterprises engaged in agricultural activities.

Figure 11.



Source: Calculated and edited by the authors based on the KSH STADAT database

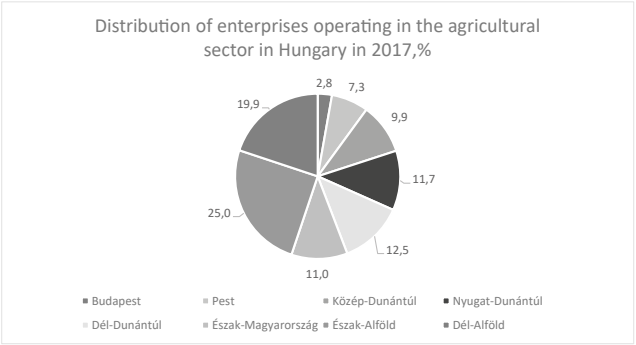
By the end of the study period, significant changes had occurred in some regions (Figure 12). The role of the already small share regions has further diminished. The share of agricultural enterprises registered in Budapest decreased from 3.5 percent to 2.8 percent (this means 848 enterprises in particular), as did the share in Pest County (from 8.4 per cent to 7.3 per cent). Even a larger decline was registered in the Central Transdanubia, Western Transdanubia and South Transdanubia regions (1.6; 1.7; 1.7 percentage points, respectively). In the regions of Northern Hungary and the Southern Great Plain, this ratio remained practically unchanged, but in the Northern Great Plain region the share of agricultural enterprises increased significantly (an increase of 7.0 percentage points). With this, the Northern Great Plain region took over the leading role in this respect. Of the total number of domestic agricultural enterprises, we found the largest proportion here, around 25 percent, which meant 6,050 such enterprises in 2017.

SUMMARY OF RESULTS, CONCLUSIONS

The authors examined the situation of the Hungarian agricultural sector and the trends of the recent years. It was pointed out that the size of utilized agricultural area has decreased in recent decades and that the production of major agricultural products, including the crop and livestock sectors, has also declined somewhat, but this has not jeopardized the domestic consumption.

At the national level, the number and proportion of employees in the agricultural sector has been steadily declining in the

Figure 12.



Source: Calculated and edited by the authors based on the KSH STADAT database

recent decades. The sector is under double pressure: on the one hand, the aging workforce needs to be replaced, and on the other hand, seasonal jobs remain, where it is possible to solve the handwork-intensive tasks with casual labor (Ukrainian, Serbian, Romanian).

There are significant regional differences behind the national average, with the Southern Great Plain being the most agricultural region in terms of employment. There are also significant differences between the sexes. The number of men employed in the sector is significantly higher than the number of women, and regional differences for both sexes are similar to national trends.

The wages of full-time employees in the agricultural sector lagged significantly behind the highest-wage domestic sectors and did not reach the national average, but improved somewhat during the study period. At the beginning of the period considered, this was still 30% behind, falling to 20%.

The sector's share of GDP was just over 4% in 2018 and this rate has been steadily declining in previous years. The number of enterprises operating in the agricultural sector, on the other hand, increased by 30%, but behind this trend we can observe significant regional differences.

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SCIENTIFIC PAPER

THE MOST RELEVANT FACTORS AND TRENDS IN ENERGY COOPERATION BETWEEN KAZAKHSTAN AND CHINA, FOCUSED ON RENEWABLE ENERGY SOURCES (RES)

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Abstract: *This paper analyses the good political and legal environments, mutually beneficial strategic policy, along with level of economic development and growth, superior geographical conditions and cultural integration degree of the important effecting factors of the energy cooperation between Kazakhstan and China. By using the main points listed above this article refers to related trade and investment theories, and it's divided into two aspects: Kazakhstan's export of Chinese energy products with time series data 1998-2014 and China's investment in Kazakhstan's energy sector with time series data 1998-2016 to construct the vector autoregressive model (VAR).We selected relevant variables and data to construct an econometric model from the perspectives of trade and investment to make an empirical analysis on the influencing factors of energy cooperation between Kazakhstan and China. Our results show that China's demand for large-scale market and for opening to the outside world as well as Kazakhstan's great energy potential are the most important factors their cooperation. It can be stated that in our days Kazakh legislation is suitable for promoting the Chinese energy investments, but in the long run it would be beneficial to mobilize national capital especially in RES investments and research. In the end, we found the most important reserves in competitiveness of electricity and heat (both from fossil and renewable energy sources) are power grid consolidation and waste heat utilization in the short run.*

Keywords: *Energy Cooperation; Foreign Trade; FDI; Energy Sector; VAR*
JEL Code: F14; Q43

1. INTRODUCTION

Kazakhstan has a huge potential on renewable energy utilization such as solar installations, wind energy and biomass. According to a report from the Ministry of Energy of Kazakhstan, green energy generated 2.4 billion kWh, which shows an increase of 77.8% over the same period in 2018. Renewable energy accounts for 2.3% of the total power generation. In 2019, 22 renewable energy facilities were put into use, renewable energy projects attracted investments amounted of 613 million US dollars, bringing total capacity of 1050 MW. In 2020, there are also plans to build 18 renewable energy facilities with a total capacity of 605,5 MW. The total capacity of installed renewable energy has boosted from 178 MW to 1635 MW between 2014 and 2020. There are 116 renewable energy projects in Kazakhstan, including 29 wind power stations, 44 photovoltaic power stations, 38 hydropower stations and 5 biomass power stations. During the long-term target period, the proportion of renewable energy power generation will increase to 6% by 2025, 10% by 2030, and 50% by 2050 in Kazakhstan (Forbes, 2020).

The most challenging year for Kazakhstan's economy was Covid-19 pandemic situation in the last two decades. COVID-19 pandemic has impacted the economy highly than the crises in 2018 and 2015. The spread of pandemic has stopped the global activity and reduced global demand and price of oil, it's the main export product. The domestic economic activity is significantly reduced due to the COVID-19 pandemic. The

national economy is projected to contract by 2.5 percent in 2020 (World Bank, 2021).

In terms of energy reserves, Kazakhstan has abundant energy reserves. Structurally, oil, gas and oil are the main energy reserves of Kazakhstan. 30% of the oil and gas in Central Asia and 3% of the world's oil are stored in Kazakhstan. Coal accounted for main share of power generation for 68%, natural gas accounting for 20%, large hydroelectric power plants for 8.8% and renewable energy and small hydropower stations for 2.8% (IAEA, 2021). Rich energy reserves make Kazakhstan a very high position in the international community and have very important strategic significance for its position on the international stage. To sum up, the energy cooperation between Kazakhstan and China plays an important role in the economic development of both countries. Therefore, the research on the influencing factors of energy cooperation between Kazakhstan and China is of great significance.

1.1. Possible limitations of the paper

While some research results have been achieved, this paper also has some limitations. First, the development data of many renewable energy industries, especially local new energy, are not fully published sometimes some years later and mostly not free service, and some analysis lacks systematic data, which affects the making analysis. Second, because the renewable energy industry is an emerging industry, there are not many empirical research literatures in this field, of which there are relatively few foreign literatures, which affects the author's vision. Third, due to the lack of provincial data on renewable energy consumption, this paper only makes an empirical analysis based on the annual data obtained from 1998 to 2014 on Kazakhstan's energy products export to China and China's investment in Kazakhstan's energy sector from 1998 to 2016. In the empirical analysis part, the selected time series variables are limited by relevant statistical data, and only a limited time series can be selected for empirical analysis. Since in our days the significance of RES is negligible both in Kazakhstani and the in the Chinese investments towards Kazakhstan, we did not make any statistical analysis in this area. However, since it has a great potential in the future, therefore we introduce some literature and our expectations in this area for the next years.

2. LITERATURE REVIEW

2.1. Energy characteristics and energy policy in Kazakhstan

Regarding energy consumption, both Kazakhstan and China has been considered as coal-dominated countries in a global cluster analysis. The potential and the expectable advantages in establishing new RES capacities are favorable in both countries, but the chance of realization is differential, since the importance of RES (excluding hydro energy) is statistically correlate with the national GNI and HDI (Tóth-Magda, 2017). The economic results of the RES projects strongly depends on the price fluctuation of fossil energy sources (especially of oil and gas prices), which are affected many times by political decisions (Pápay, 2015) and it makes uncertain the viability of renewable systems, too.

In terms of energy in Kazakhstan, it expounded and analyzed the status of oil and gas raw material base, exploitation, transportation facilities, demand, and export in Kazakhstan through descriptive statistics (YanPing, 2006; YanPing, 2007). Kazakhstan's energy development from the perspective of policy and finds that Kazakhstan's energy law tends to domestic interests, ecological security, utilization efficiency, interest control and optimizing energy structure (Li, 2012). The energy utilization efficiency of Kazakhstan is gradually rising, and the energy structure and industrial structure have an important impact on the energy utilization efficiency. The energy utilization efficiency of Kazakhstan by using the relevant energy data of Kazakhstan and the method of empirical analysis compared it with China (Pei, 2015).

Starting from the legal system, first described the current situation and forms of energy cooperation between China and Kazakhstan, analyzed the prospects of energy cooperation between the two countries based on the analysis of the current situation, and finally discussed the role of Kazakhstan's laws on China and Kazakhstan energy cooperation (Fang, 2012). Kazakhstan's energy cooperation is in line with China's strategy of diversified energy import and urges Russia to weigh its own interests and losses in the fierce competition for Kazakhstan's participation in China's energy market. In the past, Kazakhstan mostly relied on energy pipelines in Russia to export its own energy, but Kazakhstan's energy exports to China increased, it will certainly affect the export ratio through Russia and Russia's transit energy income, which will lead Russia to put China in the first place of energy cooperation, which will inevitably lead to the situation of China Kazakhstan energy cooperation towards mutual benefit and win-win (BingYin, 2004).

The investment environment in Kazakhstan's oil and gas field published to analyze many conditions affecting the investment environment in Kazakhstan's oil and gas field, such as Kazakhstan's oil and gas foundation and development conditions, domestic market demand and international market prices, transportation infrastructure and its development space, relevant domestic economic policies, and laws. The following conclusions are drawn: for some foreign companies investing in Kazakhstan's energy field, the investment environment is worse than before, which is reflected in: the Kazakh government gradually improves the mining technology of foreign energy companies, reduces or will cancel customs taxes and other taxes, and stipulates that foreign companies must hire a certain proportion of local labor force, using local oil and gas exploitation, some high-tech refining equipment and other tools, the state has the right to buy the equity sold by foreign investors, etc (Korzhubaev and Eder 2007).

Although renewable energy policies and governance have been institutionalized since 2006, progress has been slow. Many investors choose to leave, because they were

concerned with numerous gaps and inconsistencies in the governance structure. The article concluded that the use of active power by the central government does not seem to be sufficient to achieve results in policy design and governance. Yet another conclusion is that largely disregarded the role of renewable energy in providing a safe and clean energy supply, although the need to preserve the cleanliness of the environment recognized in Kazakhstan (Mouraviev, 2021). However, in the long run, Kazakhstan's energy projects are still attractive to foreign investors. Under the current circumstances, the ideal way of investment cooperation is to cooperate with Kazakhstan national oil and gas company to establish a joint venture and jointly develop and operate projects.

The Chinese government's loans and assistance are a key part of the conditions that the Kazakhstan government cannot refuse. Kazakhstan gets benefits from the geographical conditions. The Kazakhstan government must equate its so-called "multi-vector" foreign policy of diversity in foreign relations with the benefits of Chinese financial flows in the form of investments, aid and loans (O'Neill, 2014).

2.1.1. Possibilities in renewable energy areas

Biogas production in wastewater treatment is a recommendable technology for every municipalities having large-scale plants. If an upgrading technology can be financed, the biomethane, as end product can be filled in the national natural gas network, or can be used as transportational fuel, especially in the local public transport. Due to financial issues, the biogas is tipically converted into electricity and waste heat by a cogeneration technological process, which can cover the majority of energy costs of the wastewater treatment plants (Gabnai, 2017). The effectiveness of the system could be enhanced via co-utilization of chopped biomass chips produced in special energy plantations. In this case the lowest nitrogan fertilization level resulted the best efficiency, according to the experimental results of Wajszczuk et al (2016). The significance of local renewable energy systems thanks to the elimination of transportational and production costs was also emphasized by Fogarassy-Nábrádi, (2015).

Kazakhstan's carbon emissions are comparatively lower with large emitters such as China and the United States. Russia and China are the main consumers of Kazakhstan's energy and related emissions, in which the construction industry plays the most important role. It is also confronted with great pressure on CO2 emission decrease and sustainable development. Both technical and policy actions should be considered to decline CO2 emissions and "Belt and Road Initiative" is a good opportunity for Kazakhstan to develop a „Green Economy" (Wang et al. 2019).

2.2. The Kazakh-Chinese energy relations

According to REN21 (2016), China was globally the first in the order of establishing solar and wind power capacities. However, these investments operate inland, the foreign capital investment into the energy sector is exclusively towards fossil energy sources.

In terms of energy cooperation between China and Kazakhstan, the obstacles, and difficulties in energy cooperation between Kazakhstan and China from the perspective of law and from the perspective of domestic and international legal systems and mechanisms (MengMeng, 2017). The legal conflicts and obstacles of energy cooperation between China and Kazakhstan based on the international legal, including the investment barriers in the energy field of Kazakhstan, the legal conflicts caused by the customs union and the legal shortcomings of China in energy cooperation. Finally, policy suggestions on China and Kazakhstan energy cooperation are put forward from the perspective of law (Lei et al. 2014). Taking Kazakhstan as an example, first introduced the current situation of energy in Kazakhstan, summarized the fields and ways of China's energy investment in Kazakhstan, and then analyzed the problems and challenges in energy cooperation between Kazakhstan and China from the perspective of foreign direct investment (Bin and Ying 2014). The evolution of oil and gas relations between China and Kazakhstan, evaluated their long-term development prospects, discussed how China's demand for oil and natural gas transferred Kazakhstan's oil and gas resources from other energy markets, and used empirical methods to evaluate the prices provided by China to other producers in Kazakhstan. It is found that Chinese-Kazakh energy and economic cooperation can create a good foundation for the free economic zone and the development of mutually beneficial relations between the two countries (Kalyuzhnova, 2014).

Since the strategic goal of policymakers is to raise domestic companies to the level of international competitiveness. The increased state intervention in Kazakhstan's oil sector is due to long-term capacity-building, not just the economic reason of rising rent. In contrast to nationalization, the principle of participation does not give priority to asset expropriation and/or the replacement of foreign investors (Orazgaliyev, 2018).

Kazakhstan actively attracts foreign investments and the country had received significant Chinese foreign direct investment (FDI) in Kazakhstan's mining, oil, transport, and agriculture sectors, reflecting increased bilateral trade and cooperation. Kazakhstan seeks to: (1) diversify its economy by getting rid of overdependence on the extractive sector; (2) Kazakhstan, as the world's largest landlocked country, is well positioned to expand connectivity with international markets to become one of the larger beneficiaries of China's Belt and Road Initiative (BRI) (Žuvela, 2021).

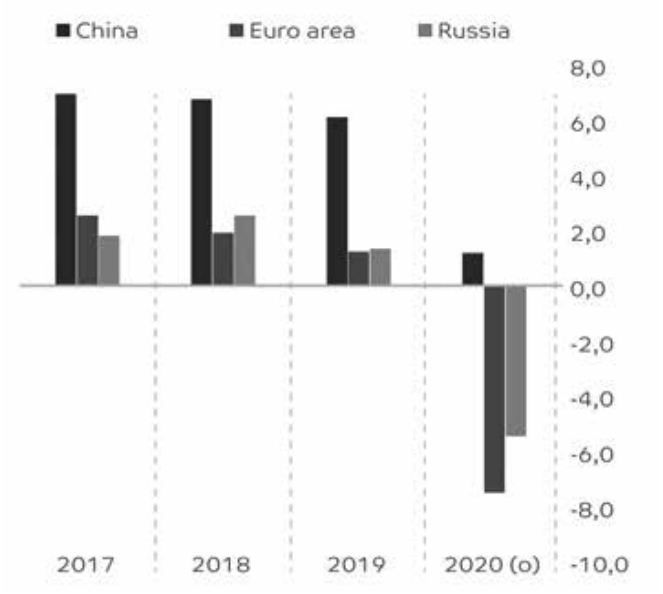
2.3. The impact of the COVID-19 on energy production sector

The country's natural gas exports in the Caspian Sea and Central Asia are already in a leading position, with more than 70% of exports going to China, Russia and Iran. Although the facts and figures on the economic impact of COVID-19 are limited, the plunge in energy prices also has economic impacts (Yasmin et al. 2020). The shock of oil prices and the COVID-19 pandemic has shown as an unorthodox

intervention to the energy market and global cooperation to support recovery. The immense oil price shock provides an opportunity to implement long-term diversification strategies, and to move towards a safe energy system to reach SDG (Azubike, 2020; Ajami, 2020).

The rapid economic decline of Kazakhstan's main trading partners in the export market reflects the impact of the COVID-19 pandemic (Figure 1). At the beginning, the epidemic caused a sharp slowdown in China's economic growth, and then spread to major areas in East Asia and Europe. (World Bank Group, 2020).

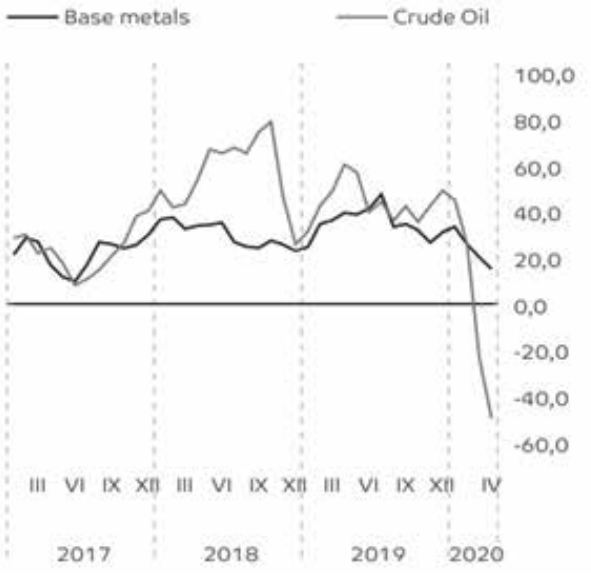
Figure 1: Decreased growth in key foreign markets (year-on-year, percent).



Source: World Bank, 2020

In March, oil prices depressed to a 17-year low at around $ 25 per barrel, reflecting OPEC + partner countries' divergence on production cuts and weak demand expectations (Figure 2). The economic impact of the coronavirus pandemic is a sharp drop in oil demand, leading to oversupply and overcapacity. Metals prices also reduced, reflecting weak demand for manufactured goods, especially from China. Tide trade and investment ties with the Eurozone, China, and Russia, as well as a high dependence on oil exports make Kazakhstan particularly vulnerable to the negative side effects of falling demand and commodity prices. While oil prices remain well below last year's levels as countries began to lift containment measures and reopen their economies, the recent recovery in demand pushed oil prices to $ 40 a barrel in early June (World Bank Group, 2020). The results show that oil price rise leads to increase in Azerbaijani international reserves. However, the results of Kazakhstani foreign exchange reserves are insignificant (Czech and Niftiyev, 2021).

Figure 2. Tendency of commodity prices (index, 2016=1).



Source: World Bank, 2020

3. MATERIALS AND METHODS

3.1. An empirical analysis on the influencing factors of Kazakhstan's energy trade with China

In this section, Kazakhstan's energy exports to China will be selected as the explanatory variables, and China's market demand, China's institutional environment and China's trade dependence will be selected as the explanatory variables to build a vector autoregressive model (VAR) to analyze the influencing factors of Kazakhstan's energy exports to China.

3.2. Variable selection and data source

The variables and data sources selected in this section are shown in Table 1. The selected variable data are time series data. When doing regression analysis for time series data, we should choose a longer time range as much as possible. In view of the availability of data, the time series period range of each variable selected in this paper is from 1998 to 2014.

Table1: Variable selection and data source

Variable properties	Variable name	Indicator selection	Variable symbol	Data sources
Dependent variable	Kazakhstan's energy production exports to China	Value of foreign trade	Trade	Unctad Database, 2018
Independent variables	Chinese market demand	GDP per capita	GDP/capita	Unctad Database, 2018
	China's political background	Perfection of legal system	Claw	World Bank Worldwide Governance Indicators, 2018
	China's trade openness	Foreign trade degree of dependence (FTD)	COP	Unctad Database, 2018

Table 2: Variable selection and data source

Variable properties	Variable name	Indicator selection	Variable symbol	Data sources
Dependent variable	China's investment in Kazakhstan's energy sector	Foreign Direct Investment	FDI	National bank of Kazakhstan website, 2018
Independent variables	Kazakhstan market size	GDP per capita	KperGDP	Unctad Database, 2018
	Kazakhstan's political background	Perfection of legal system	Klaw	World Bank Worldwide Governance Indicators, 2018
	Kazakhstan's trade dependence	Foreign trade degree of dependence (FTD)	KOP	Unctad Database, 2018

3.3. Empirical analysis on the influencing factors of China's investment in Kazakhstan's energy industry

This section will select China's direct investment in Kazakhstan's energy sector, Kazakhstan's market size, Kazakhstan's institutional environment, Kazakhstan's trade dependence and other indicators to build a vector autoregressive model (VAR) to empirically analyze the influencing factors of China's direct investment in Kazakhstan's energy sector.

3.4. Variable selection and data source

The variable data and indicators involved in the empirical analysis in this section are listed in table 2. In view of the availability of data, this section selects the longest possible time series for regression analysis, and the period is the annual data from 1998 to 2016. The specific empirical steps and results will be introduced below.

3.5. Model building

This section describes how the time series for energy cooperation to the Kazakhstan and China is construct. Usually, time series is non-stationary on the level:

$$y_t \sim \text{non-stationary I} \quad (1)$$

Where I(1) denotes that after taking the first difference, the time series will be stationary if the largest root θ of the equation (in the complex variable y)

$$\Delta y_t = \log(y_t) \sim \log(y_{t-1}) \sim \text{stationary I} \quad (1)$$

contents $\theta < 1$. Stationary is associated with the location of the roots of equation (1). In general, we say that a time series $\{y_t\}$ is included of first difference, denoted I (1), if $\{y_t\}$ is nonstationary but I (1) $\{y_t - y_{t-1}\}$ is stationary. If $\{y_t\}$is I (1), it is concerned about important to difference the data, mainly we might use all the methodologies developed for stationary time series to construct a model.

For an instance of a second-order difference process, take into account the VAR (2) series, $y_t = 2y_{t-1} - y_{t-2} + \varepsilon_t$. This process is nonstationary. Equation (1) turn into $y_t\ 2 = 2\log(y_{t-1})$, $y_t\ 2\text{-}2\ y_t + 1 = 0$. This gives (y-1) (y-1) =0, the equation gets two-unit roots. This is shown that the first difference is nonstationary. The second difference is:

$$y_t - y_{(t-1)} - [y_{(t-1)} - y_{(t-2)}] = y_{t-2} y_{(t-1)} + y_{(t-2)}$$

which is $\varepsilon_t$equal to by the definition of our VAR (2) formula. Since the second difference is stationary, $\{y_t\}$ is I (2). Actually, however, the only integer values for VAR(p) that seem to be common are I (0) and I (1). Here we restrict our discussion to whether the data needs to be distinguished once.

According to the empirical methods, the research methods of Liu Ping et al. (2019) and Eviews software method of Zhang Xiaodong (2007) mechanical industry press are used for analysis. In order to meet the needs of research and ensure the continuity and availability of data, GDP per capital, FDI, trade, perfection of law, and foreign trade degree of dependence of Kazakhstan and China to analyze the effecting factors of energy cooperation between China and Kazakhstan by establishing VAR model. At present, China's energy consumption is very large. Compared with energy, the consumption of new energy is less. Therefore, the consumption of energy and new energy alone cannot control the world energy price. Here, the energy price is analyzed as an exogenous variable. Therefore, the VAR model is as follows:

$$y_t = \beta_1 y_{t-1} + \cdots + \beta_n y_{t-n} + \varphi X_t + \varepsilon_t \quad (2)$$

y_t is a six-dimensional endogenous variable vector, y_t=(CperGDP,Claw,COP,KperGDP,KLaw,KOP).Among the six-dimensional endogenous variables, CperGDP, Claw, COP, KperGDP, Klaw, KOP represents exogenous variable; X_t=(Trade,FDI), where t represents time, N is the log order, ϕ represents the estimated coefficient matrix, ε is the error matrix, and $\beta_1 \ldots \beta_n$ is the coefficient vector. The endogenous variables in the model have n-order lag, which can be called a VAR(n) model.

4. EMPIRICAL RESULTS AND DISCUSSION ON THE INFLUENCING FACTORS OF KAZAKHSTAN'S ENERGY TRADE WITH CHINA

4.1. Results of the Unit Root Test

In this paper, the unit root test method used ADF. Stationary test (ADF test) in order to verify whether the original data of time series Kazakhstan's energy production export to China (Trade), China's demand for energy products (CperGDP), China's legal perfection index (Claw) and China's foreign trade dependence index (COP) are stable. Here, the unit root test is performed on the data by using Eviews7.2 software, and the following results are obtained (Table 3).

Table 3: ADF unit root test results

Variable index	ADF- unit root test		Test results
	t-statistics	P value	
LnTrade	-2.5900	0.1178	Not
LnTrade（1）	-4.4748	0.0043	Stationary
LnTrade（2）	-4.4594	0.0058	Stationary
LnCperGDP	-1.9004	0.3218	Not
LnCperGDP （1）	-2.2976	0.1848	Not
LnCperGDP （2）	-4.0657	0.0099	Stationary
LnClaw	-2.7245	0.0916	Not
LnClaw（1）	-5.4652	0.0006	Stationary
LnClaw（2）	-5.5800	0.0000	Stationary
LnOP	-1.9559	0.3010	Not
LnCOP（1）	-2.9838	0.0594	Not
LnCOP（2）	-6.0132	0.0003	Stationary

Note: (1) and (2) represent the first-order difference and second-order difference of variables respectively.

Before the regression of time series data, it is usually required that all variables are of the same order, that is, different variables pass the unit root test after making the difference of the same order. It should be noted that in order to eliminate the influence of variable heteroscedasticity on regression results, all-time series variables are taken as logarithmic regression in this section, and the accuracy of regression results will not be affected after taking variance. Table 3 reports the unit root test results of the time variables involved in this section. Although some variables failed to pass the test in the unit root test of the original time series and the first-order difference series, the p value of the second-order difference of all-time series variables is less than 5%, which is stable. Therefore, all-time series in this section are second-order single integer, which can be recorded as I (2).

4.2. Results of the Cointegration Test

The time series variables that pass the unit root test can be used for cointegration test. The purpose of cointegration test is to test whether there is a long-term equilibrium relationship between time series variables. If there is a long-term equilibrium relationship, the time series can be regressed. If there is no long-term equilibrium relationship, the data is invalid. In this paper, Johansen cointegration test is used. The results of cointegration test are reported in Table 4. The trace statistic p value rejects the original assumptions of up to three cointegration equations at the 5% significance level. Therefore, there is a long-term equilibrium relationship between the time series selected in this section, and regression analysis can be carried out on the time series data.

Table 4: Johansen cointegration test

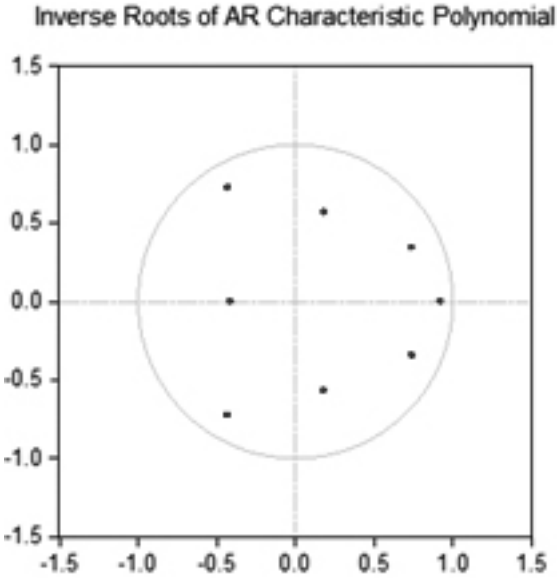
Number of cointegrating equations	Trace statistics	P value
None	132.2477	0.0000
At most one	29.7911	0.0000
At most two	15.4941	0.0330
At most three	6.6159	0.0101

Note: the trace test results show that there are four cointegration equations at the 5% significance level.

4.3. Results of the AR Unit Root Test

The purpose of AR unit root test is to verify the stability of VAR model, and the stable model is effective. The AR unit root of the effective model is less than 1, and the graph shows that all inspection points are in the unit circle. Figure 1 shows the AR unit root test results of the VAR model in this section. Obviously, all points are in the unit circle, which proves that the VAR model established in this section is stable and effective. At the same time, it also shows that there is a long-term stable equilibrium relationship between variables.

Figure 1: AR unit root test



4.4. Results of the Granger causality test

Table 5 reports the Granger causality test between the variables in this section. It can be seen from the table that the test results reject the original hypothesis that LnCperGDP is not the Granger cause of LnTrade and lncop is not the Granger cause of LnTrade at the significance level of 1%. Therefore, it can be said that LnCperGDP is the Granger cause of LnTrade; LnCOP is the Granger reason for LnTrade. The p value of other variables in the table is not significant, that is, the original hypothesis cannot be rejected. Therefore, there is no Granger causality between variables.

Table 5: Granger causality test results

Null Hypothesis	Chi-square	P value	Remarks
LnCperGDP is not the Granger reason for LnTrade	16.6641	0.0002	Reject
LnClaw is not the Granger reason for LnTrade	3.3341	0.1888	Do not reject
LnCOP is not the Granger reason for LnTrade	12.9339	0.0016	Reject

Based on the above Granger causality test results, China's market demand and China's high trade openness are the reasons for Kazakhstan's energy exports to China. Next in this section, the impulse response function and variance

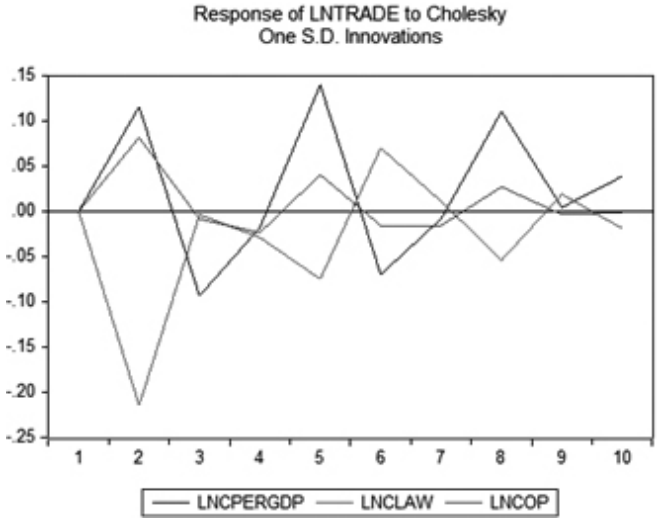
decomposition methods will be used to analyze the impact of China's market demand and China's trade opening in China.

4.5. Analysis based on Impulse response function

In this section, we will set the error term orthogonalization impulse response function, i.e., the Cholesky decomposition method, to analyze the impact of China's openness and China's market demand on Kazakhstan's export of Chinese energy products. The impulse response function analysis method is very intuitive, and the influence of various variables can be observed from the curve of impulse response function.

Figure 2 shows that China's large-scale market demand and China's high degree of foreign trade opening are important factors leading to the continuous expansion of Kazakhstan's energy export trade to China. In the short term, China's market demand and China's degree of foreign trade opening play a strong role in promoting Kazakhstan's export of Chinese energy products. In the long term, although the effect of China's market demand on Kazakhstan's export of Chinese energy products becomes smaller, it is still significantly positive. The degree of China's foreign trade openness does not significantly promote Kazakhstan's export of Chinese energy products. Obviously, China's strong market demand is a strong support to ensure Kazakhstan's increasing energy exports to China.

Figure 2: Effect diagram of impulse response function

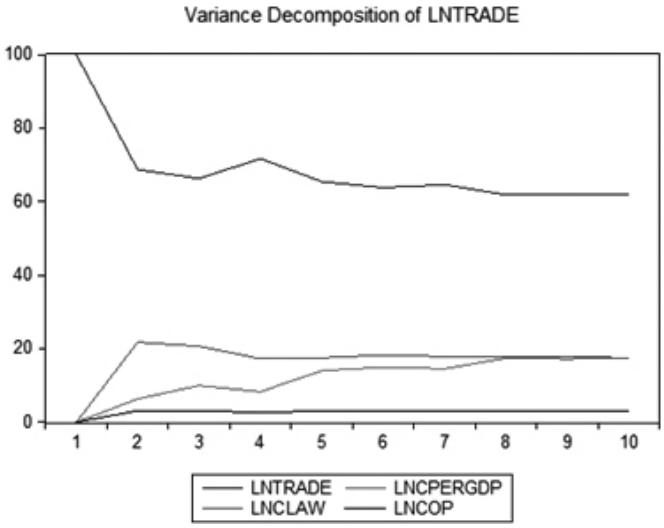


4.6. Results of the Variance decomposition analysis

The purpose of variance decomposition analysis is to determine the influence of various influencing factors on the explained variables. Its principle is to calculate the contribution of different structural shocks to the changes of different variables. In this section, the VAR model is decomposed into variance to analyze the impact of China's market demand and China's opening to the outside world on Kazakhstan's export of Chinese energy products.

Figure 3 shows the variance decomposition results of LnTrade variables. It is obvious from the figure that LnTrade contributes more to itself than other variables, and the contribution of other variables is relatively small, among which LnCOP has the lowest contribution to LnTrade. Specifically, the contribution of LnTrade to itself generally decreases with the number of periods. The decline is more obvious in the first two periods, from 100% to about 65%. From the second period to the tenth period, the impact of LnTrade on itself tends to be gentle, and finally decreases to about 60%. The contribution of LnperGDP to lntrade fluctuated from the first phase to the tenth phase, and remained stable after the eighth phase, stabilizing at the contribution rate of nearly 20%. The contribution rate of LnCOP to LnTrade is relatively stable, basically stable at 3% ~ 5% from phase I to phase X, with a small contribution.

Figure 3: Variance decomposition results



It shows that Kazakhstan's export of energy products to China is most affected by itself, which is easy to understand. Among the sectors with more energy exports, the import of oil and natural gas requires special investment from Kazakh enterprises, that is, the laying of relevant pipelines and transportation equipment by natural gas products.

4.7. Summary Findings and Discussion on Kazakhstan's energy trade with China

Considering the references in the literature chapter, MengMeng (2017) analyzed the difficulties and obstacles in the energy cooperation between China and Kazakhstan from the legal perspective. The deepening of Kazakhstan and China energy cooperation depends on overcoming the legal barriers to trade and investment in Kazakhstan's energy field, the legal conflicts caused by the customs union, and China's legal weaknesses within the framework of international law on energy cooperation (Lei et al. 2014). Scholars mostly discuss it from legal system, and the methods used are only limited to the basis of qualitative analysis. Kalyuzhnova, Y. (2014) evaluated the Sino-Kazakh energy and economic cooperation for their long-term prospects, which is completely in line with the results with ours. On this basis, this paper further quantifies the energy cooperation between Kazakhstan and China, to analyze the energy cooperation between Kazakhstan and China from the perspective of trade and investment, to make an empirical analysis on the influencing factors of energy

cooperation between the two countries, to quantify economic, strategic, policy and institutional factors. The effects of these factors on energy cooperation between the two countries are investigated. Our empirical results show the following:

- China's market demand and China's high trade openness are the reasons for Kazakhstan's energy exports to China.
- China's large-scale market demand and China's high degree of foreign trade openness are important factors leading to the continuous expansion of Kazakhstan's energy export trade to China.
- The degree of China's foreign trade openness does not significantly promote Kazakhstan's export of Chinese energy products.
- China's dependence on foreign trade plays a small role in promoting China's import of energy products from Kazakhstan.

5. EMPIRICAL RESULTS AND DISCUSSION ON THE INFLUENCING FACTORS OF CHINA'S INVESTMENT IN KAZAKHSTAN'S ENERGY INDUSTRY

5.1. Results of the Unit Root Test

Since the principle and steps of unit root test have been described in detail above, relevant contents will not be stated in this section. In addition, in order to eliminate the influence of heteroscedasticity on regression results, this section still uses the method of logarithm of time series variables to process the data. The ADF unit root test results of the variable indexes involved in this section are reported in table 3. As shown in the table, the p value of the unit root test t statistic of the second-order difference of all-time series variables is significant at the significance level of 1%. After passing the unit root test, the time series variables are stable and second order mono integer, which is recorded as I (2). Therefore, cointegration test can be done.

5.2. Results of the Cointegration Test

As show in Table 6, Johansen cointegration test is still used for cointegration test, and the test results are reported.

Table 6: ADF unit root test results

Variable index	ADF- unit root test		Test results
	t-statistics	P value	
LnFDI	-1.4832	0.5188	Not
LnFDI (1)	-5.2453	0.0007	Stationary
LnFDI (2)	-8.8783	0.0000	Stationary
LnKperGDP	-2.4698	0.1394	Not
LnKperGDP (1)	-2.1612	0.2257	Not
LnKperGDP (2)	-5.1406	0.0010	Stationary
LnKlaw	-3.1464	0.0409	Stationary
LnKlaw (1)	-3.9523	0.0088	Stationary
LnKlaw (2)	-4.9789	0.0013	Stationary
LnKOP	-1.2209	0.6413	Not
LnKOP (1)	-4.2003	0.0054	Stationary
LnKOP (2)	-5.8090	0.0003	Stationary

Note: (1) and (2) represent the first-order difference and second-order difference of variables respectively.

The p value of trace statistics shown in Table 7 rejects the original hypothesis of up to two cointegration equations at the significance level of 5%, and the test results show that there are three cointegration equations between variables at the significance level of 5%, that is, the time series variables involved in this section have a stable equilibrium relationship for a long time, and a vector autoregressive model (VAR) can be constructed for correlation analysis.

Table 7: Johansen cointegration test

Number of cointegrating equations	Trace statistics	P value
None	63.0495	0.0010
At most one	29.7970	0.0407
At most two	15.4971	0.0395
At most three	6.8415	0.1107

Note: trace test results show that there are three cointegration equations at the 5% significance level.

5.3. Results of the AR Unit Root Test

Figure 4: AR root test results

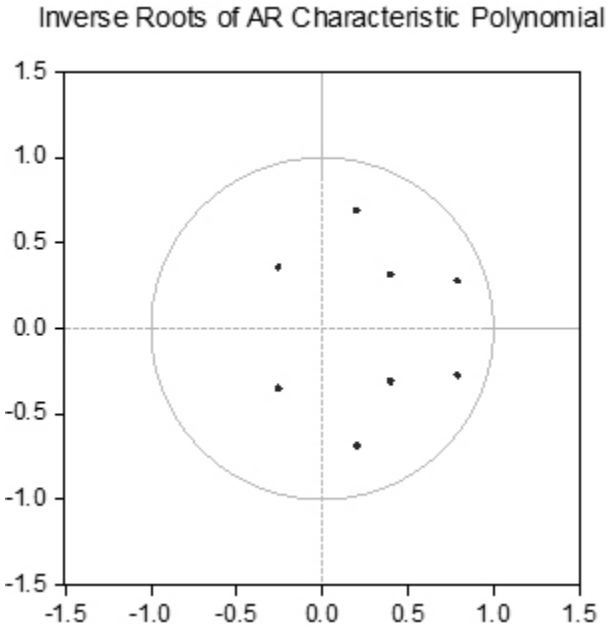


Figure 4 shows the results of AR unit root test of VAR model. It can be intuitively observed from the figure that all points are in the unit circle, which proves that the VAR model based on the time series variables in this section is stable and the analysis of the relationship between variables is also effective.

5.4. Results of the Granger Causality Test

The Granger causality test results of the time series variables involved in this section are reported in Table 8. As shown in the test results, the p value of chi square statistics rejects the original assumption that LnKperGDP is not the Granger cause of LnFDI at the significance level of 5% and proves that LnKperGDP is the cause affecting lnfdi and cannot be excluded from the VAR model. Similarly, the p value of chi

square statistics rejects the original hypothesis that LnKlaw is not the Granger cause of LnFDI at the significance level of 5%, and proves that LnKlaw is the cause affecting LnFDI, but the direction of the effect is uncertain; The p value of chi square statistics rejects the original hypothesis that LnKOP is not the Granger cause of LnFDI at the significance level of 1%, that is, lnkop has a significant effect on LnFDI.

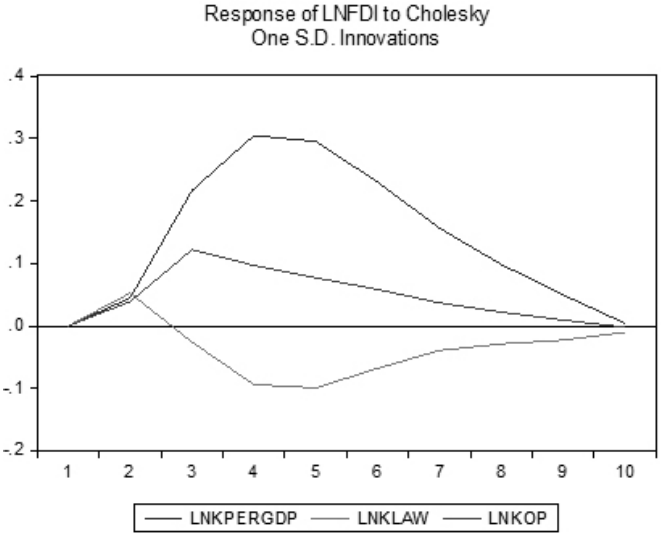
Table 8: Granger causality test results

Null Hypothesis	Chi-square	P value	Remarks
LnKperGDP is not the Granger reason for LnFDI	8.5059	0.0480	Reject
LnKlaw is not the Granger reason for LnFDI	25.0054	0.0264	Reject
LnKOP is not the Granger reason for LnFDI	108.7751	0.0096	Reject

5.5. Results of Impulse response function analysis

Based on the characteristics of the above impulse response function, it can be concluded that Kazakhstan's market scale and high openness are important factors to attract China's investment in Kazakhstan's energy sector, and Kazakhstan's market scale effect is always higher than Kazakhstan's openness in the long term or short term. Although Kazakhstan's institutional factors can promote China's investment in Kazakhstan's energy sector in the short term, Kazakhstan's institutional factors have an adverse impact on China's investment in Kazakhstan's energy sector in the long term (Figure 5).

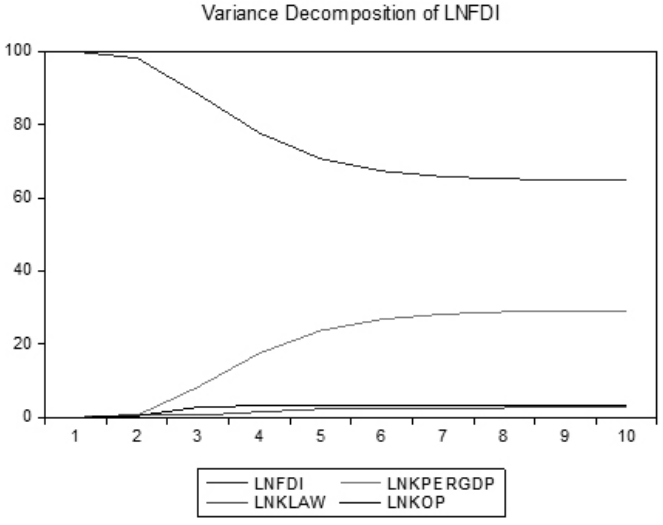
Figure 5: Impulse response function diagram



5.6. Results of the Variance decomposition analysis

Figure 6 shows that China's investment in Kazakhstan's energy sector is greatly affected by itself, that is, China's investment in Kazakhstan's energy sector in the current period will affect its investment behavior in the next period. Obviously, the investment of multinational enterprises is a gradual process. Some enterprises are in the process of investing in foreign markets, If the branches of multinational corporations show good profitability, the enterprises will make additional investment. On the other hand, the investment in some large engineering projects cannot be completed in one year but is a continuous process. Some investment projects can even reach the investment period of more than five years or even ten years. Kazakhstan's market size is an important factor to attract China's investment in Kazakhstan's energy sector, and over time, the attraction of market size to investment behavior becomes more and more obvious. Although Kazakhstan's institutional factors and openness have an impact on China's investment in Kazakhstan's energy sector, the impact is not great. Although institutional factors have been a factor hindering China's energy investment in Kazakhstan for a long time, the hindering effect is not great.

Figure 6: Variance decomposition



5.7. Summary Findings and Discussions on China's investment in Kazakhstan's energy industry

According to relevant international studies, Pei (2015) selected four factors: technological progress, industrial structure, energy price and energy consumption structure to explore their impact on energy efficiency based on the energy related data of Kazakhstan from 1992 to 2013, which do not match our results. In the studies of YanPing (2006) and YanPing (2007) the investment environment in oil and gas in Kazakhstan depends on natural, economic, organizational and other factors. The most important ones are raw material base, mining capacity, export prospects and market prices considering domestic demand, transportation facilities and development direction, as well as national economic policies, including export policies and legal regulation. According to their model analysis, Kazakhstan and China energy cooperation mechanism from economic and political level, at the same time, in the view of the problem exciting in the Kazakhstan and China energy cooperation mechanism, taking the institutional guarantee of international law as the starting point. In line with our interpretation of the empirical aspect, this paper studied the influencing factors

of energy cooperation between Kazakhstan and China by using comparative advantage theory and factor endowment theory. Comparative advantage theory is the foundation of mainstream international trade theory. Kazakhstan's export of energy products to China largely depends on the comparative advantages of its energy industry. In fact, Kazakhstan is relatively rich in energy resources reserves. According to the factor endowment theory, Kazakhstan will export energy products with high resource factor abundance, Moreover, a large amount of investment and development in the energy industry has produced economies of scale in Kazakhstan's energy sector. At the same time, the energy sector is an industry with the characteristics of natural monopoly, which determines the characteristics of diminishing marginal cost. Our empirical results show that:

- Kazakhstan's market scale, Kazakhstan's institutional environment and Kazakhstan's degree of opening to the outside world are the factors affecting China's investment in Kazakhstan's energy sector.
- The market scale of Kazakhstan and the degree of opening to the outside world have a positive impact on China's investment in Kazakhstan's energy sector, that is, the expansion of Kazakhstan's market scale and the improvement of Kazakhstan's degree of opening to the outside world will significantly promote China's investment in Kazakhstan's energy sector.
- Institutional factors promote the level of China's investment in Kazakhstan's energy sector in the short term, but they are an obstacle for Kazakhstan to attract China's investment in its energy sector in the long term.
- Among the many factors affecting China's investment in Kazakhstan's energy sector, the most influential is Kazakhstan's market scale, and its institutional factors and market openness have little effect on China's investment in Kazakhstan.

6. CONCLUSIONS

In order to verify the impact of the above factors on the energy cooperation between Kazakhstan and China, there are mainly the following paths:

First, overcoming the power grid consolidation technology and promoting the grid connection of new energy would be necessary. Both renewable energy consumption and non-renewable energy consumption are mostly in the form of power generation when serving the economy and society. At present, Kazakhstan's power generation, including photovoltaic and wind energy, has an enormous potential. However, due to technical and financial difficulties, it is still unable to be connected to the grid, resulting in a waste of a large amount of energy, which is called "waste electricity". At present, in addition to nuclear energy, other new energy sources cannot be connected to the grid due to unstable power generation and financial problems. However, two economic factors might be considered as significant reserves for the future RES investments in Kazakhstan. Firstly, renewable technologies are cheaper and cheaper, their efficiency is better and better, their investment and operation costs are more and more competitive with the maintenance and repair costs of the old coal technologies in power plants and with the investment and operation costs of new coal-fuelled plants. In this case the critical factor is how to be financed. Secondly, the waste heat should be effectively utilized locally, near to the power plant in the central heating, or (as a better alternative) for technological purposes of industrial plants. In the latter case, it would be possible to use the waste heat not only in the winter period, but also in summertime. Thanks to the effective byproduct utilization, the unit cost of the green electricity would be reduced significantly in both cases.

The large distances in Kazakhstan and the associated serious losses in the electricity network can raise the necessity of establishing local systems not only in waste heat utilization, but also in electricity use, too for the reduction of transport losses.

Regarding technological aspects and considering the existing capacities, the anaerobic fermentation of the communal sludge might be the first step, which can use the produced biogas to reduce the electricity and heat demand of the sludge management or enable even the total energy self-sufficiency. Changing the coal fired stoves in the existing power plants to biomass burners is also a relatively simple, widely used and capital-saving technology.

Although there is significant interest from Chinese investors in RES capacities (e.g. Central Asia's largest wind farm in 2021), since Kazakhstan has a great potential, it would be recommended to take small steps in realization and for the sake of mobilization of the national investment capital with state contribution. Considering the macroeconomic advantages (environment, employment, rural development, capital attraction) it would result a win-to-win economic situation.

Finally, increasing R&D investment is inevitable in new energy sources. The development of science and technology must rely on R&D investment. In order to ensure our country's energy security, it should invest in new energy R&D for a long time and continuously. The initial cost of any new energy R&D is very high. Enterprises, governments, universities, and scientific research institutions should communicate and coordinate to jointly promote technological progress.

From the analysis conclusion, we found that since Kazakhstan's market scale is the most significant factor affecting China's energy investment and cooperation with Kazakhstan, it should strengthen the promotion of Kazakhstan's economic development and enhance the degree of opening to the outside world, to further improve the market scale and potential and lay a solid foundation for bilateral energy corporations.

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SCIENTIFIC PAPER

VALUE IN GRASS – MATTER OF FIBRE AND CARBS

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Abstract: *Climate adaptation is a major challenge. Chasing the sufficient amount of hay is getting in higher priority. Distant mass hay producers give favourable offers despite long distances. Quality is also gaining position and indicators like RFQ (Relative Forage Quality) is highlighting the marketing language. Hay market as we knew no longer exists in Hungary. Most farmers produce their own hay and do not spend extra cents to buy bales. Climate change however, force them to adapt and store more bales for the future. Horse owners and dairy farmers are the main driver to convince hay producers to provide high quality forage. We gathered Hungarian regional hay-price information and evaluated the trends in this sector. The demand-driven hay-price is in contradiction with premium quality timothy grass hay.*

Keywords: grassland, replacement value, hay market,
JEL Code: Q11

INTRODUCTION

Beef and milk production should be based on high quality forage. Farmers and agroholdings represent two side of the river. Smaller farms focusing on simple feeding system while the feeding lots and industrial size dairy farms concentrate on mass production with diverse total mixed ration (TMR) feeding. Quantity is overwhelming quality issues despite quality control. The question of high-quality hay is evergreen topic, where quantity is often stands on the sideline. Droughts are more severe and rainfall's frequency is less predictable. Climate change is getting closer to daily farming where high yields hard to accomplish (Halasz et al., 2018). Dairy farming reacts fairly quickly in diet feeding as nutritionists tend to mix more digestible fibre into TMR. The goal is to reduce the rumen passage rate (RPR). For that matter meadow hay, with its low lignin content, is an increasingly tempting alternative of alfalfa hay. Efforts have been made to reduce lignin content (Orosz, 2017) in alfalfa, using gene silencing, however these breeds (HarvXtraTm) are still not widely available. Grasses are good carotene sources especially Agropyron cristatum and Festuca rubra. Valuing grass from farmers perspective does not sound difficult. As a starting material its value as raw forage straight from pasture and profit realises in meat, milk or wool. During winter feeding, quality hay becomes more valuable in TMR therefore costs start to rise. Even in beef cattle business quality hay is essential to keep on level the daily gain. Eventually quality hay, with high digestible fibre, should be the ultimate goal for every farmer to maximize their profit. Hay prices however do not follow market rules. Hungarian grass hay production has a long production especially in grass meal export. This premium product is an excellent β-carotene source but high energy prices forced to decline this sector. Quality supplementary feed additives require strict qualification system and this affects on hay qualification as well. As the European hay market is very fragmented every producer has their own qualification system but most of them based on sense perception. We introduce our data through the Hungarian scoring ISO system (Tasi, 2000). The primary goal was to determine the average animal carrying capacity around the country (Halasz et al., 2018).

MATERIAL AND METHODS

In the United States Relative feed value (RFV) has been used for years to compare the quality of legume and legume/grass hays and silages. One index for price hay and also predict animal performance. In recent years Hungarian dairy sector also applies this index to decide which diet suits better in TMR. RFV is also used for hay auctions in US and predictably

in the near future at Hungarian farms as well. Digestible dry matter (DDM) is based on Acid detergent fiber (ADF), and takes account Dry matter intake (DMI) potential (as a percent of body weight, BW) from Neutral Detergent Fiber (NDF). The final formula is the following: DDM = 88.9 - (0.779 x % ADF) | DMI = 120 / (% NDF) | RFV = (DDM x DMI) / 1.29

We have gathered hay yield data from 63 farms around Hungary. Dataset was built on historical data between 1965-2017. Based on yield, quality (K-value by Balazs, 1960), RFV and market data, we have categorized the farms' regular hay purchase price.

DETERMINE THE VALUE OF GRASS

Since the local farmers hard to convince to produce quality instead of quantity we also made economical calculation. Every farmer have their own priorities but cost effectiveness is evenly important. One says grass is valuable replacement mass forage, according to another opinion hay is exclusive forage, therefore quantity is primer issue. Generally speaking, quantity is the only important. Couple of farmers realized that higher nutritive content, quicker rumen passage seriously affect on profitability. Previously, a detailed study was carried out (Nabradi, 2007), where the author suggested 2 approaches to consider.

Deducting from products

Calculation based on a marketable product like beef or milk. This approach focus on added value as well, where a geographical identified (GI) product highly increase the importance of grassland. Eventually, the profit generated from the final product indicates the base value of the grass forage.

Feeding value based on replacement value

This point of view is very precise, when grass substitutes or supplements other forages. This complex method based on nutritional value and price matrix (Blasko et al., 2012) . In case we wish to replace maize silage with grass silage, the actual cost for one kilogram of maize plus its nutritive impact, defines the replacement value of grass. The following factors effect on the final value of hay: nutrient needs of animals, nutrient content of intensive forages, costs and area requirements, biological and technological restricting factors, volume of expected alternative income, grass nutrient content. Calculate reference replacement values depends from several factors (see above) however keeping cattle on grass could cost about 1.62-2.92 Eurocents/kg.

Pasture profit index (PPI)

Most countries where grass is important part of the forage production, calculates with its own economic valuating formula. PPI is a selection tool developed by Teagasc in Ireland (McEvoy et al., 2011; O'Donovan et al., 2017; Dilon, 2018). This decision-making index comprises the following indices: spring DM yield, mid-season DM yield, autumn DM yield, quality (across the months of April to July), 1st and 2nd cut silage DM yield and persistency. The Total economic merit is calculated from these above mentioned indices. For clearance 1st rank perennial ryegrass cultivar on the 2018 recommended list (Teagasc, Ireland; Table 1).

Relative feeding value (RFV)

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Digestible dry matter (DDM) is based on Acid detergent fiber (ADF), and takes account Dry matter intake (DMI) potential (as a percent of body weight, BW) from Neutral detergent fiber (NDF). The final formula is the following:

DDM = 88.9 - (0.779 x % ADF)
DMI = 120 / (% NDF)
RFV = (DDM x DMI) / 1.29

Example: Alfalfa hay or haylage with 32% ADF and 40% NDF

(Plug in values for ADF and NDF on a dry matter basis)

DDM = 88.9 - (0.779 x 32) = 63.97
DMI = 120 / 40 = 3
RFV = (63.97 x 3) / 1.29 = 149

Above 150 (RFV) starts the real quality.

NDF 624 ADF 361 DDM=60,78 DMI=1,92 RFV= 90,46

RESULTS

We have validated and compared the yield and nutrient content data (Table 2.). The animal carrying capacity is varying between 0.4-3.3 LU ha-1. Grass quality (K-value) and hay feeding value (RFV) is connected due to late mowing. Yields are strongly depend from rainfall.

Quality is secondary at hay purchase deals. As EU regulations control the earliest cutting date at 15th of June on NATURA grasslands, baled hay has medium or poor quality (RFV<150). High in fibre and low in protein. Feeding these bales is inevitable but necessary to give

Table 1. Pasture Profit Index Values (€ ha-1 year-1)

Variety name[1]	Ploidy[2]	Heading date[3]	PPI[4] €/ha	Spring growth[5]	Summer growth[6]	Autumn growth[7]	Quality[8]	Silage[9]	Persistency[10]	Total Yield[11] (t DM/ha-1)	Mean DMD[12] (g/kg)	1st cut silage[13] (t DM/ha)	2nd cut silage[14] (t DM/ha)	Ground cover Score[15]
Aberclyde	Tetraploid	25-May	225	57	48	37	55	28	0	10.96	856.2	5.01	3.73	5.6

Source: https://www.agriculture.gov.ie/media/migration/publications/2018/GrassWhiteCloverRecListVarietiesforIreland220218.pdf

Table 2. Average hay yields and quality at different climate sensitivity categories in Hungary

Climate sensitivity	K value	RFV	Average green yields (t ha^{-1})	Animal carrying capacity (LU ha^{-1})
Extremely sensitive	2	Poor	3-4	0.4-0.8
Very sensitive	1-3	Poor	2-3	1.2-1.6
Moderately sensitive	1>	Poor	4-5	1.6-2.5
Least sensitive	3-4<	Medium	10	2.5-3.3

supplemental forage as well. During wet years the price can be low as 14 € per bale, while in dry years hay price may climb over 32 € per bale. Horses and big yielder dairy cows cost much more. Premium hay (low ash, no stones, no mould) can bear the costs (transport and storage) due to its high nutritive value. The calculated price typically refer to a 250-300 kg 150 Ø round bale and depends on transport distance, where 20 km is the profitability limit in an average season. The needs and price sensitivity of horse owners are quite different. Reliable, continuous supply, perfect hay composition and quality are the keys for running a good hay-producing holding (Table 3).

Table 3. Meadow hay price (€ per ton) in average season in 2019 (550 mm annual rainfall)

Hay Quality Class (K-value)	Horse[2]	Dairy cow	Cattle	Sheep
Excellent (Premium herb-hay)	100 – 104	90-95	-	-
Good	65	32,4	-	-
Medium	32,4	16,2	16,2	16,2
Fair	-	-	15	14
Poor	-	-	-	10

CONCLUSIONS

So far the hay quality and digestibility is not a major issue in Hungarian farmers' mindset. However climate change and high standards in foraging both dairy and beef sectors require better hay. Small and medium scale hay producers are not forced to make high quality meadow hay because of low price and livestock farms self-sufficiency. The bigger farms and horse stables however are looking for premium quality because the long term cost reduction in supplementary feeds.

Oportunities and Perspectives

Quality hay production is not an easy task and climate dependent. Historical weather and yield data in open databases is a must to evaluate farm productivity. This database requires regular, georeferenced, yield reports and nutrient analyses. The big data set opens new breakout points like amino-acid specific feeding. Hay quality is a corner stone in dairy farming regarding dry matter uptake and rumen passage rate. Sustainable, high performance, beef and cheese production inevitably counts on a general hay qualification system integrated with a digital hay market. Climate change adaptation is also urging the revision of irrigation technologies. Flood irrigation is still a feasible solution on pastures.

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SCIENTIFIC PAPER

OPPORTUNITIES FOR WASTEWATER HEAT RECOVERY IN HUNGARY AND ITS ROLE IN THE CIRCULAR ECONOMY

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Abstract: *Most of the energy content of wastewater can be found in wastewater heat, however, its recovery is limited. In this article, the current situation, future opportunities of wastewater heat recovery are presented based on secondary data collection, mentioning the constraints and main influencing factors of sustainable implementation of heat recovery systems in Hungary. Besides, the already existing systems are described. As regards the capacities of treatment plants, 103 of the 574 domestic plants have a capacity of over 20,000 Population Equivalent (PE), of which 25 plants have a capacity of over 100,000 PE. According to our calculations, in big cities/capitals (20.000 – 100.000, and over 100.000 inhabitants), it may be possible to recover wastewater heat sustainably in several places. In small towns (5.000 – 20.000 inhabitants), wastewater heat recovery can be technologically and economically sustainable only in the presence of agricultural or industrial plants with high and continuous wastewater feed into the pipeline system. Taking into account the temperature conditions at each place of use and their estimated fluctuations, it can be said that proper, careful planning, sizing and implementation have a crucial effect on the efficiency of microbiological activity in the treatment plants. In bigger cities, of course, the effect of the temperature drop of one main collector may be minimal, however, in smaller and medium-sized settlements, excessive heat extraction may result in complete inhibition or cessation of nitrification. In Hungarian case studies, the maximum acceptable temperature drop is approx. 2-3 °C. It can be stated that energy recovery from wastewater may be very promising considering the size and temperature limitations. Therefore, the rational recovery of wastewater heat can be an important part of the implementation of circular economy and sustainable energy utilization in wastewater management, resulting in significant energy savings and pollutant reduction.*

KEYWORDS: wastewater treatment; circular economy; energy management; heat energy; nitrification
JEL CODE: Q25

INTRODUCTION

The transition of the European economy to a greener, more flexible circular model is an emerging concept (Németh et al., 2020) in which redesigning products and production processes help to minimize waste and turn unused materials into resources. According to Osztovics (2018), global megatrends — resource scarcity, technological breakthroughs, and the emergence of new generations — are now creating an environment in which waste and by-products end up in landfills. Companies and service providers that recognize the untapped potential of extending the life cycle of products and materials can enter new markets, save costs and increase consumer confidence while significantly reducing their environmental footprint. Thus, environmental challenges also mean economic opportunities; economic development does not necessarily go hand in hand with the deterioration of the environment.

Nowadays, the amount of water used is constantly increasing due to the growth in population and living standards. At present, agriculture is responsible for 70% of global water use, while urban and residential use accounts for 11% and industrial water demand for 19% (UNESCO, 2017). Another tendency is that an increasing proportion of the population moves to big cities; the proportion of the urban population exceeds 50% globally, while in Hungary it is close to 70% (KOVÁCS, 2017). The problems of wastewater management in villages and towns and the possibilities of the applied technology differ greatly, not only due to the different size and regional tasks to be performed but also due to the different income levels and wastewater quality. In the villages, therefore, smaller and semi-natural, less efficient treatment solutions are characteristic, while in the big cities - because of the more concentrated, higher amount and industrially polluted wastewater production - large-scale, automated wastewater treatment plants with mainly activated sludge technology are typical (BODÁNÉ KENDROVICS, 2018).

According to FAO (2018), nearly three hundred billion m3 of wastewater is generated on Earth in one year. However, in terms of treatment, the proportion of treated water is favourable (70% on average) in developed, economically prosperous countries, while in developing and underdeveloped, poor countries it is only one-third or a quarter on average (SATO et al., 2013). Accordingly, it is estimated that approximately 80% of the wastewater produced worldwide is released into the environment without proper treatment and purification (UNESCO, 2017). However, the energy and nutrients it contains are of great value, and their utilization can be important regarding not only waste management but also emissions. One of the greatest potentials for energy recovery is to use wastewater temperature to produce heating or cooling energy.

In our article, we present the current situation and the legal and technological environment influencing the direct recovery of wastewater heat, we describe the best practices that have already been implemented and we also cover the limiting factors that mostly influence the prevalence and efficiency of wastewater heat recovery in Hungary.

1. LITERATURE REVIEW

In the European Union, overall waste generation is stable, but the amount of sewage sludge is still increasing (EC, 2019a). The purpose of Directive 91/271/EEC is to protect the environment against the harmful effects of urban and certain industrial wastewater discharges. To achieve this, the Directive requires member states to collect and treat urban wastewater as a mandatory obligation above 2,000 population equivalents (PE).

According to European policymakers, there is a need to develop an energy sector based mainly on renewable energy sources, aspiring to the rapid phasing out of coal and decarbonizing gas (EC, 2019b).

The European Union Heating and Cooling Strategy (EC, 2016) states that in some industries, a much larger proportion of heat as a by-product could be recycled within the plant or sold to nearby buildings. The wastewater heat recovery we examined is also closely included in this issue.

1.1. Energy content of wastewater and its usability

According to MCCARTY et al. (2011) and GUDE (2015), energy is present in three forms in the average wastewater generated in the USA and their theoretical specific energy is as follows:

1. energy of organic pollutants: ~ 1.79 - 1.93 kWh/m^3
2. energy of plant nutrients (N and P): ~ 0.70 - 0.79 kWh/m^3
3. thermal energy: ~ 7.00 kWh/m^3

The values were determined by MCCARTY et al. (2011) by using the COD (Chemical Oxygen Demand) value (500 mg/l) for the organic compounds present in the wastewater, assuming a theoretical COD energy potential of 3.86 kWh/kg. In Hungary, this value is slightly higher as the wastewater is more concentrated due to the lower water consumption per capita. The energy value of wastewater is also larger in the case of higher agricultural sludge content, because of the higher N and P ratio in animal manure (Ladányi and Szűcs, 2016). WETT et al. (2007) describe that wastewater contains more energy than is sufficient to use electricity for the treatment plant, and with appropriate technology, the treatment activity in the plant can be self-sustaining, while FILLMORE et al. (2014) suggest that wastewater contains up to five times the energy required to treat it.

Most of the energy content of wastewater is found in wastewater heat, however, its recovery is limited. According to DULOVICS (2012), theoretically, 1.16 kWh of thermal energy can be obtained by cooling 1 m3 of wastewater by 1°C. The reason for the significant heat content is that the wastewater coming from bathing, washing and washing-up leaves our home at a temperature of 35-65°C and then flows underground to the treatment plant. In this regard, the following recovery methods are available by extracting the heat energy with a heat

exchanger and then increasing it to the required temperature with a heat pump: (1) from the sewerage of the building at the place of generation; (2) from the sewer; (3) heat recovery from treated water leaving a wastewater treatment plant. The energy efficiency values (COP - coefficient of performance) of the wastewater heat generated in large quantity at relatively constant temperature are significantly more favourable than that of ground heat and aquifer water:

- heating (COP): 5.0-6.5, taking into account auxiliary energy approx. 4.5,
- cooling (EER1): 7.5-8.5, taking into account auxiliary energy: approx. 6.5.
- the COP value of natural gas combustion in this context is 2.9-3.2.

The favorable recovery and COP value of wastewater compared to other heat sources lie in its constant temperature.

According to Dulovics (2012), sustainable and economical heat energy generation in Hungary is primarily ensured by the following factors:

- at least 15 L/s (1,296 m3/day) flow in the sewer,
- adequate temperature of the wastewater at the wastewater treatment plant,
- minimum heat demand of 150 kW,
- usually, 100-300 m distance between the sewer and the buildings; 300 m in non-built-up areas.

1.2. Relationship between wastewater heat recovery and wastewater treatment efficiency

Although directly recoverable heat energy represents the largest proportion, it cannot be extracted entirely due to wastewater treatment considerations.

WONG (2014) and NEDOROST (2018) draw attention to the careful and thoughtful planning of the heat recovery of the inflowing wastewater, mentioning that excessive extraction of wastewater heat before reaching the plant may cause problems in terms of treatment efficiency - due to low water temperature -, and may also lead to increased energy consumption.

The biological nutrient removal process in wastewater treatment plants released N2O as a main content. The process of the elimination of nitrogen contains two steps. These two-steps of nitrogen bio-elimination from wastewater consist of nitrification under strict aerobic conditions followed by denitrification under anoxic conditions (Thakur and Medhi, 2019). Nitrification according to Lydmark et al. (2007) is characterized in two consecutive steps by two chemolithoautotrophic groups of bacteria, called ammonia-oxidizing bacteria (AOB) and nitrite-oxidizing bacteria (NOB). During this process, ammonium is oxidized to nitrate, via nitrite.

Furthermore, in the first step aerobics bacteria known as Nitrosomonas, converts ammonium to nitrite while another group of aerobic bacteria called Nitrobacter finish the conversion of nitrite to nitrate (Trygar, 2009). Regarding denitrification, it is the biological process by which nitrate is converted to nitrogen and other gaseous end products.

The basic and crucial factor influential for the efficiency of the removal of nitrogen and carbon compounds from wastewater containing de-icing agents is the temperature.

Nitrification is a very delicate process regarding water temperature whether cold or hottest temperature. It reaches a maximum rate at liquid temperatures between 30 and 35 degrees C (86°F and 95°F). Moreover, with the increase in temperature above 40°C its rates fall to near zero. On the contrary, the cold water temperature has an impact on the nitrification rate as well. As water temperature decreases the nitrification process slows down (Trygar, 2009). According to Antoniou et al., (1990) and Hepbasli et al., (2014), wastewater temperature is depending on the season however the effective maximum specific growth rate of nitrifying bacteria is ranged between 15 and 25°C, whereas a decrease in the temperature affects the ongoing process of the specific growth rate of nitrifying bacteria. In the study of Gnida et al. (2016), the WWTP operation was analyzed during the wintertime and it shows that the activated sludge was sensitive during the decline of temperature. The nitrification efficiency is decreased under 16°C and presumably, at 10°C, the nitrification would be inhibited completely.

1.3. Case studies in Hungary

In Hungary, in recent years, 540 million m3 of municipal wastewater is treated annually at public wastewater treatment plants, according to the records of the Central Statistical Office (KSH, 2020). The records of Municipal Wastewater Information System (TESZIR, 2019) state that out of the 574 Hungarian plants, only 25 have a capacity of over 100,000 PE (population equivalent), however, these plants still represent more than half of the total treatment capacity. In general, the vast majority of wastewater is treated by larger treatment plants, typically based on activated sludge technology.

According to estimates, the investment cost of the applicable technology, developed in Hungary, is approx. EUR 1 million (two-thirds of which is the installation of the conventional energy generating capacity, i.e., the implementation cost is higher by a third of the total cost). The technology has a lifespan of 15 years. When an existing system is converted, the return is 8-10 years (savings of 120,000 EUR/year), while new constructions take 3-4 years due to the annual savings of 20-40% in energy costs of the end-user. The solution optimally provides full energy supply (cooling and heating) to commercial units and office buildings near larger main collectors (above 600 mm in diameter).

The most significant projects implemented in Hungary (with a total installed capacity of 8.4 MW) are the following (Table 1).

In the table, we can see the Hungarian examples implemented so far, and their characteristics, all of them in the capital city, Budapest. We can observe that each of them clearly exceeds the theoretical water flow limit values, which are approx. 1 300 m3/day or 15 l/sec. In chronological order,

1 EER: Energy Efficiency Ratio.

Table 1: Wastewater heat recovery references in Hungary

Project site	Water flow (m^3/day)	Water flow (L/sec.)	Average temp. of wastewater	Capacity	Year
MOM Cultural Center and Larus Event Center	2 160 m^3/day	25 L/sec.	15-17°C	1.0 MW	2011
FCSM Kerepesi Road WWTP and headquarters	3 360 m^3/day	39 L/sec.	17°C	1.0 MW	2012
MH EK Military Hospital	11 520 m^3/day	133 L/sec.	17°C	3.8 MW	2014
University of Szeged JATIK building	3 264 m^3/day	38 L/sec.	17°C	1.5 MW	2015
FCSM Ferencváros lifting/pumping station	5 760 m^3/day	67 L/sec.	17°C	1.2 MW	2015

Source: own editing based on KISS (2016)

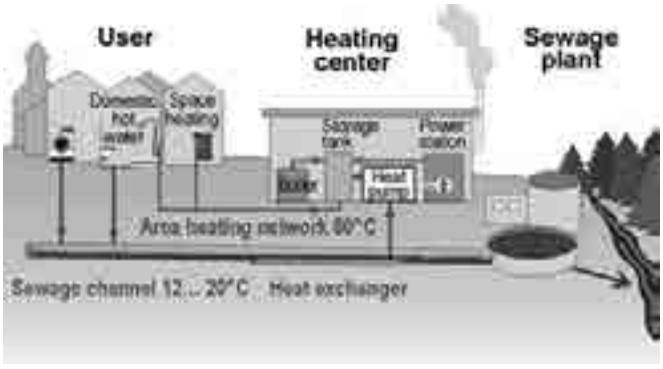
first was the Larus Event Center, while the biggest one is the system implemented for ensuring a significant part of the heat supply of the Military Hospital.

2. MATERIALS AND METHODS

In our work, after secondary data collection, we describe the current situation, opportunities and potential of wastewater heat recovery, as well as its characteristics on both the "supply" and "demand" sides.

Figure 1. shows the design of a theoretical system, which consists of the following: on the left: the users (or wastewater producers), below is the sewage channel and the built-in heat exchanger. The heating center and heat pump are at the bottom, which is responsible for the distribution of the heat. The wastewater treatment plant is on the right side, at the end of the process.

Figure 1. Design of a theoretical wastewater heat recovery system



Source: REHVA, 2012

In our calculations, we used the following data and correlations related to the supply side:

- Register of the Municipal Wastewater Information System of Hungary on wastewater treatment plants and their capacity (TESZIR, 2019).
- Domestic average wastewater production data: 130 liters/person/day (Kárpáti, 2016).
- Domestic references for wastewater heat recovery (Table 1).
- The heat obtained by using the heat exchanger and the associated temperature change (Formulas (1) and (2)).

Regarding the possibilities of wastewater heat recovery, we used the following formula by Cecconet al. (2019) and Kretschmer et al. (2016):

$$P_{RS}=Q_{RS}\cdot c\cdot\Delta T_{RS}\cdot\rho \quad (1)$$

where: P_{RS} : available heat potential (kW)

Q_{RS}: wastewater flow diverted at the recovery site for heat exchange (L/sec)

c: specific heat capacity of wastewater (4.18 KJ/kg/°C) (Funamizu et al., 2001)

ΔT_{RS}: temperature difference or decrease due to heat recovery (K)

ρ : wastewater density (1000 kg/m^3)

The temperature change in the sewer after wastewater heat recovery is described by Formula (2) below:

$$\Delta T_{SEWER}=(Q_{RS}\cdot\Delta T_{RS})/Q_{SEWER} \quad (2)$$

where: ΔT_{SEWER}: change of temperature in the sewer

Q_{RS}: wastewater flow diverted at the recovery site for heat exchange (L/sec)

ΔT_{RS} : temperature difference or decrease due to heat recovery (K)

Q_{SEWER}: flow rate in the sewer in the proximity of the building (L/sec)

Basic data related to the demand side, i.e., the user side of wastewater heat:

Specific heating energy demand (primary energy consumption by heating) (ÉMI-NFM, 2015):

- Office buildings: 86-240 kWh/m^2/year (average: 163 kWh/m^2/year)
- Commercial buildings: 146-258 kWh/m^2/year (average: 202 kWh/m^2/year)
- Healthcare and social services buildings: 151-308 kWh/m^2/year (average: 229.5 kWh/m^2/year)
- Cultural buildings: 70-198 kWh/m^2/year (average: 134 kWh/m^2/year)
- Educational buildings: 113-238 kWh/m^2/year (average: 175.5 kWh/m^2/year)

Based on this data, the calculated average demand is 180 kWh/m^2/year, which means an average power demand of 45 W/m^2 assuming a heating period of 4000 h/year, which is greatly influenced by the method of recovery.

The formula used to estimate the (peak) heating load, considering the nature of the building and the heated m^3, for an average insulated building (Internet1):

Required (peak) load = Heated floor area * Ceiling height * Specific heating demand * 1.1 (3)

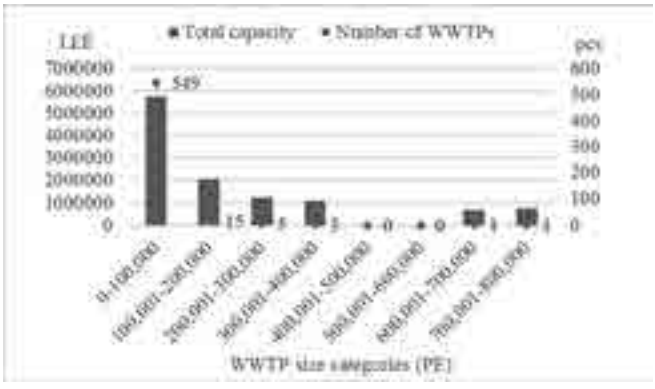
The National Building Energy Performance Strategy (2015) proposes a value of 30-40 W/m^2 as the specific heating demand. Based on the previous data, we use 35 W/m^2 in our calculations.

3. RESULTS AND DISCUSSION

When mapping the municipal wastewater heat recovery possibilities in Hungary, the size and capacity of the wastewater treatment plant of the given settlement are of paramount importance. This value is always closely related to the amount of wastewater flowing in the sewer system (main collector(s)) before reaching the plant.

The register of TESZIR (2019) helps to discover the possibilities of heat recovery. Based on the register, forming different size categories, we can find the characteristics shown in Figure 2. below. It can be observed that while 95% of the domestic wastewater treatment plants is below 100,000 PE, they are responsible for less than 50% of the treated wastewater volume.

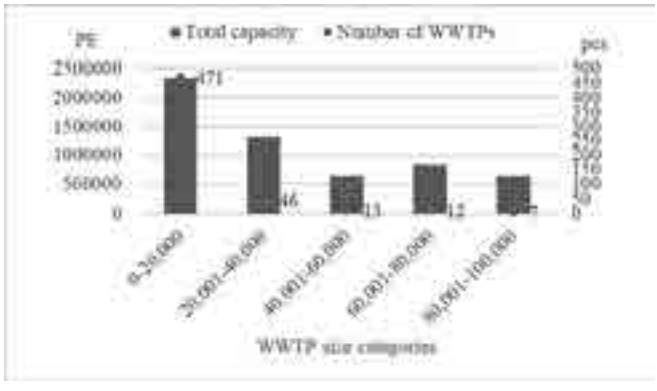
Figure 2: Number and the total capacity of wastewater treatment plants by different size categories in Hungary



Source: Own editing based on TESZIR (2019)

As the wastewater flow available in the given sewer section can be a significant limitation in terms of wastewater heat recovery, we also examined the distribution and characteristics of the first size category (plants between 0-100,000 PE) (Figure 3).

Figure 3: Number and the total capacity of wastewater treatment plants by different size categories (0-100,000 PE)



Source: Own editing based on TESZIR (2019)

On the figure, we can see the plants with less than 20,000 PE are in the vast majority (471). If we look at the contribution of plants above 20,000 PE, above 50,000 PE and above 100,000 PE, we get 80%, 65% and 50%, respectively, for the proportion of total treated wastewater.

Although our calculations show that the previously mentioned wastewater flow of at least 15 L/sec (or 1,296 m3/day) indicated by Dulovics (2012) may theoretically be available in the sewer section of a 10,000 PE plant, this is influenced by several factors in practice, including the following ones.

Limitations on the supply side:

- only the wastewater collected in sanitary sewer pipes can be used for heat recovery (usually there is a significant amount of suction and transportation involving vacuum trucks)
- in order to avoid the negative effect of the heat extraction outside the plant on nitrification and denitrification processes, the appropriate wastewater flow rate is crucial.

Limitations on the demand/user side:

- in smaller settlements, a public institution, office building, community space or catering unit, etc. with a significant, continuous heating or cooling demand is less likely to be available in the vicinity (within a maximum of 300 m) of the main collector with the appropriate flow.

Using the data of Hungarian references, assuming a residential wastewater production of 130 liters/day/person, we calculated the wastewater flow of each plant, referring to PE (Population Equivalent). Subsequently, applying the formulas by Cecconet et al. (2019) and Kretschmer et al. (2016), we determined the temperature drop in a given sewer section assuming different recovery rates (Table 2). The following is the calculation for the first plant (MOM Cultural Center and Larus Event Center) in order:

Basic formula and calculation:

$$P_{RS}=Q_{RS}\cdot c\cdot\Delta T_{RS}\cdot\rho, \text{ after rearranging}$$
$$\Delta T_{RS}=P_{RS}/Q_(RS)/\ c\ /\ \rho, \text{ substituted:}$$
$$\Delta T_{RS}=1000\ \text{kW}/25\ \text{L/sec}/4.18\ \text{KJ/kg/°C/kg/L}$$
$$\Delta T_{RS}=-\ 9{,}6\ °C$$

In the next step, the actual temperature drop in the channel section was calculated based on the formula (2):

Basic formula and calculation for a 10% recovery rate:

$$\Delta T_{SEWER}=(Q_{RS}\cdot\Delta T_{RS})/Q_{SEWER}, \text{ substituted}$$
$$\Delta T_{SEWER}=(25\ \text{L/sec}\cdot 9{,}6\ °C)/250\ \text{L/sec}$$
$$\Delta T_{SEWER}=0{,}96°C$$

In terms of recovery rates, the percentage of wastewater flowing in the sewer used for heat exchange is extremely important for changes in temperature conditions. The possible outcome is illustrated in the five columns on the right side of the table.

Table 2: Characteristics of domestic references and calculated temperature drop for different recovery rates

Project site	Water flow (L/sec.)	Capacity	Avg. temp. of wastewater	Size in P.E.	Change in temperature by different share of wastewater usage (°C)				
					100%	75%	50%	25%	10%
MOM Cultural Center and Larus Event Center	25 l/sec.	1.0 MW	15-17°C	16,615	9.6	7.2	4.8	2.4	1.0
FCSM Kerepesi Road WWTP and headquarters	39 l/sec.	1.0 MW	17°C	25,846	6.1	4.6	3.1	1.5	0.6
MH EK Military Hospital	133 l/sec.	3.8 MW	17°C	88,615	6.8	5.1	3.4	1.7	0.7
University of Szeged JATIK building	38 l/sec.	1.5 MW	17°C	25,108	9.4	7.1	4.7	2.4	0.9
FCSM Ferencváros lifting/ pumping station	67 l/sec.	1.2 MW	17°C	44,308	4.3	3.2	2.1	1.1	0.4

Source: own calculations based on KISS (2016

As shown in Table 2, assuming an average wastewater production of 130 liters/person/day, the smallest system has 16,600 PE, while the largest system contributing to the energy supply of the Military Hospital has a wastewater capacity of nearly 90,000 PE.

It can be observed that the proportion of wastewater use in the given sewer section has a significant effect on the temperature drop. If all the wastewater flowing in the given sewer section were to be used, the temperature would drop by 4.3 to 9.6°C. In contrast, if heat is extracted only from 50% of the total flow, the drop is by 2.1 to 4.8°C, while at 10% this value decreases to 0.4 to 1.0°C, depending on the amount of wastewater used for heat recovery.

Taking into account the temperature conditions at each place of use and their estimated fluctuations - according to the months and seasons, approx. 12-20°C in the range of 8°C (Cipolla and Maglionico, 2014, Wanner et al., 2005, and Kretschmer et al., 2016) -, it can be said that proper, careful sizing and design have a crucial effect on the efficiency of microbiological activity. In bigger cities, of course, the effect of the temperature drop of one main collector reaching the site may be minimal, however, in smaller and medium-sized settlements, excessive heat extraction may result in complete inhibition or cessation of nitrification.

After considering the limiting factors and characteristics of the supply side, we also performed calculations on the demand/user side, taking into account the min. 150 kW heat demand determined by Dulovics (2012).

Based on the formula applied to calculate the (peak) load required for heating, assuming a specific heating demand of 35 W/m3 and a ceiling height of 3 m:

Required (peak) load = Heated floor area * Ceiling height * Specific heating demand * 1.1, after rearranging:

Heated floor area = Required (peak) load / Ceiling height / Specific heating demand / 1.1, substituted:

Heated floor area = 150 kW / 3m / 35W/m^3, so:

Heated floor area = 1300m^2

Combining the demand and supply sides, we created a table with several possibilities, which can help to assess and determine the possibilities of sustainable heat recovery that does not endanger microbiological activity, considering the temperature conditions of the given sewer section (Table 3).

Table 3: Temperature drop in terms of water flow and heating system capacity

		Water flow (L/sec.)							
		15	30	50	100	150	200	300	500
Capacity required for heating (kW)	150	**2.38**	**1.20**	**0.72**	**0.36**	**0.24**	**0.18**	**0.12**	**0.07**
	300	4.77	**2.39**	**1.44**	**0.72**	**0.48**	**0.36**	**0.24**	**0.14**
	500	7.95	3.99	**2.39**	**1.20**	**0.80**	**0.60**	**0.40**	**0.24**
	1000	15.90	7.97	4.78	**2.39**	**1.59**	**1.20**	**0.80**	**0.48**
	1500	23.85	11.96	7.18	3.59	**2.39**	**1.79**	**1.20**	**0.72**
	2000	31.80	15.95	9.57	4.78	3.19	**2.39**	**1.59**	**0.96**
	3000	47.70	23.92	14.35	7.18	4.78	3.59	**2.39**	**1.44**
	5000	79.50	39.87	23.92	11.96	7.97	5.98	3.99	**2.39**

Note: Values to the right and down of the second column and row indicate the temperature drop in °C.

Source: own calculations

Table 3 shows how wastewater heat recovery reduces temperature under different conditions. The cells marked in bold are considered to be less risky combinations for efficient microbiological activity in the wastewater treatment plant based on the presented Hungarian case studies, while the faded cells contain the cases resulting in a significant decrease. The latter is only relevant to wastewater with much higher temperatures. In Hungarian case studies, a maximum temperature drop of 2-3 °C can ensure the efficient course of the denitrification process. A facility with a floor area (to be heated) of about 1,300 m2 has the lowest (150 kW) heating power demand, which is, of course, greatly influenced by its thermal and energy consumption properties. In the domestic case studies

(assuming a maximum temperature drop of 2.39 °C), they can supply 300-1500 kW of power, which can enable heating of 2.6-13 thousand m^2 each, reducing energy costs and the associated emissions.

Our list of wastewater treatment plant sizes (Figures 2 and 3) based on the records of TESZIR (2019) and our analysis described above show that 103 of the 574 domestic plants have a capacity of over 20,000 PE, of which 25 plants have a capacity of over 100,000 PE. In the former group, sustainable wastewater heat recovery can be achieved only in an ideal case and under the right conditions, while the sewer sections in front of the treatment plants above 100,000 PE can provide a good opportunity to extract the heat content of wastewater, resulting in significant energy savings and pollutant reduction.

Based on professional experience we can say that although the collectors with the highest wastewater flow are generally located in densely populated areas, due to the size of the sewer network and the maximum size of the collectors in medium and big cities/capitals (20,000 - 100,000, and over 100,000 inhabitants) it may be possible to recover wastewater heat sustainably in several places. In small towns (5,000 - 20,000 inhabitants), however, considering the supply side we regard wastewater heat recovery as technologically and economically sustainable only in the presence of agricultural or industrial plants with higher wastewater discharges into the sewer network. In the latter case, another important condition is the availability of a place of use within a reasonable distance and with appropriate heat demand.

Careful planning and implementation are necessary for economic efficiency and sustainability and in order to avoid adverse effects on biological processes (especially nitrification and denitrification). Therefore, not only the supply side (adequate amount, flow and temperature of wastewater) but also the demand side, i.e., concentrated and possibly continuous heating and/or cooling demand must be present. The possible return in each case depends on the investment and operating costs of the given system and the magnitude of savings provided by the system (such as the cost per unit of energy, etc.). In principle, the overall efficiency of the process could be increased by converting the thermal energy extracted from wastewater into cooling energy (by solving its recovery during summer), but the additional electricity demand required for this could only result in economical operation in case of particularly large (much higher than domestic) capacity. Such examples are public institutions that are in use all year round (e.g., community house, cultural center, shopping center, office building) or possibly cold stores, warehouses.

It can be stated that energy recovery from wastewater is extremely promising and considered as a future prospect. Therefore, the rational recovery of wastewater heat can be an extremely important complement to the implementation of circular economy and sustainable energy management in wastewater management.

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SCIENTIFIC PAPER

INTEGRATED APPROACH IN UKRAINIAN DAIRY INDUSTRY: A CASE STUDY FROM POLTAVA REGION

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Abstract: *Integration processes in the field of agriculture, and particularly in dairy industry, have real prospects for improving the efficiency of business entities in this industry due to technological features. Particular attention should be paid to vertically integrated business models that allow hedging of various risk groups and minimizing costs due to the optimal combination of the efforts of enterprises belonging to such associations.*

The purpose of the article is to study the current state of dairy industry in Poltava Region, Ukraine, and to show one of the conceptual ways to increase its economic efficiency. The paper presents a theoretical hypothesis concerning the necessity of vertically integrated agricultural formation's creation in order to improve the competitiveness of dairy production in the region and having positive effect on sustainable development of dairy industry.

The practical significance of the study includes the possibility to use findings and recommendations set out in the paper for introduction of mutually beneficial economic relations between agricultural, dairy and trade enterprises in concluding agreements on joint activities based on a successful example from Poltava Region, and contribute to the stabilization, development and increase of the enterprises' efficiency in Ukrainian dairy industry.

Keywords: *dairy industry, integrated ventures, Ukraine, Poltava Region, agro-industrial group*
JEL Code: F15, Q13

1. INTRODUCTION

Agriculture has been historically one of the main sectors of the Ukrainian economy. Considered for centuries as a "bread basket of Europe" Ukraine today possesses arable land area which equals to 30% of arable land of the European Union and 2.1% of the global arable land bank (FAO, 2019). But it has always been about quality, not quantity: Ukraine accounts for about 25% of the world most fertile black soil which makes the country unique in terms of agricultural potential. Over the last decade, agricultural sector has moved to the forefront of Ukrainian economy. Over the last 3 years agricultural sector contributed 10-12% of Ukrainian GDP (nominal), being among the three largest industries. Approximately 17% of working population is employed in agriculture (State Statistic Service of Ukraine, 2019).

Ukrainian dairy sector is one of the most important and fast-growing branches of the agrifood sector, standing for 4% of the total national output and being one of the key Ukrainian markets. Dairy farming is one of the main sources of income for the rural population, and of raw milk for processing. Four million small family dairy farms and private rural households produce more than half its gross agricultural product and 75% of its dairy (State Statistic Service of Ukraine, 2019).

Demand for dairy and fermented milk products is stable and not declining. The average world consumption of dairy products in recent years is 103-106 kg per year per capita (FAO, 2019). In Ukraine, the consumption of dairy products is at the level of developed countries: according to the State Statistics Committee of Ukraine, the average Ukrainian consumes about 240 kg of milk and dairy products per year (State Statistics Committee of Ukraine, 2019).

However, Ukraine milk production shrank to 9.8 million tonnes in 2019, hitting the lowest level since independency, a research conducted by the State Statistical Service showed. Due to this, Ukraine cut export of dairy products by 33%, compared to the previous year, to 541 thousand tonnes. Import jumped by 90% to 335 thousand tonnes. The overall population of dairy cows in Ukraine decreased by 5% to 3.6 million heads, with 2.5 million (State Statistics Committee of Ukraine, 2019).

This paper covers one of the central regions of Ukraine – Poltava Region. Poltava Region is one of the leading and well-developed from the 25 Ukrainian regions, situated at the left bank of river Dnipro. It occupies the territory of 28.8

thousand square km (5% of Ukraine territory) with the length of 213.5 km from North to South and 245 km from East to West. The region has advantageous geographical position, considerable reserves of mineral resources and temperate continental climate. It all creates good prerequisites for the development of the agriculture. Land resources of Poltava Region are formed of 2.8 million hectares among which 1.62 million are the agricultural areas. Among leading fields of food industry there are dairy and meat, oil-mill, fruit and vegetable, sugar, fruit and vegetable, baking, confectionery and food-canning (Gereles, 2014).

The purpose of the article is to characterize the dairy industry of Poltava region and its significance throughout Ukraine with the focus on integration processes. It summarises practical experience of successful integrated dairy venture of the region in order to describe the aspects of creating integrated structures in dairy sector and show its potential.

2. MATERIALS AND METHODS

A case study was chosen as a main research methodology that is commonly used in social and business sciences, together with descriptive statistics, time series and financial indicators within industry trend analysis. A case study is a research strategy and an empirical inquiry that investigates a phenomenon within its real-life context. Particularly in Business research a case study is a study in which a case or a small number of cases in their real life context are selected, and scores obtained from these cases are analysed (Dul and Hak, 2008). Descriptive statistics and time series were used to analyse major characteristics and trends of the dairy industry of Ukraine and Poltava Region, and company's financial performance and its position within the industry.

The research region was chosen because Poltava Region ranks as the leading one in terms of milk production in Ukraine – around 6-6.5% of gross production – during last 5 years and an absolute leader of milk production in 2018 and 2019 years. In the structure of milk production in the region, households account for a larger share – 56.9%, while the share of agricultural enterprises increases for the study period by to 43.1%.

Secondary data collection, both historical and up-to-date, is based on official statistics, provided by Food and Agriculture Organization of the United Nations (FAO), Emerging Markets Information System (EMIS), State Statistic Service of Ukraine and Main Statistics Department of Poltava Region. It is data derived from the state statistical observations on activity of enterprises and organizations in the field of agriculture, processing industry, trade as well as other official sources. EMIS database was used to gather industry information, company reports and financial data from dairy industry of Ukraine, specifically Dairy Product (except Frozen) Manufacturing (NAICS1 31151).

Some primary data was collected during few personal interviews with the Head of Directors' Board and the founder, Sales Department specialists of Bilotserkivka Agroindustrial Group (BIAGR) during business visits to the company.

3. RESULTS AND DISCUSSION

Production of milk and dairy products is one of the key directions of the food industry of Ukraine. The development of this sector of industry contributes to the food security of the state, as well as contributes to the development of its export potential. In recent years, there has been a clear division of regions in Ukraine in the specialization of the dairy industry. Therefore, it is advisable to study the dynamic and structural changes in the dairy industry in the regions, in order to identify the problems of dairy industry development in the regions.

Ukraine ranked the 22nd among the largest milk producing countries in the world at the end of 2019, despite a significant reduction in the number of cows and milk production based on the Dairy Report 2020 by IFCN experts. As noted, the IFCN study provides a detailed analysis of 123 countries – the largest milk producers (98% of world production) in 2019. The analysis of the dairy sector covered over 200 countries. The experts compared the profitability and productivity of dairy farms, milk and feed prices in different countries. In particular, the report indicates that in 2019 Ukraine produced 9 million tons of milk in dry matter base, the price of raw milk was 11% lower than the price on the world market, and the country's milk self-sufficiency was 104%. In 2014-2019 milk production decreased by 2.3% per year, the number of dairy farms decreased by 4.3% annually, while the average milk yield grew by 2% annually (IFCN, 2020)

In addition, IFCN experts state that in 2019 the increase in milk production in the world was 1.4%, which is significantly lower than the long-term average (2.3%). The growth came mainly from India, Oceania, Africa and the Middle East. At the same time, the growing popularity of milk alternatives in rich countries and low milk availability in developing countries has slowed the growth in demand for dairy products (IFCN, 2020).

3.1. Overview of dairy industry in Poltava Region, Ukraine

In 2019, Poltava Region took the first place in terms of milk production in Ukraine again – 758.5 thousand tons or 7.8% of Ukrainian gross production. In the structure of milk production in the region, households have a larger share – 47.7%, but their share tends to decrease, while the share of agricultural enterprises increased during the study period to 52.3% (Table 1). Increasing milk production by agricultural enterprises allows to increase its quality, as well as the efficiency of production. Moreover, Poltava Region has one of the largest breeding bases in Ukraine.

Despite constant criticisms of the quality of raw milk produced in the backyards of private farmers and constant calls for the urgent need to reform the dairy industry, households have long been the main producers of milk in Poltava Region. Thanks to the work of households, at least

1 North American Industry Classification System

Table 1. Main indicators of dairy industry in Poltava Region, 2011-2019

Indicators	2011	2015	2017	2018	2019
Cows number in all agricultural ventures, thsd. heads – Ukraine	2631.2	2262.7	2108.9	2017.8	1919.4
Poltava Region	*137.4*	*129.2*	*127.0*	*121.7*	*121.0*
in enterprises, thsd. heads – Ukraine	589.1	529.2	484.6	466.6	467.8
Poltava Region	*66.0*	*69.4*	*64.3*	*60.8*	*61.0*
in private farms, thsd. heads – Ukraine	37.4	41.1	39.9	39.2	42.8
Poltava Region	*1.3*	*2.7*	*3.1*	*3.9*	*4.4*
in households, thsd. heads – Ukraine	2042.1	1733.5	1624.3	1551.2	1451.6
Poltava Region	*71.4*	*59.8*	*62.7*	*60.9*	*60.0*
Production of milk of all kinds in all agricultural ventures, thsd.t – Ukraine	11248.5	10615.4	10280.5	10064.0	9663.2
Poltava Region	701.4	794.5	792.4	762.1	758.5
in enterprises, thsd.t – Ukraine	2216.6	2669.2	2765.7	2755.5	2728.6
Poltava Region	*302.5*	*424.8*	*424.6*	*394.0*	*397.0*
in private farms, thsd.t – Ukraine	112.1	177.4	194.8	201.8	209.2
Poltava Region	*5.8*	*17.0*	*24.0*	*25.5*	*29.0*
in households, thsd.t – Ukraine	9031.9	7946.2	7514.8	7308.5	6934.6
Poltava Region	*398.9*	*369.7*	*367.8*	*368.1*	*361.5*
Annual average milk yield per cow in all agricultural holdings, kg -– Ukraine	4082	4644	4820	4922	4976
Poltava Region	*4826*	*6016*	*6113*	*6120*	*6133*
in enterprises, kg – Ukraine	3975	5352	6025	6190	6101
Poltava Region	*4633*	*6133*	*6623*	*6489*	*6516*
in households, kg – Ukraine	4110	4437	4480	4559	4630
Poltava Region	*4991*	*5884*	*5590*	*5760*	*5741*

Source: State Statistic Service of Ukraine, 2019; Main Statistics Department of Poltava Region, 2019

for the last 20 years, that the domestic market needs of milk and dairy products production has been met. So far, only in recent years, despite the negative trend of declining production, households have sold to dairy companies more than 50% of total milk production. Prior to that, this share reached 60-65%.

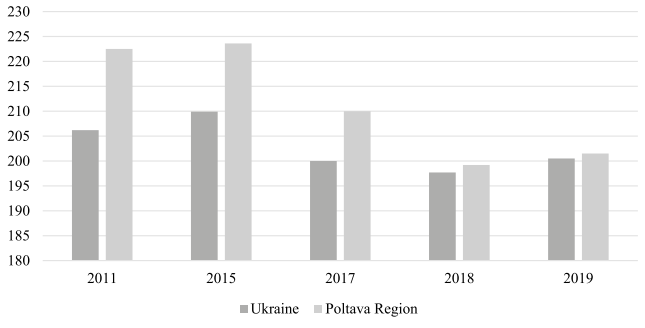
In the early 1990s, rural population kept cows almost exclusively to meet their own needs, as well as partly for the sale of milk and dairy products in farmer's markets. Dairy enterprises did not buy milk from households. Thus, during 1990-1992, processors purchased only 100 thousand tons of milk from households or 0.2% of the total volume of purchases (Keranchuk, 2017). At the same time, against the background of economic and social problems, increasing the number of cows and milk production has become one of the few opportunities for rural households to earn money in the countryside, which has suffered from unemployment. Dairy processing enterprises also implemented certain measures that supported and stimulated the development of dairy production in households. New milk collection points were established in villages, and support was provided to individual intermediaries engaged in independent procurement of raw milk from the population.

During last decade frugal industrial milk production in the Poltava Region puts dairy processors in a place that they have no choice but to procure milk mainly from households. Many processors found a way to enter into cooperation agreements with individual suppliers or with United Territorial Communities in order to increase quality of the raw milk and decrease its seasonality. Dairy processors usually offer long-term contracts with more attractive conditions, along with supplying modern refrigeration systems and milk tanks. It is also common to run some educational programs for households, for example on sanitary rules. However, milk from industrial farms continues to be the most desirable by the processors due to consistent quality. It allows production of high-margin dairy products and cheese (Goncharuk and Gamma, 2013).

Yet dairy products are strategically vital products, which induce high demand on the market. During last years, dairy industry is characterized by productivity increase, changes in consumption culture, quality of sales and others. So that, to correspond to the existing market expectation, milk processors in the conditions of raw materials shortage, use milk of bad quality, or turning to falsifications, replacing animal fats by vegetable ones (Gereles, 2014). Doubtless such situation leads to the quality loss of finished products and actually to the fraud of consumers, and, as the result, to consecutive loss of competitive advantages on the market by the producer. In spite of negative tendencies of decrease of cow livestock and milk production, productivity of milk herd increased and for ten years, average annual milk yield from one cow increased by 68.5%. The basic way to increase milk yield is food supply improvement, its quality and structure of food contentment (Fedulova, 2018).

In 2019, the consumption of milk and dairy products in the Poltava Region was 201.5 kg per person per year. The statistics shows that this consumption on average per person was a bit higher than the average for Ukraine – by 4% (Figure 1).

Figure 1. Consumption of milk and dairy products, per capita in year; kg, 2011-2019



Source: State Statistic Service of Ukraine, 2019

3.2. Current integration processes in dairy industry of Ukraine and Poltava Region

World practice has proved practicability and efficiency of integrated production, its advantages (Szőllősi, 2008; Szűcs and Szőllősi, 2014), such as: higher level of selection and veterinarian assistance, development of mechanization and automation in feeding and milking processes, better product quality control, more advanced forms of product packaging, improving of storage modes and types of transportation (Goncharuk and Gamma, 2013).

The existing researches (Szőllősi, 2008; SZŐLLŐSI, 2009; Goncharuk and Gamma, 2013; Szűcs and Szőllősi, 2014; Keranchuk, 2017; Fedulova, 2018) showed that efficiency of processing enterprises and its economic stability depend on the fixed relations with producers of agricultural production. It will lead to the necessity of improvement of economic mechanisms of regulation of these enterprises' activity (Goncharuk and Gamma, 2013).

Practically, the partnership between agricultural producers and processing enterprises means organic interests' union, focusing on obtaining high final results in their joint activity. In such way both parties are developing cooperation in agricultural production, boosting usage of high-yielding technologies in milk production and processing, deepening specialization, improving technical and technological maintenance of economic structures, optimizing logistics, increasing loading of production facilities at milk processing enterprises along with production volumes of dairy products.

The Ukrainian dairy chain consists of the following key participants: dairy farms, dairy processing enterprises and consumers (retailers, export, and new markets). Based on 2015-2019 years' statistics (State Statistics Committee of Ukraine), it can be shown as an average on the following scheme (Figure 2).

Figure 2. The dairy chain in Ukraine, average of 2015-2019 years

Source: own compilation based on State Statistic Service of Ukraine, 2019

Agro-industrial integration in the proper sense of the word means a certain organizational combination of agricultural and technologically related industrial production in order to obtain final products from agricultural raw materials and achieve greater economic benefits through mutual material interest and responsibility of all participants in agro-industrial production.

To understand the essence of agro-industrial integration and its specific manifestations, it is advisable to consider the peculiarities of the creation and functioning of certain types of agro-industrial formations. Depending on the integration nature, they can be combined into two groups: economic and intersectoral (Table 2).

Business formations are formed as associations, corporations, concerns and other associations of independent enterprises based on Ukrainian law. Economic agro-industrial formations are represented by agro-trade and agro-industrial enterprises and agro-firms.

An agro-trade enterprise is an economic and production structure in which the production of agricultural products and its sale are integrated mainly in fresh form (mainly fruit and vegetable products, potatoes, grapes, milk). It is formed on the basis of a trade network (or simply sales of products). Sometimes such an enterprise carries out primary processing (completion) of products, and, accordingly, has the necessary production infrastructure (elements of wholesale and retail trade, storage, warehouses, refrigerators). The condition for the operation of such an enterprise is the presence of the

Table 2: Directions of agro-industrial integration in Poltava Region and Ukraine

Direction of agro-industrial integration	The nature of agro-industrial formation	Organizational form of agro-industrial formation	Principles of creation of agro-industrial formation
Interfarm	Economic	Farm Agro-trading enterprise Agro-industrial enterprise/group	Economic condition and management capabilities of an agricultural enterprise
Intersectoral and Territorial	Intersectoral	Association Concern Agroholding	The presence of enterprises in various industries and their willingness to join forces

Source: own compilation

actual buyer and the proximity of the location to the markets (Andriichuk, 2013).

An agricultural firm is a relatively new type of agro-industrial formation of a sectoral nature. Initially, agricultural firms were created on the basis of an economically stable agricultural enterprise with the involvement of other enterprises (Andriichuk, 2013). They not only produced products for sale (fresh or processed), but also provided various production services (elite seeds, transport services, scientific and practical advice, etc.). The obligatory organizational unit of agricultural firms later became the market infrastructure, the marketing department.

An agro-industrial enterprise/group is a production type of agro-industrial integration, which is characterized by the presence in the structure of production of a separate enterprise of the agrarian, processing and trade link of a certain product direction (by the nature of the final product). An agro-industrial enterprise is a unity of agro-industrial production on the basis of industrial methods (Andriichuk, 2013). As a rule, such enterprises should have a well-developed specialized branch of agriculture, modern industrial processing of raw materials and their own wholesale and retail trade. Such enterprises usually produce products that can be stored for a long time and transported over long distances (juices, wines, canned fruits, vegetables and meat).

In our paper we would like to present such successful agro-idustrial group, located in Poltava Region, – Bilotserkivka Agroindustrial Group (BIAGR). Bilotserkivka Agroindustrial Group was founded in 1980. Today, it is modern agroindustrial complex of a closed cycle. The company controls quality of products at each stage of manufacturing process. All production facilities are located in Poltava Region.

3.3 Integrated dairy company case – Bilotserkivka Agroindustrial Group (BIAGR)

The specialisation of BIAGR was and is the production of butter and spreads, casein (skimmed milk powder), soft and pasty cheeses, cottage cheese. Company's mission is to provide people with high-quality food products, so everybody can enjoy tasty and healthy food. Company's principles: decency, honesty, responsibility.

The company was founded in 1960 as a production site of Myrhorod cheese factory. Since 1964 it has been a production site of the Reshetyliv Butter Plant. From 1968 to 1975 the plant was on its own balance. From 1975 to 1992 the enterprise was subordinated to the Myrhorod cheese factory. From 1992 to June 2008, the company operated as "Bila Tserkva Dairy Plant". In July 2008, the company was reorganized into a private enterprise "Bila Tserkva Agro-Industrial Group".

Currently BIAGR belongs to Bila Tserkva United Territorial Community (UTC – a.k.a. County). It is one of the first 152 communities in the country, hence Poltava Region. It was formed in 2015 (due to national administrative and territorial reform of Ukraine 2015-2020), uniting 18 villages from Bila Tserkva, Podil, Birkiv and Balakliiv village councils. The company has a strong interest in adequate rural infrastructures, which provides sufficiently attractive living conditions for employees and their families. Most of the employees are residents of the Bila Tserkva community. BIAGR is a budget-forming enterprise of Bila Tserkva UTC, as 77% of the community budget is formed from taxes on the company's commercial activities.

In 2003, founder of the company decided to establish "Bilagro LLC" – own agricultural enterprise engaged in the cultivation of grain, industrial crops and dairy farming. In 2010 a new administrative building was built. The construction of a high-quality European-style dairy farm for 2.5 thousand heads has been completed, that largely solved the problem of providing the company with raw milk. Also, in July 2011 a brand-new department for the soft and pasted cheese production was constructed and the production has begun. Currently, the company employs 577 people. The company's specialists managed to successfully solve the main task – to preserve the production technology traditional butter and create a new quality product with high nutrition properties, while maintaining an average market prices and stable quality. There is a branded store located near the factory, where all dairy products are sold on a daily basis. To ensure the continuous production the company has its own boiler room, heat generator, transformer substations, and compressors.

The product quality and safety management system are based on international standard FSSC 22000. The closed cycle of dairy production (Figure 3) begins with the choice of dairy products suppliers, besides their own dairy farm, which supplies high-quality milk in the amount of 20 tons per day. The company collects milk in surrounding households that sell milk to BIAGR at a single fixed price per litre, regardless of its quantity, and 27 small businesses and family farms with which BIAGR has concluded contracts for the milk supply for a year (classic contracts are used). The contract has 11 sections, which specify the name, quantity, quality, price, terms, total amount of the contract, order and terms of delivery, requirements for packaging, payment's order, obligations of the contractor to assist the producer in organizing the milk production, mutual property liability of the parties for breach of contract on other terms that the parties determine as necessary in the contract. At the same time the company uses its own vehicles to collect and deliver milk from surrounding households.

The company performs a thorough audit of suppliers' farms on the daily diet of cows. There is an optimised cows' diet developed by BIGAR's specialist and distributed to households and farmers. BIAGR's specialists pay particular attention to whether meadow herbs, legumen and cereal crops are included in the daily diet of cows, as well as to the presence of conditions for storing such feed. All milk suppliers are located in Poltava region, where the state of the environment remains relatively stable and is acceptable enough compared with the majority of other regions of Ukraine. Moreover, especially important that farms which supply milk to Bilotserkivka Agroindustrial Group are located near the production facilities; so, every day there is

only fresh milk used for the processing factory. Specialists of company's laboratory perform a monthly audit on all sanitary and hygienic norms there and check if cows are taken good care of. After all, both the quality of milk and the quality of manufactured dairy products depend on their well-being. Before being processed, the milk is triple tested. The production capacity of the company is 300 tons of milk per day. Dairy products of BIAGR are made on the modern European equipment of the leading companies from Germany, Sweden, Switzerland.

Figure 3. Scheme of a closed production cycle in BIAGR

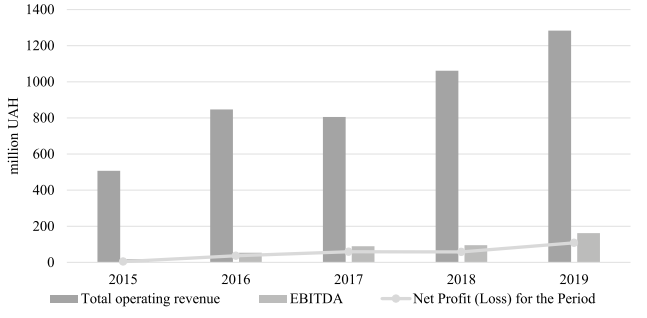
Source: BIAGR's annual reports and marketing materials

So, it meets all the criteria of a European company with highly developed equipment. For example, the high-fat cream separator from the Swedish company Tetra Pak, which was purchased in 2020, is the latest experimental model, so far, the only one in the world. In order for the separator to work, it was not enough to just buy it and deliver it to Ukraine: mechanics had to install new production lines, then test new equipment. For several months, engineers from a Swedish manufacturer worked side by side with the specialists of BIAGR.

BIAGR developed their own educational improvement program, which involves some selection of students, their preparation and adaptation to employment at the company in cooperation with the Poltava State Agrarian Academy. BIAGR's representatives took part in developing updated educational plans and became invited lecturers at some academic courses. Moreover, the company offers internship positions to bachelor and master students of the university in several professional fields on an annual basis.

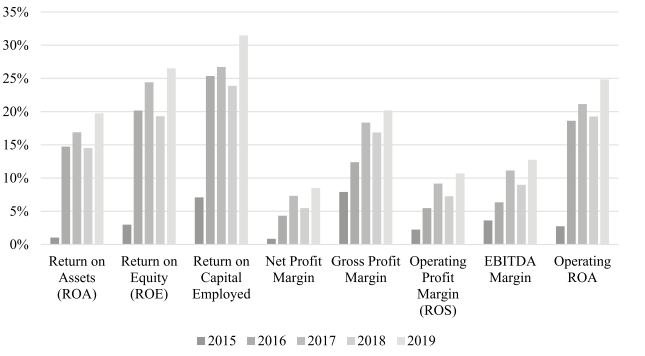
Analysing business activity of BIAGR and its financial situation during 2015-2019, it is shown positive changes (Figure 4-5). Thus, there was a significant increase in EBITDA by 875%, while total operating revenue increased in 2.5 times and net profit reached 108 million UAH (250% of 2015 value).

Figure 4. Financial performance of BIAGR, 2015-2019



Source: EMIS database, Financial statements of BIAGR, 2019

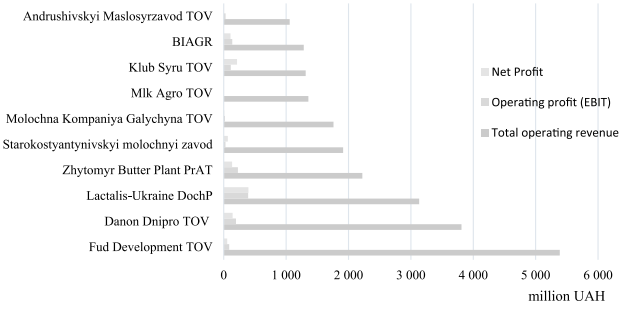
Figure 5. Efficiency indicators of BIAGR, 2015-2019



Source: EMIS database, Financial statements of BIAGR, 2019

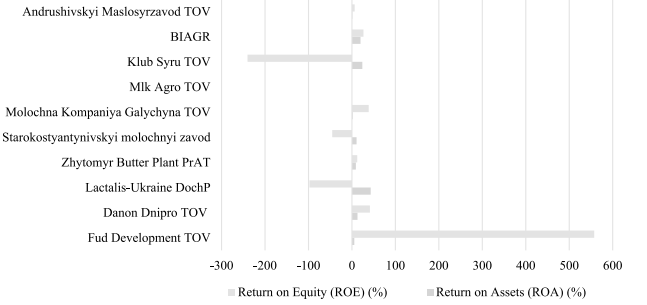
During the studied period of 2015-2019 BIARG enters ten leading dairy products manufactures within Ukrainian industry of Dairy Product (except Frozen) Manufacturing, which includes 75 companies of different sizes and ownership types. Particularly in 2019 the company occupies the 9th place based on total operating revenue (Figure 6) with 1283 million UAH, compare to the absolute leader in this industry – Food Development LLC. with 5386 million UAH. As it is shown on a Figure 7, BIARG's profitability (ROA) scores the 3rd place within the mentioned top 10 dairy products manufactures within Ukrainian industry. Overall, the ROE develops differently within those ten companies during the studied period, however, BIARG has a distinct positive ROE.

Figure 6. Top ten companies within Ukrainian Dairy Product (except Frozen) Manufacturing, 2019



Source: EMIS database, 2019

Figure 7. Profitability of Top ten companies within Ukrainian Dairy Product (except Frozen) Manufacturing, 2019



Source: EMIS database, 2019

BIAGR's products are represented in all national retail networks in Ukraine. Today, the products of the company, produced under the brand "BILOTSERKIVSKE", are in demand in both domestic and international markets. 80% of the products are sold in Ukraine, the rest is exported to more than 70 countries. Brand "BILOTSERKIVSKE" is especially popular in the Middle East and China.

Despite its strong position on Ukrainian market, management of the company BIAGR seeks to expand the sales geography. Recently it has received a 7 million EUR grant from the European Bank for Reconstruction and Development (EBRD) to modernize production to the EU standards. This will help with obtaining a permit to sell products in the European Union, first of all to the Baltic countries. In addition, such modernization involves an increase in job positions and positively influencing employment rate of Bila Tserkva UTC.

In 2020 the company is among the top three in the production of cottage cheese in Ukraine. However, to remain a leader, company's management tries the employees to get new skills and experience. In 2019, the delegation of BIAGR studied the experience of European partners in the production of cottage, its packaging, as well as processing of sour whey into dry mineralized one. In Ukraine, whey is considered almost a production waste, nowadays the company uses it to fatten cows and pigs. But in Europe it is a very valuable ingredient for making baby food. At the same time, the requirements for such products are very high and it is quite difficult production. Recently, membrane technologies have been successfully used, in particular electrodialysis, during which minerals are separated from the serum itself and nanofiltration for concentration. Company's technologists are exploring them. Hence, the plan of BIAGR to expand the product range in the future.

Due to BIAGR's top management opinion, the reputation plays an important role in business, especially if this business is directly related to the products that people buy every day. Consumers will soon stop buying low-quality goods. So, the slogan: "Honesty, decency, responsibility", which the company proclaimed, forces the whole team to constantly adhere to high standards.

4. CONCLUSIONS

As a result of the study, we identified the following main features of the dairy industry of Poltava region, Ukraine:

– During last years, Ukrainian dairy industry and as a consequences Poltava Region are characterized by productivity increase, changes in consumption culture, quality of sales and others.

– Lack of high-quality raw milk; milk producers are mainly represented by households, small and medium farms who are unable to produce raw milk in sufficient quantity and appropriate level of quality, which adversely effects on the competitiveness of domestic dairy products.

– During last decade frugal industrial milk production in the Poltava Region puts dairy processors in a place that they have no choice but to procure milk mainly from households. Many processors found a way to enter into cooperation agreements with individual suppliers or with United Territorial Communities in order to increase quality of the raw milk and decrease its seasonality. Dairy processors usually offer long-term contracts with more attractive conditions, along with supplying modern refrigeration systems and milk tanks. It is also common to run some educational programs for households, for example on sanitary rules.

– However, milk from industrial farms continues to be the most desirable by the processors due to consistent quality. It allows production of high-margin dairy products and cheese.

Using successful example of vertical integration in dairy industry, such as a represented case study from Poltava Region – BIAGR – can be used to solve those problems. During the studied period of 2015-2019 BIARG enters ten leading dairy products manufactures within Ukrainian industry of Dairy Product (except Frozen) Manufacturing, which includes 75 companies of different sizes and ownership types. BIAGR as an agro-industrial group functions in a form of integrated venture, which organizational form implies the integrating relationship of agriculture milk producers, dairy companies and resellers.

Thus, a vertical integration will allow overcoming of hostility of interests between agricultural and processing enterprises on mutually favourable conditions, and that the determined priorities should be presented to the agricultural producers through its leading role in the cycle of food production.

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SCIENTIFIC PAPER

CONSUMERS' AWARENESS, PERCEPTION AND INTEREST IN LABELLING OF PROCESSED FOODS IN GHANA: A CASE OF *'SOBOLO'*

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Abstract: *Food labels contain much information that helps consumers to make decisions based on the details which are of much importance to them. The study assessed awareness, perception and factors that influence consumers' interest in labelling of sobolo in the Kumasi Metropolis of Ashanti region, Ghana. Systematic random sampling was used to select 300 respondents from five randomly selected sub-metros and data were collected using a semi structured questionnaire. Descriptive statistics such as frequencies, tables and percentages were used to summarize the socio-economic characteristics of respondents. Perception index was used to assess the perception statements on the product labelling and the Logistic Regression Model was used to analyze the factors that significantly influence consumers' interest in labelling of sobolo. Results of the study showed that majority (97.3%) of respondents were not aware of labelled sobolo but 67% was interested, though with low awareness. The estimated perception index (2.8) showed that consumers had positive perception about labelling of sobolo. Among the socio-economic characteristics; age, education, household income and household size and respondents' perception on health and safety aspects of sobolo were found to significantly influence interest in labelling of sobolo. In conclusion, the study found that, consumers would prefer different information on labels and thus their interests are significantly influenced by different factors. It is recommended that efforts should be made to promote the awareness, education and interest in labelling of food products to enhance production, consumption and sustainability of the food industry.*

Keywords: *Food labelling, Sobolo, Awareness, Perception, Ghana*
JEL Code: Q13

INTRODUCTION

Globally, food safety has become a major issue of public concern due to outbreak of diseases in food consumption which has reduced consumers' confidence in consumption foods away-from-home, for which Ghana is not an exception. Thus, there is the need to reassure public faith in food and food-related information as it has important consequences on both consumers' welfare and the overall effectiveness and efficiency of the food supply chain (Beecham, 2000). Consumers are developing more interested in the inherent characteristics of food as their demand increases but they keep basing their choices on traditional food purchase drivers such as price, freshness and wholesomeness; nevertheless they are increasingly demanding information about aspects related to health and safety, environment, conservation, animal welfare and social responsibility (Arthur, 2005).

Food labelling is the display of information about a product on its container, packaging or the product itself. Food label has now become a popular policy tool (Héroux, 1988) and marketers as well as manufacturers spend considerable time and substantial amount of money on packaging products in a manner that will attract consumer attention and enhance the product consumption. Labelling a product offers the opportunity to protect the product, promote the product and to provide additional value and differentiation. Firms now spend more money and time on packaging more than advertisement because packaging is mostly the utmost distinguishing and unique marketing element (Dickson, 1994). For several types of consumers and industrial products, the type and extent of information that must be imparted by a label is governed by the relevant safety and shipping laws. Although labelling is becoming more popular in Ghana, the concept of labeling is still found unfamiliar to many Ghanaian consumers. The demand for food safety information has been considered important in human nutrition because some food items are adulterated and have harmful consequences to human health (Akgungor et al., 1997), and by implication, labelling as part of marketing function, helps to inform consumers on the quality and

create consumer perception for consumption or otherwise of a product. Food labels help consumers to make safer choice when making a purchasing decision for a product and reducing risk of diseases and other health-related problems. According to Caswell and Padberg (1992), food labels are the possible answers to the imperfect information dilemma in food safety.

Different consumer characteristics may also have some effect on their willingness to pay for quality labelled food product and thus provides the opportunity for studying the importance of food labelling from consumers perceptive. Additionally, sometimes due to ineffectiveness of governing agencies ensuring the quality and right information to enforce, consumers may be confused in the kind of labels and the information to trust in (Osei Mensah et al., 2012). Over the years, interest in issues of health and environment has eloped among consumers and their impacts have increased consumers perception, awareness and their everyday consumption choices worldwide. Food labels among the different sources of information available to consumers support them in making choices connected to their preferences such as the ingredients in a food product, how it is processed, nutritional content, its storage and expiration duration (Banterle et al., 2013). Kwakwa (2013), also stated that knowing what consumers want, what they want to buy, prepare and consume food, what features are important to them and what characteristics they are willing to pay for, can provide valuable insights into meeting consumer expectations and growing a food business.

In Ghana, food labeling misinformation and recent food borne diseases has led to 420,000 per year out-patient cases with an annual death rate estimated at 65,000 costing a total of 69 million US dollars to the economy (Ghana News Agency, 2010). On the other hand, consumers' growing interest in food related information and their perceptions of food labels are of low familiarity in developing countries, including Ghana. There is however limited information on consumers' awareness and use of labels on pre-packaged foods (Aryee, 2013) and this may be due to the lack of interest or lack of knowledge of the benefits of such information. Per the ideology of people, they may not even have the urge to read labels to 'fish out' the information they need to know. In trying to understand consumers' information needs, the management of information provision emerges as a particular challenge for at least two reasons: first, because there are so many potential attributes to provide information about, and second, because consumers are not all alike (Golan et al., 2001). Moreover, which kind of information that consumers may be willing to have on these labels to help them make optimal decisions is a concern mostly to suppliers whilst an excess of claims on food packaging can lead to a situation overloading consumers with information (Wansink et al., 2006). This overloading may present a source of noise for consumers, and it may prevent them from making optimal decisions (Banterle et al., 2013). Considering time as a factor, people may be unwilling to waste time reading food labels, though the most important element of interest might be to spend time to read the expiration of food products. Time-related issues may also serve as a deterrent to consumers in steadily reading all information available on food product labels (Nayga, 2000; Drichoutis et al., 2005). It is therefore important for suppliers to know the important information needs of consumers and their willingness to read them.

In Ghana, most local food products, particular local drinks are not labelled. One of such popular food drinks is *sobolo*, a locally produced drink made out of the flowers of the Roselle plant, a variety of Hibiscus with a little addition of ginger and sweeteners. The production and the sale of *sobolo* has served as a major source of income to a lot of people, especially during the Covid-19 crisis where there was an increase in its demand. According to Yeboah-Awudzi (2016), *sobolo* has a lot of nutritional and health benefits, and it is made up of nutrients like, protein, carbohydrate, calcium, Iron, antioxidants and many more. It was further stated that *sobolo* helps to regulate blood sugar levels, lowers cholesterol levels in the body, eases digestion and due to the antioxidants, helps to cure flu/cold.

In this with the foregoing, this study seeks to examine consumers' awareness and perception as well as the factors influencing their interest in the labelling of *sobolo* in the Kumasi Metropolis of the Ashanti region of Ghana. This will provide relevant information to producers of food products and other relevant stakeholders on food-related information that is relevant and of interest to consumers to help better strategize for production and consumption of food products for the sustainability of the food industry.

METHODOLOGY

Study Area

The study was conducted in the Kumasi Metropolis of the Ashanti Region of Ghana. The Ghana2010 population and housing census puts the population of the Metropolis at 1,730,249, representing 36.2 percent of the total Ashanti regional population (4,780,380) which makes it one of the most populous and rapidly growing Metropolis in Ghana. The Metropolis is divided into nine sub-metros: Kwadaso, Nhyiaeso, Subin, Asokwa, Oforikrom, Manhyia, Old Tafo, Suame and Bantama (Ghana Statistical Service, 2012). The Metropolis shares boundaries with Kwabre East and Afigya Kwabre Districts to the north, Atwima Kwanwoma and Atwima Nwabiagya Districts to the west, Asokore Mampong and Ejisu-Juaben Municipality to the east and Bosomtwe District to the south.

Kumasi was selected as the study area because it is completely urbanized and cosmopolite. The location has a mutually beneficial relationship between its neighbours all over the country and beyond. The area is conducive for food production and thus ensures food security, provides market for diverse products to all consumers and also create avenue for entrepreneurship and job opportunities. This partly explains why Kumasi has become a converging point for brisk commercial activities. In addition to this, the

Metropolis provides services at various levels in the fields of healthcare, education, inter-city transport, financial services and wholesale and retail trade among others, to residents from the adjoining districts and beyond.

Study Population, Sampling Procedure and Data Collection

The target population of the study was all consumers in Kumasi. Respondents were selected using multistage sampling technique. The Kumasi Metropolis was purposively selected out of the 30 metropolises in Ashanti Region. Kumasi was selected because it is completely urbanized and cosmopolite. At the second stage, five sub-metros out of the nine were selected at random, namely; Bantama, Oforikrom, Subin, Asokwa and Suame. Two suburbs were again selected from each of the five-sub metros by random sampling summing up to ten suburbs. Using the systematic random sampling methods, 300 respondents were interviewed with 30 from each of the 10 suburbs, namely: Bantama, Bohyen, Dakodwom, Adum, Oforikrom, Asafo, Ahodwo, Maakro, Suame and Ayeduase.

Data for the study were collected from both primary and secondary sources. Primary data on the socioeconomic status of the respondents, their perception and concern about labelling were collected by face-to-face interviews with structured questionnaire. The survey questionnaire comprised of both close and open-ended questions facilitated communication and easy data collection from the respondents.

Conceptual Framework

The basic assumption of random utility theory (RUT) is based on the premise that individuals act rationally, selecting the alternative that yields then highest utility. Consequently, the probability of selecting a given alternative will be higher if the utility provided by such alternative is the highest among the different choices. Choices made between alternatives will be a function of the probability that the utility associated with a particular option is higher than those for other alternatives (Hensher et al., 2005). According to RUT, utility of a choice is comprised of a deterministic component and error component, which is independent of the deterministic part and follows a predetermined distribution. This error component implies that prediction cannot be made with certainty. Uij=Ui (Xij), where Xij is the vector of attributes relative to alternative j and to the decision maker. It is acknowledged that consumers may take decisions that do not maximize their utility. According to Tiffin et al., 2006, this behavior may result from errors in perception resulting from lack of information on product attributes or discounting inability or market failures such as price structure that do not reveal the real cost of the production to the society or limitation in the set of products available to the customer.

Data Analysis

Descriptive Statistics such as frequency tables, percentages and means were used to analyze the socioeconomic characteristics of the consumers. In analyzing the Perception of consumer about labelling of *sobolo*, the five-point likert scale (Strongly Agree (1), Agree (2), Neutral (3), Disagree (4) and Strongly Disagree (5)) with attributes which were categorized into three (3) main perception statements, that is, the product, the benefit and the price was used. The perception formula is given as;

$$\frac{\{(fx1 * 1) + (fx2 * 2) + (fx3 * 3) + (fx4 * 4) + (fx5 * 5)\}}{X}$$

Where $fx1$ to $fx5$ represents the respondents for each category and X is the total number of respondents.

$$\frac{m1 + m2 + m3}{M}$$

Whereby m1 to m3 represents the three perception statements and M is the number of perception statements.

Empirical Model Specifications and Measurements

The Logit Regression Model was also used to analyze the factors that influence consumers' interest in labelling of *sobolo*. The log it is estimated using maximum likelihood estimation as it results in large-sample properties of consistency and asymptotic normality of the parameter estimates. The dependent variable is a binary choice, thus, having interest and non-interest in labelling whilst the independent variables include the various socioeconomic and perception factors. The logit regression model is specified as;

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \ldots\ldots\ldots \beta nXn + ui$$

Table 1. Description of variables and a-priori expectations

Variables	Variable Meaning	Description and Type of Measure	Expected Signs
Dependent Variable			
ConsInlabelling	Consumers Interest in labeling	Yes= 1,No=0	
Independent Variable			
Gender	Gender of consumers	Female=1, Male=0	+ /-
Age	Age of consumers	Years	+
MSta	Marital status	Married=1 Otherwise=0	- /+
Emp_S	Employment status	Employed=1 Otherwise=0	+
Edu	Educational status	Educated=1 Otherwise=0	+
Hd_size	Household size	Number	-
Hd_income	Household Income	Cedis	+
Health	Perception of health	Yes=1, No=0	+
Safety	Perception of safety	Yes=1, No=0	+
Nutri	Perception of nutrition	Yes=1, No=0	+

Where Y is the dependent variable, representing consumers' interest in labelling of *sobolo*, β stands for estimated factors explaining the participatory variables respectively, Xi is a vector of respondents' characteristics relevant in explaining their demand for and willingness to pay for a product with a label while ui represents the error term.

RESULTS AND DISCUSSION

Consumers' Awareness of Food Labels

All the respondents in this study area were aware of general food labels as it can be seen from Table 1. This was because a large percentage of the participants in this study were highly educated; they had basic education and beyond. Loureiro et al. (2006) explained that highly educated consumers are more likely to read scientific and academic articles and are more likely to be exposed to health and nutrition-related news sources and thus increasing their awareness of diet and health issues. Similarly, a number of studies observed that a greater part of their participants was aware of food labels and also observed that a greater proportion of their participants had high education (Washi, 2012). For instance, Schupp et al. (1998) found that majority of their study participants (52.2%) were aware of nutrition labels and most of them had higher education. Washi (2012) also observed that a large number of participants (89.5%) showed a general awareness for food label information including nutrition label information and 69.5% of their study participants were university graduates.

Table 2: Awareness and Interest in Labelling of Sobolo

		Frequency (300)	Percentage (100%)
Awareness of labelling	Yes	300	100
Interest in labelling	Yes	237	79
	No	63	21
Seen labelled '*sobolo*'	Yes	8	2.7
	No	292	97.3
Interest in labelling of '*sobolo*'	Yes	207	69
	No	93	31

Source: Field Survey, 2016

Moreover, a majority (79%) of the respondents were more interested in the labelling of food products, thus implying that labelled products help consumers to make the right decisions when purchasing food products and as a result prevents them from buying food products that can be harmful to their health. Also, food labels provide information about a product, and such information, among others, usually include amount of calories, sugars, carbohydrates, vitamin content which offer valuable information for maintaining a healthy lifestyle. Washi (2012) further reported that consumers were probably more concerned about the risks involved in consuming expired food products.

From Table 2, the study found few (2.7%) of the respondents had ever seen labelled *sobolo*. This is because, most of the respondents interviewed in our study said that it is difficult to see a labelled *sobolo* drink on the market. However, majority (69%) of the respondents were interested in the labelling of *sobolo*. The respondents were very much concerned about labelling and preferred a labelled product, since it will provide the necessary information like the nutrition content, expiration date, location and among others on the product. They mentioned that it could help them to make the right purchasing decisions and also be more conscious about their health. The remaining 31% that were not interested in the labelling of *sobolo* due to the following reasons; they stated that most information on labels in general are misleading and not true, some also said they hardly read labels whilst others purported that it was costly and such cost would be transferred to the consumers.

Components that Consumers would prefer on Labels

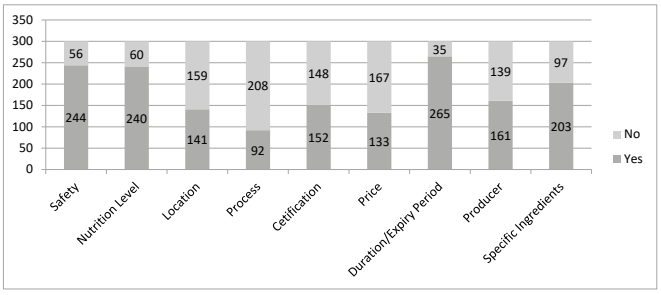
From Figure 1, the components on labels that consumers would mostly preferred were identified as Duration/expiry period (88.3%), Safety of the product (81.3%), Nutritional level (80.0%) and Specific ingredients in the product (66.7%). However, the respondents were less concerned about the process of production of the product (30.7%). This confirms the study of Grunert (2005) that, safety is an integral part of quality attribute which determines purchase intentions and choice among consumers. The study observed that consumers have varied preferences in the components of food label information and majority of respondents would prefer information on duration, Safety, Nutrition and Ingredients. Similar to Washi (2012), consumers are more interested in duration that is expiration date followed by production date, because of the risk associated with expired food consumption.

Moreover, a study by Jacob et al. (2010), also observed that the most important label information used by consumers are expiration date followed by list of ingredients and then nutrition, and in terms of duration, consumers prioritize their search for longest life span product and expiration date. A further study by Grunert (2005), also confirms safety as an integral part of quality attribute which determines purchase intentions and choice among consumers. Duration as basic interest of label information may be concluded that, all things being equal, if consumers get satisfied with product duration, then safety, nutrition and other label information may satisfy them too. This is similar to a study by Aryee (2013), which posited that participants are less concerned about nutritional content of prepackaged foods however, they purchase once they are satisfied with the expiry date.

Consumers Perception on Labelled *Sobolo*

Perception Index was computed to understand the overview of consumers' perception regarding the attributes of labelled *sobolo*. From Table 3, an index of 2.2 indicated that most of the consumers were interested in the labeling of *sobolo*. With a mean index of 2.2 consumers interviewed,

Figure 1: Components consumers would prefer on sobolo labels



agree that labeling has an effect on purchasing. From the study consumers agreed (1.8) that there is easy access to *sobolo*. The positive perception about this statement is because of the nearness of production or sales point to consumers. Likewise French et al., found low-fat labelling in vending machines to influence sales only when the labelling was provided in tandem with an educational poster. These results suggest that modest promotional efforts may prompt consumers to give nutritional information greater consideration in the food selection process.

Most of the consumers agreed (2.1) that labeled *sobolo* has a health benefit. The positive perception can be attributed to the fact that *sobolo* has its raw material mostly been herbs relative to other drinks. The natural herbs for making *sobolo* is not harmful to the body and therefore consumers are now avoiding the consumption of the other drinks which most of the time are made from synthetic raw materials. Consumers are now conscious of their health due to the negative effect of synthetic raw consumption to the body.

On the other hand, an index of 2.0 showed that consumers agree that labeling can improve the safety with respect to the use of *sobolo*, also agree (2.3) that *sobolo* possess a quality they need. Moreover, consumers agreed (2.5) that labeling can reduce any side effect when used. The mean perception index for benefit statement was 2.34 which implies that consumers have a positive perception towards the benefit statements related to labeled *sobolo*. Again, the mean perception for benefit is greater than that of the product perception indicating that consumers have more positive perception on benefit aspects of labeled *sobolo* than its product aspect. Hence, safety is to be considered as an integral part of quality, and it contributes to determining purchase intentions and choice (Grunert, 2005). Consumers seem to want information to help them achieve a balanced diet, to avoid certain ingredients that have proved not to agree with them, or to know the origin and environmental, ethical and technological conditions under which the food was produced. Among the motivations for demanding all this information, safety concerns was prominent.

Again, an index of 3.4 indicated that consumers disagree that labeled *sobolo* is expensive to buy. People are now concern about the price to which they exchange for value. The contentment of consumers in Ghana with the standard or quality of packaging of most food and beverage products made-in Ghana could therefore be interpreted as an expression of a Ghanaian cultural instinct or tendency towards food and beverage packaging. The stranglehold of plastic sachets and bottles on the Ghanaian market is attributable to the affordability of the ultimate prepackaged product to consumer whiles being less costly and more convenient to the producer as compared to other packaging technologies or designs. The mean perception index of 3.85 for price statements shows that consumers generally have a negative perception towards the price statement on labeled *sobolo*. Surprisingly, under the price perception index, labelled *sobolo* was found to be a normal good rather than being a Giffen or ostentatious goods. The study also

Table 3: Perception Index

PRODUCT STATEMENT	**Strongly Agree (1)**	**Agree (2)**	**Neutral (3)**	**Disagree (4)**	**Strongly Disagree (5)**	**Mean**
Consumers interested labelled sobolo	120(40)	80(26.7)	38(12.7)	45(15.0)	17(5.7)	2.2
Labelling has an effect on purchasing	82(29.7)	131 (43)	36(12.0)	43(14.3)	8 (2.7)	2.2
There is easy access to sobolo	112(37.3)	153(51.0)	14(4.7)	18(6.0)	3(1.0)	1.8
Concern about labelling and age	59(19.7)	85(28.3)	91(30.3)	45(15.0)	20(6.7)	2.6
Product Perception Index						**2.2**
BENEFIT STATEMENT						
Labelling of sobolo has a health benefit	89(29.7)	137(45.7)	33(11.0)	30(10.0)	11(3.7)	2.1
Labelled sobolo can improve the safety	93(31.0)	140(46.7)	35(11.7)	26(8.7)	6(2.0)	2.0
Sobolo possess a quality I need	51(7.0)	134(44.7)	84(28.0)	25(8.3)	6(2.0)	2.3
Labelling can reduce any side effects	48(16.0)	48(16.0)	52(17.3)	57(19.0)	10(3.0)	2.5
Export opportunity with sobolo	63(21.0)	65(21.7)	93(31.0)	41(13.7)	38(12.7)	2.8
Benefit Perception Index						**2.34**
PRICE STATEMENT						
Labelled sobolo is expensive to buy	9(3.0)	82(28.3)	51(17.0)	99(33.0)	59(19.7)	3.4
Labelled sobolo is normally patronized by high income earners	10(3.3)	12(4.0)	22(7.3)	85(28.3)	171(57.0)	4.3
Price Perception Index						**3.85**
OVERALL MEAN PERCEPTION INDEX						**2.8**

Figures in brackets are percentage Source: Field survey, 2016

posits that although consumers are highly confident with labeled *sobolo*, their preventive behaviour of reading labels guarantee them a purchase of safer products when paying a higher price.

Descriptive Statistics for the Empirical Model

This section compares the mean differences of interested and non-interested consumers, which is shown of labelling *sobolo* used in the empirical model. There were notable differences observed between interested and non-interested consumers of food labels (Table 4). In comparing means of interested and non-interested consumers of the various variables, for gender, household size and household income, interested consumers had higher means than non-interested consumers, though not significant. This can be explained that, more consumers attest that gender, household size and household income can influence their interest in labelling of *sobolo* which may be the opposite for non-interested consumers. However, factors of non-interested consumers such as age, marital status and employment status, had higher mean than interested consumers, though not statistically significant as well. Educational level, the perceptions of safety, nutrition and health were the significant (at 1%) differing factors between interested and non-interested respondents.

The significant differences can be explained that most consumers attest to the fact that one's educational background, safety and the need to live a healthy food product free from food borne diseases are major factors that can influence their interest in labelling of *sobolo*.

Table 4: Descriptive statistics associated with the empirical model

Variables	Interest	No Interest	Mean Differences	Sig.
	Mean	Mean		
Gender	0.5411	0.4731	0.06245	0.679
Age	33.3816	38.8602	-5.47857	0.12
Marital status	0.4251	0.4731	-0.04800	0.219
Occupation	0.7440	0.7957	-0.05174	0.45
Education	2.9903	2.4409	0.54948	0.000***
Household size	2.2222	2.1505	0.07168	0.129
Household Income	906.3768	824.3548	82.02197	0.397
Perception on health	0.8501	0.5376	0.31261	0.000***
Perception on safety	0.8696	0.5699	0.29967	0.000***
Perception on nutrition	0.6473	0.5484	0.9896	0.010***

*Significant at 1%=***, 5%=**, and 10%=**

Source: Field Survey, 2016

Factors that Affect Consumers' Interest in Labelling of *Sobolo*

Number of observations used for identifying the factors that affect consumers' interest in labelling of *sobolo* were 300 and A Pseudo R2 of 0.1786 shows that the independent variables accounts for 17.86% of the variance in the dependent variable with a Wald chi2 (10) of 50.16 Earlier studies have found age, gender, income, awareness, health and safety knowledge and educational background as factors that affect consumers' interest in labelling (Grunert, 2006; Guthrie et al., 1995); Aryee, 2013). It can be seen from Table 5 that age, the perception of health and safety have significant effect on interest in labelling of *sobolo* at 1% followed by educational status and household income at 5% and household size at 10%. Age variable had a negative coefficient but was statistically significant at 1%. This explains that younger consumers are more interested in the labelling which implies that as one grows older, the lesser their interest in labelled *sobolo*. This empirical observation from this study also agrees with Reid et al., (1996); Loureiro et al., (2006), who observed negative relation with age and interest in labelling and further found that that younger adults were more likely to use labels than older individuals due to their low understanding and low concern about labelling. Similar to Gould and Lin (1994), they also concluded that the younger generation may be interested in labels due to exposure to improved technology and available health information which encourage them to use label information. This finding however disagreed with Aryee (2013), Drichoutis et al., (2005) and Lin and Lee (2003) who concluded that old individuals use labels information more because of health constraints and restricted diets.

Household size had a positive coefficient and statistically significant at 10%. This means that household affects interest in labelling of '*sobolo*' and thus the higher a consumers' household size the higher their interest in the labelling from the study. Though other studies such as Berning et al. (2009) and Govindasamy and Italia (1999) disagree that larger households show less interest in labelling may be because they have heavy burden expenditures for their needs, thus may concentrate on price for economic reasons and grow tired of labels. In contrast, this result supports the findings by Guthrie et al., (1995); Nayga, (1996); Schupp et al., (1998); and Wiles et al., (2009) which observed larger households of four or more as likely to use labels in food purchases compared to smaller households of one or two people and individuals who live alone. They further argue that larger households spend extra time and effort searching for labelled information because it has an influence not on their dietary intake alone but that of other household members as well.

Households' income had a positive coefficient and statistically significant at 5%. This shows that higher income households are more interested in the use of label information than low household income earners. This is explained by Loureiro et al. (2006); Drichoutis et al. (2005) and Nayga (1996) in their studies as that higher income earners may be more responsible for their health which may be mainly due to high educational status and thus lower income earners are sensitive to price and for economic reasons would be more concerned about cost of the goods purchased than the quality and its nutritional benefits unlike a study Schupp et al. (1998) which disagrees with this observation.

Education had a positive coefficient and statistically significant at 5%. Thus, this indicates that, all things being equal, consumers with higher educational background are more interested in labelling. Education is observed in several

Table 5: Determinants of consumers' interest in labelling of sobolo

Variables	Coefficient	Standard error	Z-values	dy/dx	P-value
Gender	**0.2408**	0.2849	0.85	**0.0401**	0.398
Age	**-0.0365*****	0.0130	-2.81	**-0.0060**	0.005
Household size	**0.3022***	0.1831	1.65	**0.0503**	0.099
Household income	**0.0005****	0.0002	2.04	**0.0007**	0.042
Marital Status	**-0.1061**	0.3431	-0.31	**-0.0176**	0.757
Education	**1.3005****	0.6226	2.09	**0.2167**	0.037
Employment Status	**0.0998**	0.4052	0.25	**0.0166**	0.805
Perception of health	**1.2322*****	0.3833	3.40	**0.2061**	0.001
Perception of safety	**1.0264*****	0.3833	2.68	**0.01710**	0.007
Perception of nutrition	**0.1256**	0.3032	0.41	**0.029**	0.679
Constant	-2.0320	0.9270	-2.19		0.028
Wald chi2(10), 50.16; Prob > chi2, 0.0000; Pseudo R2, 0.1786; Number of obs, 300					

*Significant at : 1%=***, 5%=**, and 10%=**

Source: Field survey, 2016

studies as an important significant factor amongst the lots that affects interest in labelling. From this study, this observation may be due to the positive increase in consumers' knowledge, ideas and will-power which is transferred to and evident in their life experiences. Thus, in relation to this study consumers with higher educational status may probably be more interested in labelled food products because of their intense capability to read and understand labelling information than those with lesser education as observed by Govindasamy and Italia (1999); Kumar and Pandit (2008) and Nayga et al. (1996). Likewise, Schupp et al. (1998) posited that respondents with higher education were more aware of and use labelling information than respondents who had lower education. Though, other studies have shown no significant relation between labelling and educational level (Angulo et al., 2005).

Perception statements on health and safety had positive coefficients and statistically significant at 1%. Due to the recent outbreaks of food borne diseases, consumers are more concerned about their health in relation to the quality and safety of products consumed. From this study, consumers may not be concerned about nutrition if they perceive what they consume as healthy and safe. According to Verbeke (2005) and Angulo et al. (2005), experience in recent cases such as genetically modified foods, food irradiation, and even functional foods, demonstrates that perceived safety can drop dramatically when new information is provided even without medical or scientific evidence.

Nevertheless, Angulo et al., (2005) in his study argue found that, Spanish consumers perceive food safety as a minimum responsibility producer have and do claim that producers should guarantee safety without consumers being obliged to pay a premium for it or being a burden for consumers.

CONCLUSION

The study found that all the respondents interviewed were aware of food products but awareness and evidence of labelled *sobolo* was found to be low (2.7). However, majority (69%) of the respondents were very much interested in the labelling of *sobolo*. The study also revealed that duration, safety, nutritional contents and list of ingredients were the most important information consumers would prefer on labelled *sobolo*. Prominent among some of the reasons are to know the manufacturing and expiration date and also the nutritional and safety benefit. Respondents had a relatively positive attitude towards labeling *sobolo* per the perception index. The implication of this result is that consumers generally have positive perceptions regarding labeled *sobolo* in terms of price, benefit and product. It was also found that consumers are more conscious of their health and therefore, are more willing to purchase the labeled *sobolo*. It is again concluded that, consumers' perceptions on health and safety have a positive impact on their concern about labelling of *sobolo*.

The empirical study shows that consumers' interest in labelling of *sobolo* is influenced by their socio-economic characteristics such as age, education, household size and household income and perceptions of health and safety. Thus, this study concludes that consumers are different from one another which means that they base on different factors to choose different information needs that suit them.

RECOMMENDATION

Efforts should be made to enhance awareness and interest in labelling of food products as well as how to interpret them to consumers; among the lower educated and the aged by encouraging them through public education to look out for information on foods, especially prepackaged foods they purchase. Interpersonal interaction during social gatherings can also be used to enhance awareness about nutrition labels. Professional groups such as hairdressers association, dressmakers association, and artisan groups could be targeted to enhance awareness among the lower educated.

More emphasis should be placed on the attributes of the labelled *sobolo*, particularly regarding the health, nutritional content and safety of the product since consumers' rate these

attributes to be very important when purchasing the product. Again, the labelled *sobolo* must be promoted by creating awareness to consumers. Students at the tertiary level should be targeted for the labelled *sobolo* since people with higher educational level were more willing to pay a premium for the product. Consumers with all levels of income should be also targeted since consumers with various income tended to be interested in labelled *sobolo*. Promoting the benefits of labels through public education can motivate consumers to often use nutrition label information when purchasing prepackaged foods. Consumers should also be encouraged to check all labelling information when shopping. Producers should label their food products in order to boost consumers' confidence in food safety. Producers can also target their labelled products to the youth and the middle aged since from the study they had the major interest in the labelling of *sobolo*. Promotional strategies can also be adopted to help influence consumers purchasing interest in the labelling.

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SCIENTIFIC PAPER

EXPLORING LIVELIHOOD STRATEGIES OF HERDER HOUSEHOLDS IN MONGOLIA: INCOME-BASED APPROACH

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Abstract: *The classification of livelihood strategies is important for identifying different lifestyles and developing poverty reduction measures. The research was aimed to identify Mongolian herder households' livelihood strategies and assess capital factors that impact their choice and livelihood outcomes in connection with wealth and poverty. A total of 350 herder households were surveyed using the stratified sampling methods from four different economic regions. The Income-Based Approach was applied to identify herder households' livelihood strategies based on their primary income sources and Pearson correlation was used for assessing the influencing input. The study hypothesizes that herder households earn the majority of income sources from animal husbandry and an essential factor in the choice of livelihood strategy is the number of animals. The study found that livelihood strategies of nomadic herder households clustered into four main types: a) livestock income sources, solely b) earn from kinship and assistant herder salary in addition to livestock income; c) social benefits and pension income in addition to livestock income and d) income sources dependent on natural resources in addition to livestock income. Location, financial capital, and physical capital were the main factors for choosing a specific livelihood strategy. There was an insignificant difference between poor and wealthy herder households in terms of physical assets ownership. To reduce rural poverty, we need tailored sustainable development policies based on different herder households' livelihood strategies.*

Keywords: *livelihood strategy, income based approach, herder households of Mongolia*
JEL Code: Q01, Q12, I30, D19, D31

1. INTRODUCTION

The agriculture sector is the traditional economic sector and of which, the livestock sector accounts for 88 percent (Gombodorj et al., 2019). Total of 181 thousand herder households herding five types of animals like horse, cattle, camel, sheep, and goat throughout four seasons. Mongolia has a total of 1.56 million hectares of land, of which 1.1 million hectares is pastureland. The number of livestock reaches the highest in 2019, or 70.9 million heads (NSO, 2020). However, the livestock sector remains vulnerable to weather conditions, as seen from the severe dzuds (World Bank, 2012). Thus, herders' livelihoods are dependent on access to a natural resource with a fragile ecosystem (Worldbank.org, 2015), and they are responsible for all production inputs, risks, and decisions. In Mongolia, pasture land area decreased from 140 million ha to 112 million ha, and 65% of pastureland is degraded to a particular extent, varied by ecological zones (MoFA and SDC, 2015). Moreover, in particular herder household's livelihood strategies, an increase in livestock numbers impact the quality of grassland and its ecosystem(Li et al., 2018; Tumur et al., 2018).

In addition to an increased number of animals and overgrazing problems, rural poverty has been a concern for nearly 30 years, its index ranges from 26.4 to 30.8 percent between 2014 to 2018 (NSO and World bank, 2020). NSO and World Bank (2020) was noted that increasing livestock product demand and prices, better connectivity to markets, more wage employment opportunities, government subsidies, and transfers have contributed to improving herders' wellbeing. However, their livelihoods, highly dependent on livestock, are still highly vulnerable to unexpected shocks, including livestock price fluctuations and natural disasters. The recent acceleration of pastoral degradation could also negatively affect the sustainability of herders' livestock activities and welfare.

Consequently, there is a demand to study ways to improve and sustain rural people's living conditions by overcoming natural disasters, economic shocks, and livestock disease

shocks. National and international researchers have been studied interdisciplinary topics, rural poverty, natural disasters, and pastureland degradation and how these issues affect herder households' livelihoods in Mongolia. However, there are no studies that classify herder households' livelihood strategies. Nevertheless, Robin Mearns (2004) stated that income from animal husbandry is not the sole income source for the Mongolian herder households; some irregular income is accounted for. Additionally, assistant herders, who have very few animals, helping wealthier herders and receives a salary or material things without contracts are mostly classified as poor herder households (Murphy, 2015). It is traditionally named kin relationship help. Thus, their livelihood strategies and poverty trends are not clear yet.

The research objective is to identify Mongolian herder households' livelihood strategies and assess capitals that impact their choice in connection with wealth and poverty. We hypothesize that herder households earn the majority of income sources from animal husbandry and an essential factor in the choice of livelihood strategy is the number of animals. The study result would provide helpful information for policymakers and researchers for developing sustainable livelihood programs for Mongolian herder households.

2. LITERATURE REVIEW

The basic premise of the Sustainable Livelihood Framework is a DFID framework based on the work of Chambers & Conway (1992)(DFID, 2001). Later, Ian Scoones, (2015) developed his work in 1998 and created a well known diagram that illustrates different assets and resources that would lead to certain types of livelihood strategies outcomes, influenced by a set of context and institutional processes. Batterbury (2015) argued that all actors in sustainable development framework emphasize in different ways, however, all come to the one idea that sustainability of rural livelihoods should form the basis for improved rural development and poverty alleviation. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resources base.

Classification of livelihood strategy and investigation of its transitions in a systemic and quantitative approach is essential for understanding the dynamics of rural livelihoods, the determinants of livelihood strategy choices and mobility, and the implications for designing significant poverty alleviation and rural development strategies (Jiao et al., 2017; Yang et al., 2020). Households are challenging to receive various income sources. Thus household strategies indeed mix various activities. In a joint publication, United Nations Food and Agriculture Organization (FAO) and World Bank (WB), Farming systems and poverty, small producers in developing countries around the world, supply most of their food but remain in poverty, described their livelihood strategies based on similar new qualities to improve their livelihoods. As a result, 72 farming systems were identified in six developing regions, with an average agricultural population of about 40 million inhabitants. This research invented the eight broad categories of the farming system. Mongolia is classified in "Rainfed farming systems in dry or cold low potential areas, with mixed crop-livestock and pastoral systems merging into systems with very low current productivity or potential because of extreme aridity or cold categories global farming system" (Dixon & Gulliver, Aidan with Gibbon, 2001).

Rural households of less developed or developing countries often engage in a diverse set of income-generating activities to diversify their income base to reduce risk exposure, maintain consumption requirements in the event of shocks, and accumulate wealth. After shifting to the market economy in Mongolia, some studies were carried on the herders' livelihood. However, those available studies are multidisciplinary studies mainly focused on pasture management, overcoming natural disaster-dzud, community-based rangeland management (G.BrownArunAgrawal, 2013), (María E.Fernández-Giméneza, B.Batkhishiga, B.Batbuyan, 2012),(Mearns, 2004b) (Schmidt, 2006), (María E.Fernández-Giméneza, 2015), (Peng et al., 2017). Robin and Mearns studied Mongolia's pastoral livelihood and Poverty assessment in 2000 based on the sustainable livelihood theory using an income-based approach. However, in his study, due to insufficient data could be gathered for very poor households to include this category in this analysis with any degree of confidence; and, inter-household transfers and kinship support — while a very important livelihood source is absent (Mearns, 2004b).

Like in most agriculture-based countries, socio-economic and ecological developments are inextricably linked in Mongolia. The number of animals is regarded as a proper approximate measure of the wealth of herding households in Mongolia as the animal origin product is the primary income source of herder households. Although the number of animals increases, herder's income inequality has been extending. A share of herders' households with less than 200 animals is 43% of the total number of herder households, while their herd size accounts for only 12% of the total number of animals (FAO and MoFALI, 2018). A study conducted by the Japan International Cooperation Agency (JICA) and the Ministry of Food and Agriculture (MoFALI) in 2006 on the income of herders with different herd sizes are reported: herders with herds of between 101-200 animals have expenditures roughly equal to income, but at a subsistence level; no funds remain. They are not worth the expenditure on long-distance moves. Furthermore, other investments, such as purchasing improved breeds, are not feasible (JICA and MoFA, 2006).

Classification of livelihood strategy and investigation of its transitions in a systemic and quantitative approach is essential. Methods of classifying livelihood strategies incorporate the asset-based approach, activity choice approach and income-based approach (Sun et al., 2019).

The formal method of determining the livelihood of herder households is an asset-based approach. The asset-based approach is from the perspective of input used across different activities, while the income-based approach classifies livelihood strategies from the perspective of output according to income from a certain source such as nonfarm income, forest income, cash transfer income (Sun et al., 2019). Income-based Cluster analysis is the most commonly used approach (Nielsen et al., 2013). Compared with the asset-based approach and income-based approach, the activity choice approach stems from the definition and essence of livelihood strategies and classifies livelihood strategies from the perspective of the process. Input, activity and output are interlinked. Thus, Nielsen et al., (2013) emphasized that activity variables should connect assets and the outputs. Although the livelihood survey focuses on household income and expenditure, some middle-class households fall into the extremely poor category due to excluding some irregular incomes (Mearns, 2004a). This study classified the herders' livelihood strategies adapting income-based approach. . Mongolian National Statistical Office and other livelihood studies classify herder households' livelihoods using their livestock number (Altangerel et al., 2015; Marion et al., 2018; Mearns, 2004b; Mongolia Ministry of labour and Social Protection Mongolia, 2019; Murphy, 2015; Oniki & Dagys, 2017). Mongolia conducts an annual livestock census in December. According to the official government welfare grouping indicator, herder households are classified as very poor is having 0–50 animals; poor 51–100 animals; an average 101–500 animals; better-off 501–1000 animals; and wealthy is over 1000 animals (Leisher et al., 2012)

3. METHODOLOGY

Two steps analysis was applied in this study. In the first step, different household livelihoods are classified by their income using the nearest neighbor clustering method of SPSS covering 350 herder households Mongolia. Total eight income sources including livestock income, wage, growing crops and vegetables, natural resources, services, small business, social welfare, and handcrafts income are included in the survey.

In the next step, 33 major factors (variables) are included in the Pearson correlation analysis to identify the affecting factors to pursue specific livelihood strategies. These include the variables loan, saving, whether a commercial bank account, share of livestock income in the total income, the income share of wages, agriculture, family business, social welfare, natural resource, services and handcraft income; livestock insurance coverage, educated family member percentage in the family, number of working-age household members, family literacy level, family member coverage of health insurance, percentage of family member attendance of adult and continuing education training, number of housing, water accessibility, water sources for animals, number of winter and spring places owned, percentage of fertile plants in the livestock pastures, family members' coverage of social insurance, participation level in the local election, number of mobile phones in the households, information source of "A" level animal diseases spread, membership status of cooperative, and pasture user group which support herders' activities. All 33 variables are grouped into Financial capital, Human capital, Physical Capital, Natural capital, and Social capital.

Sample selection

This study was conducted in Mongolia, covering four economic regions: Khangai, Central, East and Western regions. The primary data was selected from the Socio-economic Baseline Study of herder Households. Data were collected with a nationwide survey between July to August 2017 by Mongolian Marketing Consulting Group, financed by the Green Gold and Animal health project of Swiss Development Cooperation. Income-based cluster analysis was used to classify the herder households, and calculations were made using the SPSS program. Pearson correlation analysis was used for correlations between herder household income and livelihood sources with a significance of 1 percent and 5 percent.

The data collection was applied to two-stage stratified sampling methods. Animal numbers and herder households at soum (the second administration unit of Mongolia) and the bag level (The first level of the administrative unit of Mongolia) were taken from the annual animal census-2015 of the National Statistical Office Mongolia. Herder households are nomadic. The study excluded the households with livestock at 330 soums (The second level of the administrative unit of Mongolia) centres and 21 aimag centres (The third level of the administrative unit of Mongolia). The first stage or soum sampling considered every zone's representation, the number of herder households (1-499 and 500 more), and distance to aimag centres (1-199 km and 200 km more). According to these indicators, every soum (total 309 soums) has been divided into stratum. One soum per stratum was selected.

The following formula determined the number of herder households for sampling

$$n=(Z^2\ p(1-p))/e^2 \quad (1)$$

Where: n – sample size, Z –Z table value in confidence interval (1.96), p – phenomena expectation (unit weight of herder households to a total number of households), e – accuracy expressed by relative expectation. Survey sample size (95.0%-confidence interval, 5.0%-accuracy).

Thus, a total of 350 herder households were selected. The number of survey respondent units from the chosen soums are done by the equal distribution method (350:15=23). As a result, 23-24 households per selected soum were involved. Herder households were selected from 10 different livestock groups numbers: up to 10, 11-30, 31-50, 51-100, 101-200, 201-500, 501-999, 1000-1499, 1500-2000 and 2000 above at each soum . Finally, a total of 350 herder households were involved in surveying. One herder household represented 410 herder households on average.

Figure 1. Selected 15 soums for sampling.

In result, from Khangai region-Arkhangai aimag-Ikhtamir, Battsengel, Tsakhir soums, Bayankhongor aimag- Bayanlig, Bayantsagaan soum, Khuvsgul aimag- Alag-Erdene, Arbulag soum; Uvurkhangai aimag-Bogd soum; Central region- Tuv aimag- Undurshireet, Buren, Delgerkhaan soum, Umnugobi aimag-Mandal-Ovoo soum; Western region- Zavkhan aimag-Erdenekhairkhan soum, Khovd- Chandmani soum; Eastern region- Dornod aimag- Tsagaan-Ovoo soum. 15 soums of 9 aimags have been selected as the survey respondents.

4. RESULTS AND DISCUSSION

Livelihood strategies adapting income-based approach using Nearest neighbour cluster analysis

As a result of the first step of the analysis, the herder households livelihood strategies were classified the following:

Cluster 1, herder households that have primary income from wages and salaries;

Cluster 2, herder households that are reliant on the income from livestock-related products and activities, solely;

Cluster 3, herder households that are dependent on the social welfare; pension, allowances and special care services,

Cluster 4, herder households that are reliant on undermining natural resources.

The result shows that 88.9 percent of the herder households' livelihood is dependent on livestock (Cluster 2). All other three clusters account for 11.1 percent only. The result is relatively close to the different research results on herder livelihood carried out by other researchers. For instance, the joint study of The research institute of labour and social protection & Ministry of Labour and Social Protection (2018) has stated in their research that 66.8 percent of herder households get their income from livestock sources, 10.7 percent from salaries, wages, 17.2 percent from pension, benefits, and the remaining 5.3 percent get their income from other sources.

The herder households that earn wages and salaries make up around 3 percent. These herder households own comparatively few animals (see Table 1) which is not sufficient for their livelihood. Therefore, herders households look after the herds of absentee herders who live in soum centres and other urban areas. They have paid wages in a combination of cash and in-kind. Kinship, or also known as an assistant herder, is a new type of labour for herders. As of 2019, out of the 285.5 thousand herders, 94.7 percent of them are main herders, 15.2 thousand or 5.3 percent are assistant herders (NSO, 2018). In Mongolia, the number of wage-based and share-based labour contracts has grown but has not displaced clientelism or kin-based cooperation (Murphy, 2015). With the increasing number of livestock heads, there is a tendency for an increased number of herders who are strategically thinking to become assistant herders. As for wage distribution, many forms are being used as a combination.

As for Cluster 2, herder households generate direct income from cashmere, wool, meat and dairy product sales. Herders' income from the livestock differs between regions. Khangai region depends more on animal origin income. Khangai region differs from the other regions by their ability to create income from milk and dairy products as they have more cows, yak and many animals. Herders who own more livestock generate more income. The Mongolian government provides monetary incentives for every kilogram of wool and cattle and horse hides. Those with few animals require income diversification, while others with more livestock are primarily busy and are not dependent on other types of income sources. A study conducted by the Japan International Cooperation Agency (JICA) and the Ministry of Food and Agriculture (MoFALI) in 2006 on the income of herders with different herd sizes are reported: herders with herds of between 101-200 animals have

Table 1. Clustered livelihood strategies

		Type of Cluster							
		Cluster 1		Cluster 2		Cluster 3		Cluster 4	
		Count	Mean	Count	Mean	Count	Mean	Count	Mean
Regions/ Households	Central	2		87		3		-	
	Khangai	6		160		22		2	
	Western	-		45		-		-	
	Eastern	2		19		2		-	
	Total	10		311		27		2	
Total (%)		2.9		88.86		7.71		0.57	
The average number of livestock per household			90		546		171		55
Annual income, mln MNT			6.3		10.9		5.7		0.8
Annual household income, thousand USD (ex. rate 2454, by 2017)			2.6		4.4		2.3		0.3

Source: Author estimated result

Table 2. The correlation between household income and livelihood resources (capital).

Dependent variable: Household income

Independent variables			Region			
			Central	Khangai	Western	Eastern
Financial capital	Number of Livestock	Pearson Correlation	.710**	.605**	.674**	.784**
		N	92	190	45	23
	Saving	Pearson Correlation	.399**	.277*	.550**	
		N	92	74	22	
	Insurance of Livestock	Pearson Correlation	.241*		.661**	.598**
		N	92		45	23
Human capital	Education	Pearson Correlation				.416*
		N				23
Physical capital	Number of housing, yurt, and barns	Pearson Correlation	.273**	.274**	.373*	
		N	92	190	45	
	Number of winter and spring housing	Pearson Correlation	.270**	.436**		
		N	92	190		
Social capital	Percentage of family members with social insurance	Pearson Correlation			.334*	
		N			45	
	Percentage of a mobile phone user	Pearson Correlation	.215*			
		N	92			

Source: Author estimated results

*Note: *. Correlation is significant at the 0.05 level (2-tailed) **. Correlation is significant at the 0.01 level (2-tailed)*

expenditures roughly equal to income, but at a subsistence level; no funds remain. They are not worth the expenditure on long-distance moves. Furthermore, other investments, such as purchasing improved breeds, are not feasible (JICA and MoFA, 2006).

Cluster 3, herder households rely on social welfare, pension, allowances, and special care services. The average number of livestock is 171 and at the subsistence level. Therefore, it is difficult to live without additional sources of income. Herders' retirement age has decreased to 50 and 55, which has increased the chance to create income from their pension (Gombodorj et al., 2019). Those on a pension or on temporary disability welfare do not have the workforce's capacity to herd many animals. Due to the Covid 19 pandemic, starting from March 2020, 100 thousand Mongolian tugriks are being distributed to those under 18, and these types of social welfare support directly to increase herder households' income.

Cluster 4, herder households that are reliant on undermining natural resources. They take up less than one percent of those involved in the research and are only located in the Khangai region. The Khangai region has a reach of pine nuts, fruit in the autumn, and abundant wild animals for hunting, allowing them to gather their primary income source from nature while herding a few animals.

Correlations livelihood resources and income with regional differences

In the second step of the analysis, we chose a total of 33 factors that affect herder household's income and livelihood strategies: 13 factors from financial capital resources, 5 from human capital, 7 from physical capital, 4 from natural capital, and 4 from social capital. Statistically significant variables are exhibited in Table 2. Correlation analysis results show that herder households' income has positive correlations with livestock insurance, savings, and livestock numbers across all regions. Education effects exist only in Eastern-Steppe regions. That might be explained that the steppe region has less availability of natural and physical resources. Housing for humans and animals is an essential factor in the Central and Khangai regions. The Group of factors of the social capital relations to the herders' livelihood is various.

5. CONCLUSION

We have analyzed the Mongolian herder households' income diversification with regional differences using The Income-Based Cluster Analysis method. The result shows that livestock number is important in the income diversification and choice of livelihood strategy. Thus, the research hypothesis is accepted. The higher the number of livestock, the higher the herder's reliance on their livestock-related income, as they have livelihood strategies revolving around their livestock. However, as the number of livestock decreases, a herder household's income consists mainly of social welfare income and other income sources. Financial and physical capital has a positive effect on the decision making of a herder household's livelihood strategy and income. Tailored policies based on different herder households' livelihood strategies are needed to reduce rural poverty and enhance sustainable rural development.

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