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Contents

PREFACE

This issue of Apstract consists of eleven papers.

Two papers relate to macro-economic issues. One paper is a note on the Dutch disease in which a simple macro-economic trade model is used to analyse the resource curse, whereas the other paper.

Investigates the relationship between the global innovation index on the one hand and, on the other hand, GDP per capita, life expectancy and human development index.

Two papers discuss general issues with respect to behaviour of suppliers. The relationship between corporate corporate governance and corporate social responsibility is the topic of a literature study. The other paper investigates, by means of desk research the possibility of using drones to improve the performance of agriculture in Mongolia.

Four papers relate to agricultural firms. Credit access of cocoa farmers in the Ahafo region in Ghana is the topic of the first paper whereas an agricultural-technical analysis of the production of maize in Hungary is performed in the second paper. The two other papers to other issues. One paper pays attention to the water requirements for some selected crops in southern Italy, and the one to the employee turnover and business performance in the Zyimba district in Zimbabwe.

Three papers focus on consumer behaviour. One paper is a segmentation study of the Hungarian population based on healthy eating. The topic of the second paper is the impact of consumer innovativeness on shopping styles among students in Pakistan. The third paper analyses the characteristics and motivations of luxury wine buyers (over 50$ per bottle) in the USA.

Wageningen, March 2020.

Johan A.C. van Ophem

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SCIENTIFIC PAPER

ECONOMIC ANALYSIS OF SOME AGROTECHNICAL FACTORS IN MAIZE PRODUCTION. A HUNGARIAN CASE STUDY

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Abstract: *This paper focuses on the economic and statistical evaluation of the production technology findings of the polyfactorial maize production experiments carried out between 2015-2017 at the Látókép Experiment Site of the University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management. The examined agrotechnical factors included irrigation, previous crop, tillage, crop density, hybrid and N nutrient supply, while the effect of different crop years was taken into consideration. In addition to descriptive statistical methods, we used multivariate regression analysis during the statistical evaluation. In the course of the evaluation, we examined three models that differed in terms of tillage methods and the consideration of crop year. In our best fit model, the factors were 71% responsible for the change in yield value. We carried out efficiency and comparative analyses in the course of the economic evaluation.*

Averaged over the three examined years, it can be stated that nutrient supply and crop year had an outstanding effect on yield, while irrigation had a minimal effect. However, global warming may justify irrigation in the future, not only from a biological point of view, but also from an economic aspect.

Ideal tillage is also greatly affected by crop year, too. Altogether, of the examined tillage systems, subsoiling proved to be the best from an economic point of view.

Our investigations confirm that it is better to perform intensive farming under more favourable market conditions. The optimum of N fertilisation is probably outside of the range we examined, if the extreme changes in maize and fertiliser prices are ignored.

Keywords: *precision farming, year effect, fertilization, profit, efficiency*
(JEL Classification: *Q16, Q12, Q13, O32*)

INTRODUCTION

The success of maize production is fundamentally affected by the natural and economic conditions of production and the applied agrotechnology. At the same time, the economic evaluation of the obtained experiment findings and the drawing of generalisable conclusions can be seriously hindered, since the frequent change of weather and the fluctuation of input-output prices, the accelerated technological development, the reliable management of the cross-effects between individual expenditures and the prediction of future tendencies can only be performed on the basis of long-term experiments. Based on our hypothesis the optimum level of the fertilization is significantly affected by not only the input-, but also the output prices, depending on the other inputs' level and the weather's conditions. Our results might be useful for the adoptability of precision farming, which is a perspectivic segment of agriculture.

Our aim was to analyse the technological elements with the greatest impact on yields and profit (especially the applied tillage system and irrigation) with the help of different models. Based on the available data, we sought to determine the optimum active substance level of nitrogen fertiliser, which is also important for precision farming.

Technical literature review

Knowing the prevailing agro-ecological conditions (water supply, soil), the selection of the most appropriate hybrids and the harmonisation of agrotechnical elements with the economic and biological environment are essential for economical and sustainable maize production (Karancsi, 2015). In the recent decades, the physical, chemical and biological properties of Hungarian soils have deteriorated to a great extent, which also affects maize production. Only the use of hybrid-specific agrotechnical solutions adapted to the given production site can provide protection against the yield-reducing effects of climate change (Pepó, 2006). Many experiments have been carried out both in Hungary and in other countries with the aim to perform economically and environmentally sustainable maize production in the areas with different endowments and quality. These studies primarily examined the impact of different agrotechnical elements on each other and on the potentially obtainable yields.

The combination of production technology and agrotechnical elements fundamentally determines the cost-benefit characteristics, i.e. the economicalness, profitability and environmental impact of the production activity. The applied tillage method, nutrient management and irrigation are widely examined agrotechnical elements.

Conservation tillage can be used for improving soil condition and soil life, for preserving soil moisture and for increasing humus content. The basic principles of this approach are reduced tillage, soil coverage and crop rotation. Examples include zero tillage, zone, strip or row tillage (Underwood et al., 2013). In the case of reduced tillage, similarly to conventional tillage, the entire surface is cultivated with or without ploughing. Combining or omitting certain operations can reduce the time and energy consumption per hectare by up to 50% (Husti, 2015). In zero tillage, light subsoiling is applied for deeper tillage, while discs and cultivators are used for shallow tillage (AKI, 2017). Sarauskis et al. (2011) discussed the positive effects of subsoiling, emphasising that this method of zero tillage can contribute to the proper air and water management of the soil and it prevents the leaching of nutrients caused by rainfall. Busari et al. (2015) discussed the importance of environmentally friendly tillage methods concerning sustainable crop production and climate change. The authors highlight the beneficial physical, chemical and biological effects of no-till solutions, reduced tillage, soil coverage, ridge tillage and contour tillage on the soil life of different soils. In many cases, compared to conventional tillage, environmental pollution impacts can be significantly reduced while achieving better yields. Accordingly, conservation tillage reduces greenhouse gas emissions through smaller interventions (machine work) and by increasing the organic carbon content of soils, and thus can be classified among "climate-smart" agricultural practices (Kuhn et al., 2016). In addition, these tillage methods contribute directly to the prevention of leaching and soil erosion (Bhatt et al., 2006).

Improving economic performance is a crucial factor regarding the spread of PF. Barnes et al. (2019), after interviewing 671 farmers in five different EU countries concluded that access to investment subsidies and the possibility of reducing annual costs were the most important aspects when farmers decided to buy and apply precision technology. According to the study carried out by Parihar et al. (2017) in India, the economic results and energy efficiency of the application of PF are greatly (6-60%) influenced by the fertilization technology used in maize-wheat-mungobean crop rotation, depending on the crop year.

Based on the three-year comparative analysis of Ferencsik (2015), the fuel use of no-till technologies is about 35% (strip tillage) and 20% (light subsoiling) lower than that of ploughing. The difference is mainly due to the difference in the energy demand of primary tillage, but the use of reduced tillage production technologies results in further savings. In terms of production costs, ploughing has the highest value (325 thousand HUF ha^{-1}), followed by loosening (314 thousand HUF ha^{-1}), while strip tillage has the lowest cost (306 thousand HUF ha^{-1}). According to Griffith et al. (1973) and Wittmuss et al. (1971), the yield potential of strip tillage is higher than, or (at least) the same as that of conventional tillage systems. However, this observation refers only to soils with good water management. Based on the results of Randall-Vetsch (2005), the yields achieved in conventional tillage in cold or rainy crop years may significantly exceed the yields achieved in reduced tillage systems.

Based on the long-term field experiment of the University of Debrecen at the Látókép Experiment Site, Sulyok (2005) and Nagy (2006a) demonstrated that autumn ploughing is the most preferred method of primary tillage for maize

on calcareous chernozem soil in comparison with spring ploughing and disc tillage. At the same time, Ferencsik-Rátonyi (2014) emphasised that strip tillage and loosening may be suitable alternatives to conventional ploughing on chernozem soil, especially in dry crop years.

Various research findings focused on the improvement of the N-efficiency of maize hybrids and the different yield responses obtained at different N levels. While the yield curve of the hybrids produced until the mid-1960s was flat in the case of applying 80-120 kg N, the optimal N dose of the hybrids produced in the 1970s was 160 kg ha^{-1} (Győrffy, 1979 in Micskei, 2011).

According to Dóka and Pepó (2007), the amount of applied nitrogen has the greatest role in achieving the surpluses in maize yields, especially in the case of monoculture. Based on the analysis of Balla (2017), both the yield measured on the control plot and the plot on which 120 kg ha^{-1} nitrogen was applied were significantly lower than the yield achieved as a result of the 240 kg ha^{-1} nitrogen fertiliser treatment. The 10 t ha^{-1} yield achieved as a result of applying 240 kg ha^{-1} N was 1.59 t ha^{-1} higher than the average yield obtained in the case of applying 120 kg ha^{-1} N. As regards the control treatment, the harvested yield of 7.97 t ha^{-1} was 2.03 t ha^{-1} lower than most yields (10 t ha^{-1}). However, the effect of nitrogen fertiliser is highly dependent on rainfall conditions. According to the long-term experiment findings of Széll and Kovácsné (1993), the yield increasing effect of nitrogen fertilisation, averaged over the 5 examined years, was 34% when 100 kg ha^{-1} N was applied and 50% when 200 kg ha^{-1} N was applied. However, in the case of rainy weather, the yield obtained in the case of the 300 kg ha^{-1} N dose was almost as high as that of the 200 kg ha^{-1} N dose. According to Árendás et al. (2000), the availability of nutrients is deteriorating in dry years, thus reducing the yield increasing effect. However, if moisture content is not a limiting factor, yield increased sharply until applying 100-120 kg ha^{-1} N, and the maximum yield was achieved as a result of applying 160-170 kg ha^{-1} N^{-1} ha. At the same time, it can be concluded that the optimum amount of nitrogen fertiliser depends on the given crop year, as well as soil quality and the level of nitrogen supply (Nevens-Reheul, 2005; Berenguer et al., 2008; Ragán, 2017). Fertilisation is capable of partially compensating for other unfavourable agrotechnical endowments (Nagy, 2006b).

Long-term experiments have been carried out at the Látókép Experiment site, the location of our research, since 1983, the results of which have been published in several journals and a brief summary can be found in the paper of Nagy-Pepó (2015). The most important results of this polyfactorial maize experiments can be summarised as follows:

Optimum nitrogen fertiliser active substance in maize (1986-2012):
- monoculture:180-240 kg ha^{-1}
- biculture: 120-180 kg ha^{-1}

Yield surplus due to irrigation (1986-2012):
- dry crop year: 3.4-5.4 t ha^{-1}
- average crop year: 0.8-1.3 t ha^{-1}

Factors affecting maize yield the most (2004-2013):
- fertilisation: 39 %
- crop rotation: 28 %
- irrigation: 14 %
- crop year: 11 %
- population density: 7 %

MATERIALS AND METHODS

Agroecological characteristics of the performed experiments

Soil characterisation is based on the works of Sulyok et al (2006) and Nagy-Pepó (2015). The polyfactorial experiments carried out between 2015-2017 at the Látókép Experiment Site of the University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management. The performed measurements consisted of 15 treatments of 6 production technology elements (4 replications each), and we were able to evaluate 972 yield results over the 3 examined years.

The experiment site is located on the Hajdúság loess ridge, 113-118 m asl. The greater part of the area is calcareous chernozem soil, while the lower part of the site is leached chernozem with meadow characteristics. The physical soil type is mid-heavy adobe. The proportion of gravity pores is significantly reduced in the 10-15 cm layer below the cultivated layer. As a result, water slowly leaves the cultivated layer. Groundwater is located 3-5 meters deep. The most important other soil properties are characterised with the following values:

Total porosity:
- in the cultivated layer: 44-48 %
- beneath the cultivated layer: 50-53 %.

Humus layer:
- thickness: 70-80 cm,
- humus content: 2.5-3.0 %.

Soil
- acidity (pH): 6.2 (mean value)
- total nitrogen content: 0.15 % (average supply)
- AL-soluble P_2O_5 content: 133 ppm (average supply level, heterogeneous distribution)
- AL-soluble K_2O content: 240 ppm (favourable supply level).

The climate in the area is basically continental, with increasingly frequent extreme temperatures and precipitation. The multiple-year average weather data can be characterised with the following numbers based on the data obtained by Nagy-Pepó (2015):
- mean temperature: 9.84 C (increasing tendency)
- yearly precipitation: 565 mm (decreasing tendency)
- number of sunny hours: 2065

Details of the experiment design

Our analyses were performed on the database of the polyfactorial long-term tillage experiment established for three years (2015-2017) on the Látókép Experiment Site of

the University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute for Land Utilisation, Regional Development and Technology (Table 1).

Table 1: Agrotechnical characteristics of the experimental setup

Irrigation	Irrigated, non-irrigated		
Previous crop	E1 (maize), E2 (wheat)		
Tillage	Autumn ploughing	Strip tillage	Subsoiling (50cm)
Crop density	60 thousand crops per ha, 80 thousand crops per ha		
Hybrid	H1 (Armagnac, FAO 490)	H2 (Loupiac, FAO 380)	H3 (Sushi, FAO 340)
Fertilisation	N1 = 0 kg N ha^{-1}	N2 = 80 kg N ha^{-1}	N3 = 160 kg N ha^{-1}
Replications	4		

Source: Own construction based on the data collected by DE AGTC

The yearly amount precipitation in the examined years could be characterised with the following data:

- 2015: 518 mm
- 2016: 818 mm
- 2017: 641 mm

From the aspect of our examinations, it is fortunate that the examined period included a dry crop year, a particularly rainy and an average crop year. In our analyses, we assumed that the required phosphorus and potassium supply in the soil is ensured to achieve the expected yields in the experiment.

Special factors in the economic evaluation of precision fertilisation

Comparative analyses were carried out between different input levels, technological variants and crop years during the economic evaluation. Data from non-irrigated, non-fertilised and ploughed plots were used as controls. There are two factors that make it difficult to determine optimal expenditure levels:

- In addition to the proportions of prices, the obtained yields and the efficiency of resources used depend greatly on crop year and Liebig's law of the minimum, i.e., the given variety under examination, the prevailing soil conditions and the extent to which the amount of other expenditures is optimal. Due to the crop year effect, the optimum level is at different input levels each year, even in the same area, growing the same species and varieties. If an input is a bottleneck, the increase in other expenditures results in zero to slight yield increase.
- Determining the optimum technology and input level would presume the use of the lowest possible input ranges, with which the marginal efficiency can be calculated with sufficient accuracy. If the basic data necessary for accurate calculations are available, a longer time series is necessary to create reliable production functions that are to be verified under the conditions of the given production site in general (and not only for a few years). This paper focuses on the correlations between the main production technological characteristics and the yield for a three-year period. Since the database of measurements contains extensive expenditure intervals, we did not calculate the marginal, but the average efficiency for the period between 2015-2017.

The basic economic data used in the performed calculations reflect the yearly mean data of the HCSO in 2017 (the final year of the experiments), except for maize prices, where the highest and lowest prices of the last 10 years have been taken into account. These are the following:

- N active substance price (2017): 219 HUF kg^{-1}
- N active substance content of fertiliser: 32%
- maize prices:
  - minimum price: 27 HUF kg^{-1}
  - minimum price (2017):42.6 HUF kg^{-1}
  - maximum price: 56 HUF kg^{-1}
- tillage costs:
  - autumn ploughing and finishing: 27 000 HUF ha^{-1}
  - subsoiling: 12 000 HUF ha^{-1}
  - strip tillage: 13 000 HUF ha^{-1}

The variable data of the three model variants examined in N-fertilisation is the price of maize, which is independent of yield (on average 10 t ha^{-1}) in the model calculations; therefore, its change is equal to the effect of revenue per hectare.

Statistical evaluation

Due to the significant uncertainty factors, correlation analysis play an important role in our data analysis. In our evaluation, we developed and analysed multivariable linear regression models in addition to descriptive statistical indicators. Of the various descriptive statistical indicators, we calculated the mean, standard deviation, median, range, minimum and maximum values. In the regression models, we examined the effects on yield values for different maize sales prices. Of the different factors affecting the examined models, we were focusing on irrigation, previous crop, three different hybrids, different tillage methods, crop density and the different active substance amounts of the applied N fertiliser. For categorical variables, we used dummy coding to designate a given category as a reference category. Based on the regression parameters thus obtained, it was possible to quantify the effects of the other categories compared to the reference category.

Model variables

Three models were examined in our research. In our first two models, we analysed the data of the 3 examined years together and individually. In the third model, the examined years were incorporated as dummy variables. In the first two models, we used the average maize price of 2017 (42.6 HUF kg^{-1}) in our calculations, while in the third model, we examined the effect of the change in maize prices using the minimum prices (27 HUF kg^{-1})

and maximum prices (56 HUF kg^{-1}) in the last 10 years. In all three cases, we analysed the factors influencing yield value based on the available experimental data, which were the following in different models (factors different from the other models are in italics):

First model

$$A=\beta_0+\beta_1 B+\beta_2 C+\beta_3 D_1+\beta_4 D_2+\beta_5 E+\beta_6 F+\beta_7 G$$

- A: Maize revenue (HUF/ha)
- B: Irrigated and non-irrigated technology
- C: Previous crop (maize or wheat)
- D_1; D_2: Hybrids (H1 – basic category, H2, H3)
- E: Sowing seed costs in the case of germ numbers of 60 thousand and 80 thousand
- F: Fertiliser costs (in the case of 0/80/160 kg N active substance)
- G: Tillage system (general costs of autumn ploughing, subsoiling and strip tillage)

Second model

$$A=\beta_0+\beta_1 B+\beta_2 C+\beta_3 D_1+\beta_4 D_2+\beta_5 E+\beta_6 F+\beta_7 G_1+\beta_8 G_2$$

- A: Maize revenue (HUF/ha)
- B: Irrigated and non-irrigated technology
- C: Previous crop (maize or wheat)
- D_1; D_2: Hybrids (H1 – basic category, H2, H3)
- E: Sowing seed costs in the case of germ numbers of 60 thousand and 80 thousand
- F: Fertiliser costs (in the case of 0/80/160 kg N active substance)
- G_1; G_2: A change in potential results (with dummy coding) to be obtained with the other two tillage systems (subsoiling, strip tillage) compared to autumn ploughing

Third model

$$A=\beta_0+\beta_1 B+\beta_2 C+\beta_3 D_1+\beta_4 D_2+\beta_5 E+\beta_6 F+\beta_7 G_1+$$

$$\beta_8 G_2+\beta_9 Y_{2016}+\beta_{10} Y_{2017}$$

- A: Maize revenue (HUF/ha)
- B: Irrigated and non-irrigated technology
- C: Previous crop (maize or wheat)
- D_1; D_2: Hybrids (H1 – basic category, H2, H3)
- E: Sowing seed costs in the case of germ numbers of 60 thousand and 80 thousand)
- F: Fertiliser costs (in the case of 0/80/160 kg N active substance)
- G_1; G_2: A change in yield value (with dummy coding) to be obtained with the other two tillage systems (subsoiling, strip tillage) compared to autumn ploughing
- Y2016; Y2017: Crop year effect (change in yield value in 2016 and 2017, compared to 2015 (with dummy coding))

RESULTS

Descriptive statistical evaluation of the different models

In this section, we present the statistical evaluation of fertilisation, irrigation, tillage and the crop year effect (ceteris paribus), using the indicators described in the methodology.

Table 2: The effect of the examined factors on the average yield

	2015	2016	2017	3-year average
Yearly average yield (t ha^{-1})	8.4	12.4	9.1	10
Effect of fertilisation				
Yield obtained with 160 kg ha^{-1} N active substance (t ha^{-1})	9.4	14.3	11.7	11.8
Yield obtained with 80 kg ha^{-1} N active substance (t ha^{-1})	9.4	13.2	9.7	10.8
Yield obtained with 0 kg ha^{-1} N active substance (t ha^{-1})	6.3	9.8	5.9	7.3
Effect of irrigation				
Irrigated yield (t ha^{-1})	8.6	12.1	9.1	9.9
Non-irrigated yield (t ha^{-1})	8.1	12.8	9.1	10
Effect of tillage				
Yield with ploughing (t ha^{-1})	8.4	12.8	9.3	10.2
Yield with subsoiling (t ha^{-1})	8.4	12.8	9.5	10.2
Yield with strip tillage (t ha^{-1})	8.3	11.7	8.5	9.5

Source: own calculation

Table 2 clearly shows that the crop year of 2015 was unfavorable, 2016 was excellent, and 2017 was close to average on the basis of yield, parallel with rainfall conditions. In the crop year of 2015 (taking into account the additional costs of fertilisation and the additional yield value resulting from with it), it was reasonable to apply up to 80 kg ha^{-1}, while in the other two years, even up to 160 kg ha^{-1} of N active substance was justified based on the approach of additionality, in the case of any maize price.

Averaged over the three examined years introduced in Table 2, irrigation resulted in identical yields compared with the non-irrigated treatment, with a difference whose extent and direction depends on the rainfall amount and distribution of the examined crop years. Based on the obtained data, it can be concluded that, from the biological point of view, risk is greatly reduced by the installation of irrigation technology. However, from the economic point of view, irrigation has the opposite effect, due to the significant fixed costs (the depreciation costs of the equipment). Averaged over the three examined years, it can be stated that the minimum surplus yield (0.1 t ha^{-1} year^{1}) did not make irrigation more profitable. However, based on the examination of several years, as well as the increase in the frequency of dry and warm crop years, irrigation farming may even be justified from the economic point of view in the future. A new national strategy to reduce the administrative costs of irrigation can contribute to this effort (Szilágyi, 2013; Government Decision 1426/2018).

In the case of the different tillage systems (Table 2), the

old farmers' observation was partly confirmed, i.e., in rainy years, ploughing significantly increases yield, but alternative tillage methods could be more efficient in dry years. In this case, ploughing resulted in 0.8-1.1 t ha^{-1} extra yield in comparison with strip tillage in better crop years, while the obtained yields were identical in 2015. In more favourable crop years, the increase in yield values outperformed the extra cost of ploughing, compared to strip tillage. Surprisingly, subsoiling resulted in the same yields in each crop year as that of ploughing, which justified subsoiling during the examined period, compared to both strip tillage (yield surplus) and ploughing (machine cost savings).

When examining individual expenditures, it can be clearly concluded that the fertiliser doses used in everyday practice can affect yield potential the most, as its value could reach at least 30-40% compared to the control treatment, thereby showing the importance of precision nutrient management, which aims for the most efficient fertiliser use. Irrigation and strip tillage systems require higher investment requirements compared to a control plot (non-irrigated, ploughing technology), which increases the risks in the economic sense, and the expected yield increase is also lower (below 10% in both cases).

Model evaluation

First model

The first model was run in four different ways: the three years at once and each year separately. The value of the F test was significant in each variant ($p<0.001$). The multivariate regression function fitted onto the three-year-long data series and the 2015 data had moderate fitting (R2: 39.7%, and 47.5%), while it was strong in the case of the other two crop years (2016: 63.2%, 2017: 69%). Accordingly, it can be concluded that, in the case of the best fitting model (2017 data), the factors were 69% responsible for yield value (Table 3).

Table 3: Statistical summary of the 1st model

Model	R	R Square	Adjusted R Square		F	df	Sig.
2015 - 2017	.630	0.397	0.395	182.104	7	1936	.000
2015	.689	0.475	0.469	82.775	7	640	.000
2016	.795	0.632	0.628	157.217	7	640	.000
2017	.831	0.690	0.687	203.791	7	640	.000

Source: own calculation

When looking at the data of the three years together (Table 4), it can be concluded based on the standardised beta values that the cost of nutrient supply had the greatest impact on yield (0.56), followed by the previous crop (0.27) and both factors had significant effect. The effect of the other parameters was below 0.05. Of them, the effect of hybrid 3 was significant in comparison with hybrid 1, while the cost of tillage was also significant. Of the expenditures expressed in monetary value, only the efficiency of applying fertiliser was above 1 (5.4 HUF HUF^{-1}), while one-unit increase of the other examined expenditures (crop density, tillage) did not result in any income (beta values below 1).

Table 4: Regression coefficients of the 1st model

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
2015-17	(Constant)	341624	25271	-	13.518	0.000
	Irrigation	2366	4884	0.009	0.484	0.628
	Previous crop	-78059	5981	-0.266	-13.050	0.000
	Hybrid_2	7248	5981	0.025	1.212	0.226
	Hybrid_3	-11715	5981	-0.040	-1.959	0.050
	Seed cost_ HUF	0.963	0.673	0.029	1.430	0.153
	fertiliser_ HUF	5.405	0.170	0.560	31.712	0.000
	Tillage_ HUF	0.469	0.238	0.035	1.972	0.049
2015	(Constant)	345259	26473	-	13.042	0.000
	Irrigation	23360	5116	0.131	-4.566	0.000
	Previous crop	-56105	6266	-0.296	-8.954	0.000
	Hybrid_2	12106	6266	0.064	1.932	0.054
	Hybrid_3	-3498	6266	-0.018	-0.558	0.577
	Seed cost_ HUF	-0.354	0.705	-0.017	-0.501	0.616
	fertiliser_ HUF	3.789	0.179	0.608	21.220	0.000
	Tillage_ HUF	0.116	0.249	0.013	0.464	0.643
2016	(Constant)	412315	31639	-	13.032	0.000
	Irrigation	-30222	6114	-0.118	4.943	0.000
	Previous crop	-122382	7489	-0.452	-16.343	0.000
	Hybrid_2	-103	7489	0.000	-0.014	0.989
	Hybrid_3	-3741	7489	-0.014	-0.499	0.618
	Seed cost_ HUF	2.198	0.843	0.072	2.607	0.009
	fertiliser_ HUF	5.415	0.213	0.608	25.374	0.000
	Tillage_ HUF	0.938	0.298	0.076	3.151	0.002
2017	(Constant)	267298	28976	-	9.225	0.000
	Irrigation	-236	5600	-0.001	0.042	0.966
	Previous crop	-55690	6858	-0.206	-8.120	0.000
	Hybrid_2	9740	6858	0.036	1.420	0.156
	Hybrid_3	-27907	6858	-0.103	-4.069	0.000
	Seed cost_ HUF	1.045	0.772	0.034	1.354	0.176
	fertiliser_ HUF	7.012	0.195	0.789	35.880	0.000
	Tillage_ HUF	0.353	0.273	0.029	1.296	0.195

Source: own calculation

The crop year effect can be summarised in comparison with the 3-year joint model as follows:

2015: Due to the less precipitation in 2015, irrigation had a notable and significant positive effect on yield value (value of the standardised coefficient: 0.13, beta value: 23360 HUF ha^{-1}), while the effect of fertilisation and previous crop remained similar. Although the efficiency of fertilisation is still effective, its value decreased significantly (3.8 HUF HUF^{-1}).

2016: Due to the rainy crop year, the effect of irrigation was similar to that of the previous year, but it had a negative value (standardised coefficient: -0.12, beta value: -30222 HUF ha^{-1}). The peculiarity of this year is that, besides the outstanding cost efficiency of fertilisation, the increase of sowing seed costs is also effective (2.2 HUF HUF^{-1}).

2017: In this year, irrigation had no significant impact on yield value. Both the potency (standardised coefficient: 0.79) and efficiency of fertilisation (7 HUF HUF^{-1}) are outstanding. The effect of previous crop remains significant (0.21, -55690 HUF ha^{-1}) and has a significant effect on yield value. In this year, the impact of hybrid 3 compared to that of hybrid 1 also played an important role in gaining profits (-27906 HUF ha^{-1}).

Second model

The second model was also run in four different ways: the three years at once and each year separately. The value of the F test was significant in each variant ($p<0.001$). The multivariate regression function fitted onto the three-year-long data series and the 2015 data had moderate fitting (R2: 40.6%, and 47.6%), while it was strong in the case of the other two crop years (2016: 65.4%, 2017: 71%). Accordingly, it can be concluded that, in the case of the best fitting model (2017 data), the factors were 71% responsible for yield value (Table 5).

Table 5: Statistical summary of the 2nd model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	df		Sig.
2015-17	.637	0.406	0.404	106887	165.324	8	1935	<0.001
2015	.690	0.476	0.469	65115	72.554	8	639	<0.001
2016	.809	0.654	0.650	75496	151.308	8	639	<0.001
2017	.842	0.710	0.706	69046	195.370	8	639	<0.001

Source: own calculation

When looking at the data of the three years together (Table 6), it can be concluded based on the standardised beta values that the cost of nutrient supply had the greatest impact on yield (0.56), followed by the previous crop (0.27) and strip tillage (0.09).

The effect of hybrid 3 was only 4% in comparison with hybrid 1. Of the expenditures expressed in monetary value, only the efficiency of applying fertiliser was above 1 (5.4 HUF HUF^{-1}), while one unit increase of the other examined expenditures (previous crop, seed cost, strip tillage) did not result in any income (beta values below 1).

Table 6: Regression coefficients of the 2nd model

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
2015-17	(Constant)	358671	24900	-	14.404	0.000
	Irrigation	2366	4848	0.009	0.488	0.626
	Previous crop	-78059	5938	-0.266	-13.145	0.000
	Hybrid_2	7248	5938	0.025	1.221	0.222
	Hybrid_3	-11715	5938	-0.040	-1.973	0.049
	Strip tillage	-27536	5938	-0.094	-4.637	0.000
	Subsoiling	3823	5938	0.013	0.644	0.520
	Seed cost_ HUF	0.963	0.668	0.029	1.441	0.150
	fertiliser_ HUF	5.405	0.169	0.560	31.943	0.000
2015	(Constant)	349407	26274	-	13.299	0.000
	Irrigation	23360	5116	0.131	-4.566	0.000
	Previous crop	-56105	6266	-0.296	-8.954	0.000
	Hybrid_2	12106	6266	0.064	1.932	0.054
	Hybrid_3	-3498	6266	-0.018	-0.558	0.577
	Strip tillage	-5882	6266	-0.031	-0.939	0.348
	Subsoiling	204	6266	0.001	0.032	0.974
	Seed cost_ HUF	-0.354	0.705	-0.017	-0.501	0.616
	fertiliser_ HUF	3.789	0.179	0.608	21.220	0.000
2016	(Constant)	445800	30462	-	14.634	0.000
	Irrigation	-30222	5932	-0.118	5.095	0.000
	Previous crop	-122382	7265	-0.452	-16.846	0.000
	Hybrid_2	-103	7265	0.000	-0.014	0.989
	Hybrid_3	-3741	7265	-0.014	-0.515	0.607
	Strip tillage	-45330	7265	-0.168	-6.240	0.000
	Subsoiling	-269	7265	-0.001	-0.037	0.970
	Seed cost_ HUF	2.198	0.818	0.072	2.688	0.007
	fertiliser_ HUF	5.415	0.207	0.608	26.156	0.000
2017	(Constant)	280807	27860	-	10.079	0.000
	Irrigation	-236	5425	-0.001	0.043	0.965
	Previous crop	-55690	6644	-0.206	-8.382	0.000
	Hybrid_2	9740	6644	0.036	1.466	0.143
	Hybrid_3	-27907	6644	-0.103	-4.200	0.000
	Strip tillage	-31396	6644	-0.116	-4.725	0.000
	Subsoiling	11534	6644	0.043	1.736	0.083
	Seed cost_ HUF	1.045	0.748	0.034	1.397	0.163
	fertiliser_ HUF	7.012	0.189	0.789	37.037	0.000

Source: own calculation

The crop year effect compared to the 3-year joint model was perfectly identical to that observed in the case of the 1st model.

Third model

The third version of the model was run with three different maize prices (27 HUF kg^{-1}, 42.6 HUF kg^{-1} and 56 HUF kg^{-1}), and the different years were built into the model as dummy variables. As only the maize prices differed in these models, the value of the F-test was significant ($p < 0.001$) for each variant and only the error of function fitting (Std. Error Of the Estimate) was different. The fitted multivariate regression functions properly characterised the examined baseline data (r2: 70%); and the error of fitting of the model was the most significant (Std. Error of the Estimate: 99609) in the case of the highest maize price (56 HUF kg^{-1}) (Table 7).

Table 7: Statistical summary of the 3rd model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	df		Sig.
42.60 Ft	.838	0.702	0.700	75775	454.88	10	1933	<0.001
27 Ft	.838	0.702	0.700	48026	454.88	10	1933	<0.001
56 Ft	.838	0.702	0.700	99610	454.88	10	1933	<0.001

Source: own calculation

Taking into account the three different maize prices for each variant, it can be established on the basis of standardised beta values that the examined variables had different effects on yield

Table 8: Regression coefficients of the 3rd model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
42.60 HUF	(Constant)	290298	17819	-	16.292	0.000	-	-
	Irrigation	2366	3437	0.009	0.688	0.491	1.000	1.000
	Previous crop	-78059	4210	-0.266	-18.543	0.000	0.750	1.333
	Hybrid_2	7248	4210	0.025	1.722	0.085	0.750	1.333
	Hybrid_3	-11715	4210	-0.040	-2.783	0.005	0.750	1.333
	Seed cost_HUF	0.963	0.474	0.029	2.032	0.042	0.750	1.333
	Fertiliser_HUF	5.405	0.120	0.560	45.058	0.000	1.000	1.000
	Year = 2016 (FILTER)	173184	4210	0.590	41.139	0.000	0.750	1.333
	Year = 2017 (FILTER)	31935	4210	0.109	7.586	0.000	0.750	1.333
	Strip_tillage	-27536	4210	-0.094	-6.541	0.000	0.750	1.333
	Subsoiling	3823	4210	0.013	0.908	0.364	0.750	1.333
27 HUF	(Constant)	183992	11294		16.292	0.000		
	Irrigation	1499	2179	0.009	0.688	0.491	1.000	1.000
	Previous crop	-49474	2668	-0.266	-18.543	0.000	0.750	1.333
	Hybrid_2	4594	2668	0.025	1.722	0.085	0.750	1.333
	Hybrid_3	-7425	2668	-0.040	-2.783	0.005	0.750	1.333
	Seed cost_HUF	0.610	0.300	0.029	2.032	0.042	0.750	1.333
	Fertiliser_HUF	3.426	0.076	0.560	45.058	0.000	1.000	1.000
	Year = 2016 (FILTER)	109764	2668	0.590	41.139	0.000	0.750	1.333
	Year = 2017 (FILTER)	20241	2668	0.109	7.586	0.000	0.750	1.333
	Strip_tillage	-17452	2668	-0.094	-6.541	0.000	0.750	1.333
	Subsoiling	2423	2668	0.013	0.908	0.364	0.750	1.333
56 HUF	(Constant)	381613	23424		16.292	0.000		
	Irrigation	3110	4518	0.009	0.688	0.491	1.000	1.000
	Previous crop	-102613	5534	-0.266	-18.543	0.000	0.750	1.333
	Hybrid_2	9528	5534	0.025	1.722	0.085	0.750	1.333
	Hybrid_3	-15400	5534	-0.040	-2.783	0.005	0.750	1.333
	Seed cost_HUF	1.266	0.623	0.029	2.032	0.042	0.750	1.333
	Fertiliser_HUF	7.105	0.158	0.560	45.058	0.000	1.000	1.000
	Year = 2016 (FILTER)	227659	5534	0.590	41.139	0.000	0.750	1.333
	Year = 2017 (FILTER)	41981	5534	0.109	7.586	0.000	0.750	1.333
	Strip_tillage	-36197	5534	-0.094	-6.541	0.000	0.750	1.333
	Subsoiling	5025	5534	0.013	0.908	0.364	0.750	1.333

Source: own calculation

in the following order. The biggest impact was seen in 2016 (0.59), compared to 2015. The cost of nutrient supply had the second greatest effect (0.56), followed by the effect of previous crop (0.27) and 2017 (0.11), compared to 2015. Strip tillage had the next significant effect (0.09) - compared to autumn ploughing. Seed cost (0.03) had a significant impact, too. The effect of the other examined parameters was not significant.

As shown in Table 8, of the expenditures indicated in monetary value, in addition to the cost of fertiliser application (3.4; 5.4 and 7.1 HUF HUF^{-1}) and the price of maize (56 HUF), the effect of seed cost (1.3 HUF HUF^{-1}) was above 1, and one-unit increase of the other expenditures (previous crop, tillage) did not result in extra income (beta values below 1). At the same time, the impact of crop year resulted in an increase in income compared to the 2015 base year in the case of all maize prices. Compared to 2015, the year 2017 had a smaller impact on revenue growth (20, 32 and 42 thousand HUF), while the impact of 2016 (compared to 2015) was the most significant (110, 173 and 228 thousand HUF).

Determining the optimum nitrogen active substance dose

Based on the examined regression models, we also analysed the impact of the change in maize prices over the past 10 years on the cost-effectiveness of fertilisation. As a matter of course, higher maize prices justify the use of higher fertiliser doses or more expensive fertilisers. On the basis of the examined data, one unit change in fertiliser prices result in the following revenue change in a similar direction in the case of the 2017 prices and the maximum and minimum maize prices during the last 10 years (Table 9).

Table 9: The effect of fertiliser prices on maize revenue

Maize price (thousand HUF t^{-1})	Regression coefficient of fertiliser
27	3.426
42.6	5.405
56	7.105

Source: own calculation

Based on Table 9, we concluded that the average efficiency of N fertiliser use in the 0-160 kg ha^{-1} range is far beyond the efficiency of both bank deposite and loan rate, even at low maize prices, which can be justified with higher risks from the economic aspect. The available data characterises only two active substance intervals (0-80 and 80-160 kg ha^{-1}), and the yield value surpluses they result in. As a matter of course, these values are only average figures, and the marginal efficiency of initial expenditures is much higher. At the same time, in the case of maximum doses, their application may no longer be recommended from the economic aspect. As a consequence, we made calculations to determine the optimum active substance level, which is suitable for achieving the economic outcomes above the bank investment level in the case of different model variants.

The effect of average maize prices on the revenue per hectare is shown in Table 10, averaged over all examined experimental parameters and all three years, using the most commonly used descriptive statistical indicators.

Table 10: Descriptive statistics of revenue per hectare in the case of different model variants

		maize price (thousand HUF t^{-1})		
		minimum	actual (2017)	maximum
		27	42.6	56
Mean	HUF ha^{-1}	269	425	558
Median		266	420	552
Std. Deviation		88	138	182
Range		414	653	858
Minimum		62	98	129
Maximum		476	751	987

Source: own calculation

The average potential revenue based on Table 10 ranges between 269-558 thousand HUF ha^{-1}, i.e., the worst and best market prices, while the standard deviation is between 88-182 thousand HUF ha^{-1}, which means a 32% coefficient of variation, suggesting that the reason for the observed significant heterogeneity is due to different experimental settings.

An important part of our economic analyses is the calculation of the fertiliser dose that is economically rewarding. The optimum level of production function is significantly affected by the selling price of maize, the considered opportunity cost, the regression coefficient for fertilisation shown in Table 9 and the active ingredient content of the N fertiliser, among other factors. Considering the effect of all these factors, the active substance content per hectare is shown in Table 11.

Table 11: N fertiliser active substance content to be recommended in the case of various maize prices

		maize price Ft/kg		
		minimum	2017	maximum
		27	42.6	56
yield value	thousand HUF ha^{-1}	269	425	558
average fertiliser cost *	thousand HUF ha^{-1}	50	79	103
fertiliser doses*	kg ha^{-1}	227	359	472
active substance content*	kg ha^{-1}	73	115	151

*based on the obtained regression coefficients

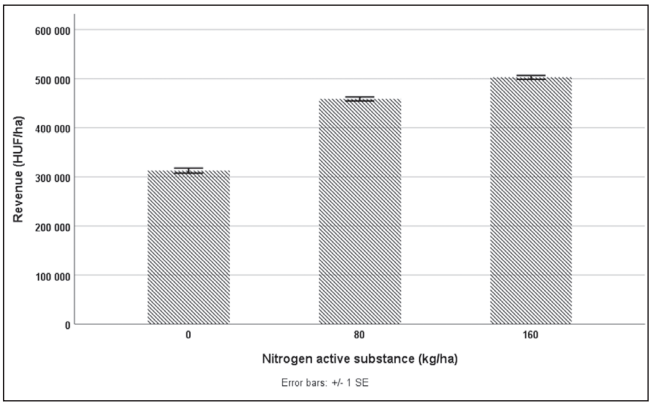
Source: own calculation

Maize price, as expected, has a very pronounced effect on the optimal dose of the fertiliser active substance and varies between 73-151 kg ha^{-1} in each model. These values are true only in the case of the N active substance price of 219 HUF

kg^{-1}, which is considered to be the current price. The change in active substance prices result in an identical, but opposite change of the optimum dose.

We would like to emphasise that the three fertilisation levels available to us (0, 80, 160 kg N ha^{-1}) provide a very limited opportunity for accurate decision-making. Figure 1 shows the average sales revenue for each fertilisation level, as well as the optimum active substance content obtained above. Figure 1 shows, in line with the principle of diminishing returns, that sales revenue increases until the expenditure level of 80 kg ha^{-1}. After this point, revenue increased to a significantly lower extent, i.e., it is more appropriate to carry out more intensive farming activities under more favourable market conditions.

Figure 1: Yield value to be obtained with nitrogen active substance doses used in the performed experiments.



Source: own calculation

DISCUSSION AND CONCLUSIONS

The obtained experimental findings confirm that yield shows a very close correlation with the yearly precipitation conditions in the case of all examined expenditures. Favourable crop years and irrigation are the main reasons for higher level of outputs, according to production functions.

Contrary to the earlier experiments at Látókép (Nagy-Pepó, 2015), irrigation resulted in practically identical yields with non-irrigated treatments (averaged over the three examined years). The difference between them depended on the extent and nature of the rainfall of each examined year. However, these differences were much smaller than in previous experiments.

It is important to emphasise that, although biological considerations and climate change may justify the installation of irrigation technology, there is a definite risk from an economic point of view, due to the significant increase in fixed costs.

In the rainy crop years, the economic outcome of ploughing far exceeded that of strip tillage, which corresponds to the findings of Randall-Vetsch (2005). Based on our calculations, however, subsoiling was more competitive than strip tillage (yield surplus) and ploughing (machine cost savings) during the three examined years.

By dividing the maize prices by the regression coefficients, it is possible to calculate the fertiliser cost per hectare, which can be considered typical (average) for the given experiments, although its efficiency varies. Since the latter value ranges between 343-711% (the additional fertilizer cost of 1 HUF results in an increase of 3.43-7.11 HUF in yield value, depending on the maize price), it significantly exceeds the considerable values of opportunity cost. Using the N active substance price, the obtained fertiliser cost per hectare was converted into fertiliser amount and, based on the N active substance content, into active substance amount, which can be used to achieve the average fertilisation efficiency of the performed experiments.

Of the individual expenditures, the rational increase of fertiliser doses is capable of affecting successful maize production both biologically (30-40% increase in yield and a weight of 0.56 in affecting yield) and economically (5.4 HUF HUF^{-1} average efficiency). These findings greatly support the importance of precision nutrient management. The second most important factor in yield was the previous crop effect (0.27). Our results attribute greater importance to fertilisation, while that of the previous crop is the same as the previous examinations at Látókép (Nagy-Pepó, 2015).

Of the random factors, the crop year effect significantly affected yields (0.11-0.59), resulting in a yield surplus of 32 HUF ha^{-1} in an average year and 173 HUF ha^{-1} in a rainy year, compared to a dry crop year.

According to our calculations, the average efficiency of the use of N fertiliser in the 0-160 kg ha^{-1} active substance range far exceeds the efficiency of banking investments, even at low maize prices. On the basis of the three-year average and the principle of additional efficiency, it is also advisable to apply 160 kg ha^{-1} N, provided that the marginal efficiency of doses close to 160 kg ha^{-1} is obviously significantly lower than the additional efficiency of the examined range; therefore, the accurate determination of the economical dose of active ingredient calls for applying significantly lower dose than the 80 kg ha^{-1} fertilisation range (with differences being up to 10 kg ha^{-1}). This calculation is in line with all previous experimental results (Nagy-Pepó, 2015; Balla, 2017; Dóka-Pepó, 2007; Győrffy, 1979), which confirm that the optimum of N fertilisation is above 120 kg ha-1. It should be noted that, in the European Union, there is a legal limit on N application from the environmental point of view (Nitrate Directive (1991) and Nitrate Regulation (2008), 170 kg ha^{-1} year^{-1}).

At the same time, the change in active substance prices may be significant and result in an identical, but opposite change of the optimum dose.

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SCIENTIFIC PAPER

THE INFLUENCE OF EMPLOYMENT MODES ON EMPLOYEE TURNOVER AND AGRI-BUSINESS PERFORMANCE: A CASE FOR HUNYANI FARM IN THE ZVIMBA DISTRICT, ZIMBABWE

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Abstract: *The labour intensive nature of Zimbabwean agriculture demands that farmers meet excessive labour requirements, at the same time keeping labour costs as low as possible to guarantee profits and achieve maximum business performance. This study, carried through a questionnaire survey, at the Hunyani Matura Farm, in the Zvimba district of Zimbabwe between from October 2017 to March 2018, investigated the effect of employment mode on turnover and agri-business performance. Data collected from the participants, was compared with the information from secondary source documents. From the results temporary workers performed better than permanent workers and they cited problems of low wages, poor working conditions, high work targets, inequality in work allocation, job insecurity and constant shuffling. Temporary workers had higher turnover and turnover intentions than permanent workers. Temporary employment mode had a positive effect on agri-business performance. This study recommends the use of permanent employment mode on key positions like forepersons, stores persons and supervisors, and temporary employment mode on general farm tasks, while seasonal contracts were seen good for skill demanding operations such as tobacco seedbed establishment, tobacco reaping and curing and grading. A ccareful selection of employment modes reduces inequalities and unhealthy attitudes at work and improves on farm business performance.*

Keywords: *employment mode, farm labour requirements, temporary labour, labour costs, staff turn-over, agri-business performance*

(JEL Classification: Q12)

INTRODUCTION

Today's business is carried out in an environment where the need for efficiency calls for employers to cut employment costs by shifting to manageable temporary and freelance workers (Huber, 2004:239). Economic hardships in Zimbabwe have weakened profitability and hence capacity of employers to hire labour. The high rates of unemployment have also led to a vast supply of labour and a general willingness for the unemployed to accept any form of employment and the conditions that come with it (Pasurai, 2017). Recent developments in the agricultural industry indicate general shift towards more temporary and informal forms of employment that the permanent forms due to the seasonal nature of the operations (Collins and Krippner, 1999:511). Of late, the

agricultural industry has not been performing to its best in Zimbabwe (Zimbabwe Agricultural Statistics, 2016).

The past employment practices under colonialism in Zimbabwe were oppressive to the blacks and were characterized by racial discrimination (Ncube, 2000:164). There were no jobs for which defined wages or remuneration were paid to farm workers (Aldrich et al. 2000). The employment system aimed at ensuring continuous supply of cheap labour, in the farms. According to the ILO(1978) the black people were not considered as employees and could not form or be part of any forum that determined employment conditions, and were not protected by law. The agricultural industry was mainly characterized by labour casualisation because of the seasonality of operations which caused fluctuating labour demands.

The post-independence period saw a boom in commercial agricultural production (Zimbabwe Agricultural Statistics, 2016), which enabled the employment of a significant number of reliable permanent workers. However, the droughts which followed in 1982/1983 and 1987/1988 cropping seasons disturbed agricultural activities (Maiyaki, 2010:4160).These droughts, together with the introduced minimum wages caused farm employers to be more capital intensive and contributed to the fall in agriculture's share of total formal employment from 35% to the 1990 figure of 24.3% (Ncube, 2000:165). This is because employment protection laws made it impossible to adjust the workforce levels in accordance with the economic downturns that followed (Ncube, 2000). Since the law allowed dismissal of casual workers, most companies started employing casual employees that could be laid off easily. This shift to flexible employment modes was also noted by (Chiripanhura and Makwavarara, 2000:23), who noted an increased tendency towards casualisation of labour, especially in large commercial scale agriculture where the percentage of people employed on full time basis went down from a peak of 75% in 1981-1982 to 47% in 1998. In 1989 the government gave back the liberty to the employer to lay off workers in an effort to achieve flexibility of the labour market (Ncube, 2000:163). Most employers laid off majority of permanent workers and the use of flexible employment modes increased as employers hired and fired at their convenience (Thata, 2015).

The land reform program implemented in the year 2000 to address the colonial imbalances in land ownership, resulted in the sudden exit of white farmers from commercial farms without compensation (Selby, 2005). By November 2002, an average of 85 percent of the farms had either halted or significantly scaled-down operations and reduced capacity to employ Sachikonye (2003), with a shift towards temporary employment modes (Wandera, 2011).

Permanent employment occurs when employees work on a regular basis for a stipulated average number of hours per week and the contract ties them to one organization for an unspecified length of time (George and Chattopadhyay, 2015). Temporary employment on the other hand is whereby employees are hired for a specified period of time (e.g., one month) (Ton and Huckman, 2008). "Short term employment" or part time is commonly defined as a job where the individual does not have an explicit or implicit contract for long term employment, the short term nature of the job being recognized by both parties (Nardone et. al., 1997). Some employers now employ temporary workers to fit in key managerial positions (Ongera and Juma, 2015:4).

Whilst the agricultural industry surely makes use of permanent employment modes, there are a number of temporary employment options for employers. Seasonal work is performed only at certain times of the year (Labour Act, 28:01; ILO, 2015; Filmer and Fox, 2014). Seasonal contracts are formulated in a way to guarantee employment continuously throughout the busy farming season. In casual work, an employee is engaged by an employer for not more than a total of six weeks in any four consecutive months (Labour Act, 28.01). Under casual employment, employers only make sure that the total number of days for which each casual worker is taken does not exceed six weeks in a consecutive period of four months and employers take casual workers only on the specific days needed (Jayne and Ameyaw, 2016); Yeboah and Jayne, 2016). Fixed term employment is defined by Ongera and Juma, (2015) as employment contracts for which the date of termination is pre-determined at the beginning of the contract and agreed on by either party to the contract of employment. According to the ILO (2015:23) these type of contract are less popular in the agricultural sectors of most countries. In Zimbabwe farm employers are allowed to employ fixed term contract workers for nine months contracts which are renewable six times (statutory instrument 16 of 2017).

Task work or piece rate forms of employment are ones under which payment is entirely determined by output per day (Jayne and Ameyaw, 2016). The targets can be daily, weekly or task based, completion of which guarantee employees a certain pre-promised reward (Jayne and Ameyaw, 2016:10). Mostly the payment could be flexed depending on size of tasks, where employer tries to encourage workers to put an extra effort for an extra reward (Jayne and Ameyaw, 2016:14).

Turnover is the average of total number of employees newly recruited and departed within a period, divided by the average number of employees over the period (Harris et. al., 2002:3). Temporary job contracts lead to increase in involuntary turnover rate by default and the opposite is true for permanent jobs contracts, all things being equal (Wandera, 2011: 193).

In general, business performance is defined as the operational ability to satisfy the desires of the company's major shareholders (Smith and Reece, 1999; Colase, 2009). In Zimbabwe most agri-businesses are still labour intensive because of the slow rate of farm mechanization (Zimbabwe Agricultural statistics, 2017), performance of an agricultural operation is deemed to be affected by such things as labour costs, employee productivity and

performance.

The effect of employment on profitability is mostly centered around its effects on cost. Whilst decreasing employee costs within an organization is a critical aspect of strategic human resource management with regard to competitive global market (Allen et al., 2016) as cited by (Wandera, 2011:189), many researchers have conflicting arguments about whether the use of temporary employment modes have a positive or negative effect on profits. George et al. (2015) advocates that it is less costly and more flexible to employ on temporary basis than on permanent basis because the use of temporary employment modes, allows firms to adjust their workforce to business-cycle fluctuations at relatively low termination costs (Nielen and Schiersch, 2014).

Hunyani Matura Farm is currently being run as a Strategic Business Unit (SBU) for the School of Agricultural Sciences and Technology. It farm has two sections which are the livestock section where there are cattle, sheep, goats and chickens, the later comprising the indigenous, broilers and layers; and the crop section which grows maize, soya beans, pastures trees, tobacco, potatoes (CUT, 2017). The crop section also runs a horticulture production which sees production of horticultural and field crops. It is also used as an experimental platform for agricultural research. The university finance department is the one that funds Hunyani Matura Farm projects and the accounts department thereof prepares the financial statements regarding income and expenditure. Hunyani Matura Farm, like any business unit is faced with a goal to make profit and maximize business performance. The labour intensity of operations puts on its shoulders the need to balance labour requirements with the need to lower costs. Whilst flexible employment modes are an attractive option, the need for experienced, trained and reliable people who uphold the production culture at the farm also cannot be denied. The maximum level, to which Hunyani Matura Farm can use of temporary employment modes before the disadvantages start to outweigh the benefits, is not clear. Given a labour intensive operation, employee's feelings and perceptions about the employment modes and their effect on turnover are also to be considered. There is need to ascertain how the overall performance of the agri-business is affected and come up with the best way to combine various employment modes.

A lot of research has been conducted which acknowledges the existence of various forms of employment and their effect on employee turnover and productivity, yet these have not been contextualized to the Zimbabwean economy. Furthermore, little has been done to contextualize studies to the country's agribusiness sector, where 70% of Zimbabwe's employment is derived (Maiyaki, 2010). Rogovsky (2005) has revealed the need to permanently employ the right people, for profitability and continued success of any business, citing employee turnover as contributor to quality decline and increase in training costs. Generally the number or percentage of workers who leave an organization and are replaced by new employees becomes high, the costs of training new workers also increases and generally, high employment turnover is accompanied by quality decline as the new employee still has to learn efficient ways of doing their job. However, in the Zimbabwean agri-business context, economic conditions and seasonality of operations make it more costly to keep a large number of full-time employees, necessitating flexible employment modes (Pasurai, 2017). On the other hand, some studies reveal that the use of nonstandard workers is not cost effective in, when other costs like productivity turnover are considered (Nollen and Axel, 1996). The study brings out how various modes of employment can be combined to maximize performance of a seasonal agri-business within a developing economy like Zimbabwe.This study sought to investigate the effect of employment modes on employee turnover and agri-business Performance using Hunyani Matura Farm as a case study. It is hypothesized in this research that the employment mode has a significant influence on employee turnover, employee performance and farm business performance.

METHOD

Site description

This study was conducted at the Hunyani Matura Farm in the Mashonaland West Province of Zimbabwe. Hunyani Matura Farm is in the Zvimba District. The Hunyani Matura Farm is situated 120 km Northwest of Harare, just after Manyame river on the north eastern end of the main campus (CUT Weekly, 2016:1) and was given to the university under the land reform program in the year 2005. The farm area is 550 hectares. Hunyani Matura Farm is in the Natural Region IIb area of Zimbabwe, which is characterized by mean annual rainfall of approximately 600-850 mm yr-1 and mean daily temperature of 26°C (Surveyor General, 2002). The coordinates of the Research Farm, Teaching and Extension Unit are: 17° 21' 0.00"S, 30° 12' 0.00"E (Latitude:-17.3500; Longitude: 30.2000). The site is at an elevation of approximately 1.158 m above sea level. The site soils on the study site are well drained clay loam soils. In general the area in which Hunyani Matura Farm is located is a hub for agriculture, with soils and climate suitable for commercial agriculture that involves production of maize, soya, tobacco and several vegetable crops

Data collection

Population of the study

The population of the study was personnel from Hunyani Matura Farm, that is, the permanent employees (13) and the temporary employees (at least 60 at a given time). The total population was then made up of 13 permanent workers and a fluctuating number of temporary employees. This is because farm operationsare busier at certain times of the year than the others.The Farm Manager was purposively chosen because he is the key person who plans

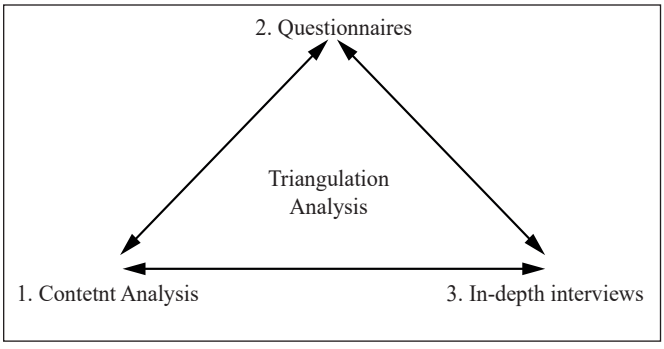
production, and has the knowledge about the fluctuation of activities and the labour requirement trends. The farm manager presided over the activities of both permanent and temporary workers. The livestock section had three (3) permanent employees and these were chosen owing to their small number. There were five (5) permanent field workers who were chosen since they are the people who work with different temporary employees on daily basis. There was one (1) farm driver on a permanent contract who was chosen. There were also two (2) security guards employed on permanent basis, one for the livestock section and one for the crop section. The one for the crop section (where the bulk of casual workers work) was purposively chosen. There is also an employment register keeper employed on permanent basis.

A total of forty (40) casual workers were randomly chosen because of their large number (120 -150. The study therefore relied both on purposive sampling in some areas, targeting knowledgeable respondents who are aware of the employment policies, the management of employment contracts and the profit and productivity and performance trends being explored, to promote a deep understanding of phenomena under investigation (Mhlanga, 2008; Yin, 2009); and random sampling on other instances like the selection of temporary workers because of the size and homogeneity of the sub population.

Sampling Strategy

This study utilized stratified sampling where participants were first grouped into the following subpopulations; Hunyani Matura Farm management, permanent workers, temporary workers. The study then made use of purposive sampling, targeting knowledgeable respondents including managers, and random sampling on the selection of temporary workers.

Figure 1: Triangulation of data collection methods Source: Adapted from Jona (2015), Research Methodology in Journalism and Media Studies, (IJM 5201)



The triangulation of data collection methods (Figure 1) was used as an attempt to explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint (Cohen and Manion, 2005). The aim was to increase credibility and validity of results, under the expectation that either two or three of the selected methods will produce similar results. Triangulation was also applied to guarantee that the shortcomings of one data collection method would be addressed by the strength of the other.

Questionnaires

Structured questionnaires would help the subjects to explain the interaction between the phenomena under study in confidence without the interference of the researcher (Kawulich, 2005). The questionnaire consisted of 25 questions designed to obtain information on social biographic data of age, sex, tenure and level of education of workers and, also information on work allocation, ability to meet targets, perception on compensation and wok relationships.

In-depth Interviews

The interview technique was most applicable within this study because interviews, according to Yin, (1994) offer the possibility to gather knowledge from participants who are familiar with the research topic. Conducting interviews made it possible to clarify vague answers by probing and allow observation of non-verbal expressions which made it easier for researcher to understand verbal responses. Aspects like relationship among workers, standard allocation of work by managers as well as the general work atmosphere. The interviews allowed respondent to express themselves freely and reduce the risk of incorrect information, the presence of the interviewer may have influenced the manner in which the questions answered.

Content analysis of Secondary Source Documents

Secondary data is gathered and recorded by someone else prior to the current project (Constantine: 2001). Existing information included internal records like employment registers, production and financial records. Whilst the method could provide even unwanted data, it is cost effective and rules out the involvement of a third party, at the same time providing readily analyzed data which is incorporated easily into the research.

Data Presentation and Analysis plan

The data was input into a spread sheet and Microsoft excel tool were used to analyse the data. Chi-square test of association was used to bring out relationships among different variables, while graphs were plotted using Microsoft excel. This study also used pattern matching of findings against a backdrop of literature reviewed. According to Carolyn J. and Knight J. (2002), pattern matching is a useful technique for linking in – depth interview data to theoretical propositions guiding the study. Thematic analysis was used for data presentation and analysis through constructing themes that are related to the four objectives of the study. Thematic analysis, according to Jensen (1982: 247) enables the study to compare, contrast, and abstract all constitutive elements of meaning with ease, thus making the analysis orderly, concrete and smart.

RESULTS

Descriptive statistical evaluation of the different models

The employment modes at Hunyani Matura Farm and the provisions under them

Hunyani Matura Farm engaged workers under permanent, fixed term and casual employment contracts.

Permanent Employees

The permanent workers consisted of general hands, drivers and farm managers. The permanent general hand employees had a basic salary of at least US$400/ per month. All permanent workers were engaged for 8 hours a day and their contract provided for payment of overtime and night shift allowances. Permanent workers had access to free health services in cases of injuries on the job, and were also provided transport to and from work. The permanent employees got personal protective clothing and had access to loan facilities both from the university.

Casual employees

Casual employees' contracts were not engaged on form of written contact and Ewere paid on a daily rate of US$3. Some casual workers had night shifts in irrigation and tobacco curing for the same daily rate of US$3.The casual employees were also given access to medical supplies for injuries on the job and transport to and from work. In some cases a casual employee would bring their working tools like hoes, axes, mattocks and picks to work. The casual workers were taken on daily basis for performance of specific tasks. There is no provision for safety clothing for the casual workers.

Fixed term contract employees

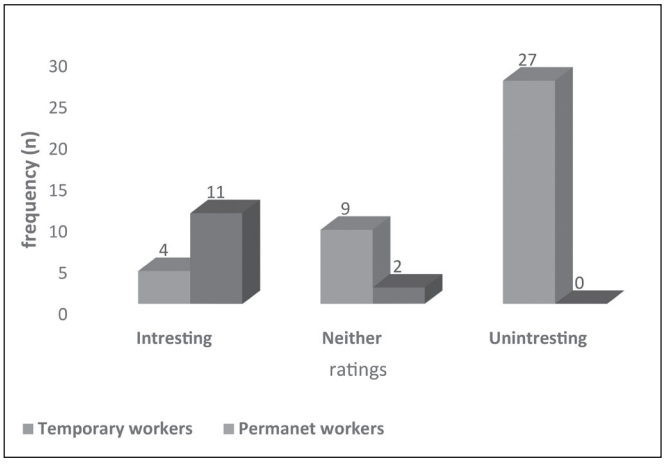
All fixed term contracts were 6 months long for such roles as drivers and security guards. The fixed term contract workers were provided with personal protective clothing, were paid at the rate determined by the National Employment Council of Zimbabwe and also got transport and medical services, but their contracts do not provide for any form of night duty allowance.

The Hunyani Matura Farm sometimes provided farm produce for preparation of lunch and breakfast for all the workers.

The effect of employment modes on employee turnover

Ninety percent (90%) of the casual workers had been engaged for a period of less than a year, whilst all the permanent workers had been at the farm for at least 3 years. Most (67 %) of these workers did not have the basic five ordinary level subject passes. A high turnover intention was identified, with 72.5% of the casual employees indicating expectation to work at Hunyani Matura Farm till they find "a permanent job". Sixty seven (67.5%) percent of the casual workers found work uninteresting and 22.5% found work neither interesting nor uninteresting and the rest (10%) indicated that work at the farm was "interesting". However, all permanent workers found work "interesting" at the farm and none indicated an intention to leave Hunyani Matura Farm (Figure 2).

Figure 2: Employee responses on whether they found work interesting at Hunyani Matura Farm

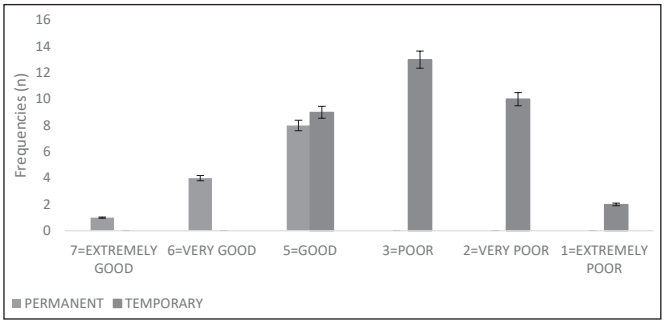


Source: Primary data

Eighty nine (89%) percent of those who found work uninteresting cited too high daily targets with an inequitable pay rate, poor working conditions and the insecurity of not being guaranteed of a job the very next day," as the major reasons why they found work uninteresting citing "big work-loads, lack of personal protective clothing and the chasm between casual and permanent worker wage rates" as the major reasons.

The participants were also asked to rate the working conditions at Hunyani Matura Farm (figure 4.3).The modal rating for the permanent workers was the "5=Good" (n=8), while that for the temporary staff was the "5= Poor" (n=13). A chi-square test of association between mode of employment and the rating of working conditions was highly significant ($p < 0.05$) (Ho=no association) (Figure 3).

Figure 3: Employee ratings on working conditions at Hunyani Matura Farm



Source: Primary data

Ninety two (92.5 %) percentof the temporary employees felt there was a mismatch between their expectations and what they finally found upon getting hired. Eighty seven (87.5%) percent expected to secure a permanent employment within 6months of engagement, while 65% (26) expected regular wage increases. Hunyani Matura Farm was not an employer

of choice to most temporary employees (98%) because the conditions of employment and wages were perceived better at neighbouring farms. The perceived better conditions in neighbouring farms included "a pay rate of US$4.5 per day; workers pick up glean produce from the field; daily targets achievable; always engage on seasonal contracts; always provide protective clothing". Some 85% of the casual workers indicated that they had no other source of income besides working at Hunyani Matura Farm.

Effect of employment modes on performance of the Agri-business Unit

Hunyani Matura Farm was also assessed in relation to the aspects proposed by Colase (2009:) as cited by (Achim and Borlea, 2012), which are profitability, growth, productivity, efficiency, competitiveness and productivity. In an effort to facilitate an accurate and coherent data presentation, analysis and interpretation of the research findings the researcher adopted the use of tables by Mapolisa (2015) to highlight main themes and their sub-themes, together with their substantiating statements. Researcher first highlights perception of managers and the farm director then tries to back this up with what the farm reports revealed and the questionnaires revealed. A close examination of Hunyani Matura Farm reports was done to bring out production, profit, sales and labour costs trends.

Table 1: Theme(s) and sub-themes regarding performance of Hunyani Matura Farm in relation to the employment under various modes comparatively, basing on the perspectives of Managers

Theme(s)	Sub-themes	Substantiating Statements
Performance of the business operation	1. Profitability	" It's far much cheaper to work with temporary employees at US$3 per day that permanent staff at US$400 per month" Manager B "Assuming they come to work 30 days a month, temporary employees earn 90 dollars a month that's significantly lower than the US$400 for permanent workers....honestly no one can argue with such a reduction in labour costs ..." Manager A
	2. Employee performance	"If you really want to get things done on a time scale, the casual workers can get things done... permanent workers have a sense of superiority over the casuals, you can only get results from them if you give them a supervisory task which feeds their ego" Manager A"…you give them (temporary employees) daily targets you are guaranteed they put their best to it because their working day is complete when the task is done" Manager B "…temporary workers perform better than permanent workers because first they want to continue being taken for the job and secondly the day is only marked in the register if the given task is completely done. '' Foreman
	3. Growth	"we have tremendously grown in terms of scope of activities, market share and sales revenue ever since we flexed our employment contracts" Manager A

Source: Adopted and adapted from Mapolisa 2015:160

Business growth

In an effort to analyze performance in terms of growth, researcher came up with a few sub themes under the theme "growth" (table 3).

Table 2: Theme(s) and sub-themes regarding growth at Hunyani Matura Farm in relation to sales revenue, market share and scope of activities, basing on the perspectives of Managers

Theme(s)	Sub-theme	Substantiating statements
Business growth	Sales Revenue	"By October 2017 daily sales from horticulture were averaging US$400 per day… by December 2017 the highest recorded amount of daily sales was US$1700 at times when we were selling potatoes." Manager A "In 2016 we generated an amount of almost US$66 000 in revenue from maize only and 43 000 revenue from tobacco up from less than US$1000 which was received from each of the crops in the previous year… before 2015 we could hardly achieve sales of 20000 from all farming activities." Manager B
	Market share	"Most tobacco farmers in Mash West who used to get seedlings from Kutsaga Research station seeds in Harare now come to Hunyani Matura Farm for tobacco seedlings (US$9000). We have Customers coming to buy our cabbages and butternut from as far as Kariba, Mhangura, Karoi, Banket and Chegutu…we now supply maize to GMB…we also sell produce to the University community…" Manager A'We now supply local Supermarkets with green beans, carrots, butternut etc. Most vendors in Chinhoyi come to buy direct form our field and we also have a lorry that carries farm produce to the Chinhoyi Market place. Our crop section also supplies the livestock section with maize for livestock feed... truth is we never used to produce enough to meet all such demand before 2015" Manager B
	Scope of activities	"If we had not switched to employment of more temporary workers we would not have been able to increase the both the number of our crops and the scale at which we grow them...We managed to increase our horticultural projects from 1 hectare to a total area of 30 ha… we introduced tobacco(30 ha) and also increased maize area from 10 to 35 ha" Manager A " We have successfully increased number of crops and area without any staff shortages... actually our activities are expanding every year since we started hiring under flexible modes…we are even growing gum trees" Manager B "…by reducing our labour cost we were able to support expansion of more farm activities therefore we increased our area of almost every crop we used to grow and also introduced new crops such that we now make better utilisation of our capacity…we are considering taking baking back the portion of land we previously leased to the Chinese" Farm Director

Source: Adopted and adapted from Mapolisa 2015:160

Table 3 below shows increases in area of commercial maize from 10ha to more than three times as much from 2015 to 2017. Tobacco area also increased form less than a hectare of experimental crop in 2015 to a peak of 30ha by 2017. Hunyani Matura Farm also introduced soy bean at ten hectares in 2017.

Table 3: Summary of Crops grown, Area, Yield per hectare, Total Output and Sales Revenue realized from 2015-2017 based on Hunyani Matura Farm production and sales records

	Maize			Tobacco			Soy Bean		
Year	2015	2016	2017	2015	2016	2017	2015	2016	2017
Total area (ha)	10	20	35	0.5	30	22	0	0	10

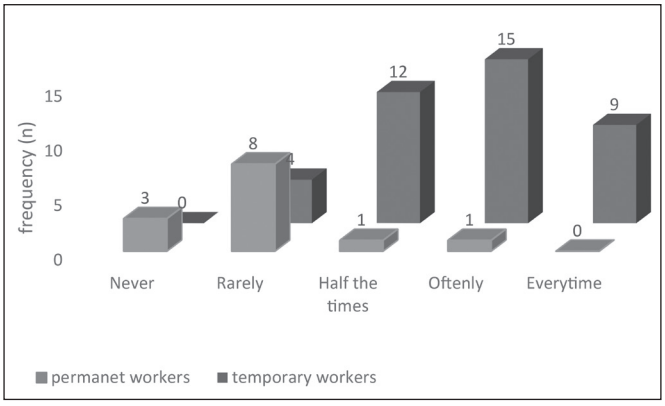
Source: Secondary data

Employee performance

Eighty five (85%) percent of the temporary employees felt the temporary workers performed better than the permanent workers. Both farm managers concurred and surprisingly almost half (46 %) of the permanent workers admitted that temporary employees performed farm duties better than permanent employees citing that

- "The permanent workers boast over their salaries higher wages that that of temporary workers …they spend the day loitering and shunning the work"
- "When given a combined task with temporary workers, the permanent workers drag down because they don't lose anything if they fail to finish …"
- "When tasks were completed early temporary workers would be free …permanent workers always knock off at 5pm"
- "its better to make them work separately"

Figure 4: Employee responses on ability to meet daily targets at the Hunyani Matura Farm



Source: Primary data

The modal rating for the permanent workers was the "Rarely" (n=8), while that for the temporary staff was the "Often" (n=15). A chi-square test of association between mode of employment and the ability to meet daily targets was highly significant ($p < 0.05$) (Ho=no association), showing that there is a relationship between employee performance and employment mode. It can also be noted that the ratings for the temporary workers are skewed towards the positive ratings and the opposite is true for the permanent workers' ratings.

DISCUSION

The basic salary for farm permanent workers of at least US$400 was significantly above the National Employment Council (NEC) rates and the rates in the collective bargaining agreement between farm workers and farm employers of US$3 a day or US$75 per month. The 8 hours per day, for which the permanent workers work, the overtime and night shift allowances, were in line with Zimbabwean Labour Act (28:01). Workers at Hunyani Matura Farm had access to free health services at the Chinhoyi University of Technology clinic in cases of injuries on the job. Providing transport for the permanent workers was on the other hand an expense but on the other it ensures workers are at work on time every day to avoid unnecessary delays. Providing safety clothing for the permanent workers was not only in line with basic safety requirements, but it also ensures that the workers can work with free minds without fearing for their health. However there was need to improve on safety for workers working in tobacco bans, to avoid respiratory problems.

The use of unwritten contracts meant there were no stipulated task definitions, durations of employment or conditions thereof. The casual employeeswere paid on a daily rate of US$3, as by then required by both NEC and under the collective bargaining agreement betweenfarm workers and agricultural employers in 2016.

Defining the working day by a specific a task was a reliable performance management technique. However, since a day was deemed completed when the task assigned was completed, regardless of the time taken to complete it or the time of day the task gets finished, the workers might be vulnerable to exploitation in cases when tasks could be increased without a corresponding increase in wages. There was need to standardise tasks to avoid perceptions of exploitation and keep good attitude towards work.

Provision of access to medical supplies for injuries on the job to casual employees was not only an ethical employment practice, but could make the casual workers feel important and as part of the farm "family". Whilst providing transport to and from work for the farm workers was an additional expense, it also ensures reliable supply of manual labour on a continuous basis and timely start of daily operations. Although the unwritten requirement for casual employees to bring their working tools to work reduces risk of theft of equipment by employees, doing this without giving an allowance for the tools, could be viewed as an unethical employment practice since the employer was paying the same wage for both the labour and his tools. The use of casual employees whose contracts were subject to renewal on daily basis, gave rise to the need to closely monitor work registers to ensure compliancewith labour provision in terms of maximum period of engagement for temporary workers. The lack of provision for safety clothing for the casual workers could be demotivation.

The use of fixed term employees provided a certain level of job security as compared to temporary workers.

The provision of farm produce for meals at work also ensured workers were well fed and had strength to perform tasks (Parker 1994).

The high turnover intentions at the Hunyani Matura Farm were similar to the findings of other researchers elsewhere (Wandera 2011), and could be due to absence of a legal obligation to stay in the absence of any written contract. The simplicity of the farm tasks for which Hunyani Matura Farm hires casual employees, made it easier to replace without incurring significant training costs. It also explained the lack of effort by farm management to control turnover levels.

The Lack of skills, basic educational qualifications or total illiteracy among the temporary workers gave the leeway to farm management to keep wages to the minimum. Without any special skill, the casual workers were easily hired, fired and replaced without much disturbance to the flow of work (Costa and Silva, 2007). According to Nonaka and Takeuchi (1995) the constant hiring actually allowed employers to gain from new knowledge that comes in new employees.

The significantly high levels of dissatisfaction among casual workers could be because of the cited heavy workloads, low wages, lack of protective clothing, general mismatch between expectations form work and what eventually materialized, and unequal treatment as compared to their male counterparts. According to the Equity theory workers who perceive a breach of the general "equal work for equal pay principle" may end up sabotaging work, or stealing to achieve a perceived balance between what their work efforts and what they get from work (Fisher, 1948). Workers who fail to strike a psychological balance end up leaving or intending to leave (ILO, 2015). According Wandera (2011) short term employment has underlining certain characteristics that make short term workers more prone to work related strain which causes dissatisfaction, poor performance (Rousseau and Libuser, 1997) and high intention to leave.

Matura Farm has strict a performance management policy for temporary employees which ties their output to reward. On the other hand the fact that there is no extra incentive to permanent workers, tied to the completion of daily targets and no punishment resulting from not meeting the daily target as opposed to the assertion by Taylor (1996) whose scientific management theory linked compensation to output. The general contentment, relaxation and less anxiety in permanent employees could be a result of satisfaction derived from being paid above national rates, provided safety clothing, less supervision in terms of targets and feelings superiority to the temporary counterparts.

The increase in market share could be emanating from ability to satisfy higher levels of demand which comes from increase in capacity to employ more labour in the form of cheaper temporary contracts, to support expansion. Reduction of permanent workers and replacement of these by cheaper temporary employees results in release of funds for expansion and increased capacity to employ more labour to support the expansion. Hence the ability to meet higher demand levels

The growth in output and increase in the production portfolio means increase in variety for the customer and hence more customer satisfaction. It also means generation of more streams of revenue and profit. However there is need to watch out for overproduction which result in reduction of average prices and hence revenue and profit. The ineffectiveness of terms combining temporary and permanent workers emanated from the difference in both contract provisions and wages, whereas the same differences do not exist in the nature and size of tasks, resulting in perceptions of unfairness.

It was also found out that temporary workers had high levels of dissatisfaction, high turnover intentions and low commitment to Hunyani Matura Farm, agreeing with (Rousseau and Libuser, 1997:107, Wandera 2011:193). Despite the expense involved in the use of permanent employees, almost all of them indicated a high level of job satisfaction and zero turnover intention as evidenced by their positive ratings on working conditions.

CONCLUSIONS

Hunyani Matura Farm utilised permanent employment contract, fixed term contracts and casual work arrangements. The farm uses more of casual work arrangements than any other mode of employment. Workers employed under contract and casual employment modes had a higher level of job dissatisfaction than those who were on permanent mode of employment. Although temporary and casual workers had high intention to leave, the two categories had higher work output than their permanent counterparts, indicated by ability to complete their daily targets all times. The high labour turnover Hunyani Matura Farm had different implications continuity of agricultural operation. A change from permanent to temporary employment mode reduced the cost of production, increased profits, increased growth in sales revenue, scope of activities and market share. The Farm also became more productive both in terms of total area under production and yield per hectare.

RECOMMENDATIONS

Therefore, based on the findings of this study, the best combination of employment modes for Hunyani Matura Farm is one which involves:

- A few permanent employees who occupy key positions that require specially qualified and stable employees with high commitment and no intention to leave. This is because of their high level of stability and intention to stay. These positions should include people in supervisory positions, stores and requisition positions, employment record keeping and also the directors, since changing key management every three years is likely to result in disruptions to the equilibrium.

- As many as needed more productive and cheaper casual workers to occupy the simple easy tasks which require no special skill or qualifications and which are flexibly hired, rotated and replaced.
- Seasonal contracts for supervisors of seasonal tasks that require specific knowledge and job experience. With reference to Hunyani Matura Farm, these take form of supervisors for specialised tasks like tobacco drying and grading. These should be employed to oversee the drying and grading of tobacco to train the casual workers taken in that regard. Attractive seasonal contracts should be drafted for these to enable Hunyani Matura Farm to get the best experienced candidates and minimise loss due to mistakes.

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SCIENTIFIC PAPER

THE RELATIONSHIP BETWEEN CORPORATE GOVERNANCE AND CORPORATE SOCIAL RESPONSIBILITY

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Abstract: *Corporate governance (CG) is a corporate governance system for large companies which includes policies and procedures for corporate social responsibility (CSR). The present study examines the relationships between CG and CSR, and analyzes the studies that separate or combine the explanation of the two concepts.CG can be interpreted as the relationship between governors and stakeholders. Angyal (2009) and Auer (2017) agree that the two phenomena coexist and are connected at several points. The goals of the two phenomena are intertwined, compliance with other important requirements (environmental, labor law) besides the primary corporate goal. CG is a system based on the sharing of power and roles between owners, management and boards (board, supervisory board). The roles of ownership, supervision, and control are separated. The division of power means that the boards keep the management under strict control and the owners can account for the boards (Tasi, 2012). According to Tasi (2012), responsible CG involves careful management; financial planning and implementation; control mechanisms for the operation of the company; company transparency and business ethics issues; publicizing corporate information and corporate social responsibility policies and practices.*
Angyal (2009) sees that CG and CSR are intertwined "neither intersection, nor intersection, nor parallelism, but coexistence". (Angel, 2009: 14). It does not agree with the incompatibility of corporate governance or corporate governance and social responsibility, in practice the former two are more common. Corporate governance encompasses corporate social responsibility policies, procedures, and can be interpreted as the relationship between governors and stakeholders. The authors of the studies analyzed agree that the two phenomena coexist and are connected at several points. The goals of the two phenomena are intertwined with compliance with other important requirements (environmental, labor law) besides the primary corporate goal.

Keywords: *Corporate Social Responsibility, Corporate Governance, multinational companies.*
(JEL Classification: G30; G39, M14)

INTRODUCTION

Corporate Governance (CG) is the system of big companies that includes corporate social responsibility (CSR) policies and procedures. CG in Hungarian means social responsibility, more specifically corporate steering. The term, responsible corporate governance, is often used in Hungarian literature. In addition, the corporate word appears meaning company, so the word composition is also used as responsible corporate governance (Kecskés, 2011).

CG or company management has been known for more than 150 years in the management of business organizations and was included in the management literature as a concept. CG is often interpreted in many ways. Fayol already distinguished it in 1918 as the most important factors of government such as owners, directors, CEOs and their tasks (Fayol, 1984). One such definition states that the relationship between shareholders, management, public authorities, and supervisors or any other person and organization interested in the operation can be called corporate governance. On the other hand, CG creates and adheres to the principles and rules that govern and limit the people who act on behalf of

the company (Peter Druckert, 1993 in Angyal, 2001). One of the other definitions that identify governance with leadership states that governance means, which policies the company pursues and how governance manages and serves its interests (Wood, 1994- in Angyal, 2001).

Another CG definition is the organizational solution which represents and serves the interests of the company's investors (Mayer, 1995 in Angyal, 2001). In every country and age, corporate governance has been defined as the set of rules that have allowed the oversight of companies (O. Pastré, 1994 in Angyal, 2001), CG (solution) is the system by which companies are managed and regulated (Sir Cadbury, 2000 in Angyal, 2001). Based on the definition of the German Corporate Governance Code, the concept of corporate governance and social responsibility already seems to be linked. The Codex regards the continuous increase of the value of the company as the essence of governance and sets out three target systems: 1) legitimate, lawful behavior, 2) economic gain, and 3) moral and social responsibility.

Corporate governance or responsible corporate governance is the systems of big companies; a system based on the sharing of power and roles between owners, management and boards (board and supervisory board). According to the roles, ownership, supervision, and leadership roles are separated. The division of power in this definition means that the syndicates keep the management under strict control and these syndicates are accountable to the owners (Tasi, 2012). According to Tasi (2012), responsible corporate governance involves careful management; financial planning and implementation; control mechanisms for the operation of the company; company transparency and business ethics issues; publicizing corporate information and corporate social responsibility policies and practices. Angyal sees that CG and CSR are intertwined in a "neither intersection, nor junction, nor parallelism, but in a co-existing faze which prevail above all." (Angyal, 2009: 14). He does not agree with the incompatibility of corporate governance with social responsibility. Furthermore, according to Angyal (2008), governance and responsible behavior can be interpreted by observing the relationship between governors, syndicates and stakeholders.

MATERIALS AND METHODS

Interpreted at the level of large companies, CG means: the long-term goal of securing the growth of investor wealth, meeting the needs and expectations of the social environment, harmonizing economic and non-economic goals, and ensuring global competitiveness in line with the mentioned above three. According to Angyal (2001), CG can be described by the following concepts: the stakeholders' relationship with one another, regulation of corporate life, and the allocation of power within the company, shared power, special organizational solution, associate management, and collaboration between them. By interpreting the concept of corporate governance, Angyal continues Chikán's (2000) idea that the consumer is not a king but a partner, but winning him is a prerequisite for the survival of the company and adds two more points to company management, investor confidence and social satisfaction (Angyal, 2001).

According to Auer (2017), corporate governance and corporate social responsibility are linked at several points. His point of view is that corporate governance is an "inside system focusing on the internal structural mechanisms of the company", while corporate social responsibility is focused on "extern processes", taking into account non-statutory ethical standards (Auer, 2017: 27). The goals of the two phenomena are linked so those in both cases, besides the primary goal of the company (profit maximization), the completion of other requirements (environmental protection, labor law, etc.) are important. Corporate governance has emerged in the specialized literature as a response to corporate scandals, while social responsibility involves more complex problems than solutions to environmental, economic, and societal difficulties (Auer, 2017).

Braun (2015) regards corporate governance as one of the areas of social responsibility, while Kun (2009) regards corporate governance as a system of corporate social responsibility within the company.

According to Auer (2017), responsible corporate governance and corporate social responsibility appear at different levels within the company, and at the strategic and operational levels, if appropriate behavior is established in these areas, corporate governance will also work effectively.

Effective corporate governance can be achieved by adhering to the principles of business and ethics, in which much depends on the impeccable, and moral integrity of the leaders.

Moral principles cannot be disregarded from business operations, and compliance with basic moral laws prevents the person responsible for corporate governance from acting. Rules-based corporate governance should not be opposed to ethical leadership, and in this the moral power of economic factors plays a major role.

RESULTS AND DISCUSSION

The evolution of corporate governance is also a new area for economic historians, writes Herrigel (2006). In addition, he says that CG (Corporate Governance, Corporate Steering) refers to the processes that shape the relationship between company owners and management.

Based on the OECD guidelines (2004), good corporate governance is the rules and practices that guide the relationship between the company, managers and shareholders, as well as stakeholder relations, such as employees and creditors, who contribute to growth, financial stability, market confidence, strengthening the financial market integrity and economic efficiency.

Corporate Governance research by Herrigel (2006), OECD Principles (2004), Kirkpatrick (2009), Zandstra (2002), Alpaslan (2009), Johnson and Greening (1999), and Fama (1980), has highlighted that knowing the characteristics and evolution of corporate governance not only helps us

better understand the dynamics of companies' performance and economic development, but also how the events of the company and the political and legal order change and relate. Herrigel (2006) presents the historical evolution of the corporate governance system of five countries (United States, United Kingdom, Germany, France, and Japan) and discusses corporate governance in a chronological order within a given country and, at the same time, the cross-sectional differences between countries. Countries are grouped by the author according to concentrated and diffuse ownership systems, and corporate ownership is embedded in social, institutional and power systems. Herrigel described the features of a concentrated and scattered ownership system. In the concentrated case, he wrote about weak securities markets, owners controlling large blocks of shares, low market transparency, limited role of the corporate market, and the monitoring function of large banks. The diffused ownership system is the opposite of the former, where it refers to strong securities markets, strict requirements for corporate information provision, market transparency, and an active corporate market.

The OECD Principles of Corporate Governance (2004) provides policy-makers, regulators and market players with specific guidance to improve legal and regulatory framework conditions that underpin corporate governance, as well as advice on stock exchanges, investors, organizations, and other parties involved in the process of developing good corporate governance. The Principles cover six important areas of corporate governance that provide the basis for an effective governance framework: 1) shareholder rights, 2) equitable management of shareholders, 3) the role of stakeholders in corporate governance, 4) disclosure, 5) transparency, and 6) the responsibility of the board of directors. The key to the success of the Principles is that they are fundamentally based and non-prescriptive, so they can retain their validity in changing legal, economic and social contexts. The necessary legal / regulatory framework is an essential requirement to support effective corporate governance, which should be an integral part of the Principles. On the other hand, the aim is to create an effective system of brakes and balances between the board and the management. Managers have a key role in multi-owned companies, and monitoring is required to avoid potential misuse of their positions.

Kirkpatrick (2009) says that the post-2000 market and macroeconomic environment is the one that expects the corporate governance system to be: management boards need to be aware of the company's strategy and risk appetite; in order for these to be compatible with corporate goals and risk appetite. Kirkpatrick formulates the concept and purpose of enterprise risk management (ERM): "The process influenced by the board of directors, the management, and other actors in the corporate staff, is used in the strategy-making process for the whole company, used to identify potential events that may affect the entity and manages the risk within the limits of risk appetite, in order to gain reasonable assurance on the achievement of the entity's goals."

The ERM consists of eight components:

- External environment: it encompasses the nature of the organization and provides a basis for managing the risk and for which members of the entity are involved;
- Target designation: The goals had to be formulated before the management can identify potential events that affect their targeting;
- Event identification: it is necessary to identify external and internal events that affect the entity's goal achievement, distinguishing between risks and opportunities;
- Risk assessment: risk analysis is carried out with regard to the probability and impact as a basis for deciding how to manage them;
- Risk response: management selects risk responses by planning a series of actions, sorting out risks according to the entity's risk tolerance and risk-hunger;
- Control actions: procedures and policies are set up and implemented to ensure that risk responses are effectively carried out;
- Information and communication: relevant information is identified, acquired and communicated throughout the organization in a form and timeliness that enables people to assume their responsibilities;
- Monitoring: The completeness of the company's risk management is monitored and changes can be made if necessary.

According to Kirkpatrick (2009), ERM becomes visible in three dimensions: the goals, the totality of the company and the framework. Defining goals proceeds: strategic, operational, meaning efficient and effective use of resources, reporting that includes reliability and consistency with applicable laws and regulations. These can be applied at enterprise, division, business unit and subordinate levels.

Zandstra (2002) claims that the company may fail if the board cannot operate morally and ethically. He mentions the failure of Enron as an example. President Bush at this time worked out a plan to clarify the core issues of corporate responsibility, but he forgot to take into account one of the important weaknesses of corporate governance, says Zandstra (2002), whose duty is to oversee the company, to trust the public and the shareholders, and to build trust with his actions. Corporate governance is also the responsibility of the investors and the monitoring of the company law. Enron would not have been saved by a new set of regulations or new versions of laws or accounting practices. Examining the fall of Enron, Zandstra believes that as long as all companies are governed by state law, the state has no legal requirements for eligibility for board membership.

The boards must have at least 3 functions:

- The Board is responsible for providing the company with the air of legitimacy. Members must be people with expertise and business experience. Their affiliation with the company must be trusted, awaken to those who buy the company's shares;
- Focuses on auditing and legal requirements. Auditing is usually done by the Audit Committee, which is a department of the Management Board;

– Administrative role. The Board of Directors is expected to define, amend and approve the business plan. Corporate executives are responsible for entering into a dialogue with the board of directors, for supplying and executing the decisions of the board giving them the necessary inputs if the situation requires it.

Zandstra (2002) highlights an important element of corporate governance, and claims that a company may be prevented from collapsing by a properly functioning board of directors, if its members are willing to take their ethical responsibility seriously for their shareholders and their public responsibility.

Alpaslan (2009) believes that many of the traditional corporate governance thinkers agree that within legal constraints and ethical practices, the only duty of managers is to maximize shareholder value (Friedman 1970, Jensen & Meckling 1976, Vidaver-Cohen 1998: 395- 397, Jensen 2002 in Alpaslan 2009). He asks what happens in the context of a conflict or a crisis when someone tries minimizing the loss of stakeholders with the goals of maximizing shareholder value. In line with the traditional corporate governance principle, managers can only minimize the losses of stakeholders if they maximize shareholder value without violating the legal rules and ethical practices of society.

Alpaslan points out that although the shareholder model dominates corporate governance practices (Bradley et al. 1999, Margolis and Walsh 2003: 271 in Alpaslan, 2009), it is still unable to provide satisfactory guidance in a crisis situation.

Corporate Governance Share Ownership is incapable of ethically answering the question of "how can companies be governed in the context of the crisis"? (Alpaslan 2009: 49). It can be stated that the stakeholder model seems to be an ethically more suitable corporate governance choice in the context of crises, unlike the shareholder model, which begins to maximize shareholder value and treats ethical considerations as a constraint; which from the start, includes ethical considerations.

Economists dealing with company theory (Baund, 1959; Simon, 1959; Cyert & March, 1963 in Fama 1980) are concerned with the incentive problems that arise when decision-making is the responsibility of executives who do not belong to the company's securities holders. Examples include behavioral and managerial company theories (Fama, 1980), which reject a model that favors profit maximization and considers it important to seek to motivate business leaders who manage but at the same time are not owners.

The theories introduced by Fama (1980) also favor the positive attitude of entrepreneurs towards CSR, because the company's behavioral model does not seek to maximize profit in the classical sense, but gives space for further motivation factors of the existence of the company, such as employment policy, cooperation with stakeholders, continuity of philanthropic activities. On the other hand, management company theory does not assume information asymmetry, but that the market, as to call it, the manager market, sets limits and opportunities against the services of company managers, so it focuses on motivation, so besides the personal interest of the manager, the collective interest of the company also prevails, this way, the chances of abuse on the part of the company managers are reduced.

According to another approach dealing with corporate theory (Alchian & Demesetz, 1972 & Jens- Meckling, 1976 in Fama 1980), the company is considered to be a set of contracts between production factors. The company is considered a team where members act on their own behalf, but their fate depends on the survival of the team, in a competition where they compete against other teams. In classical theory, the operator who impersonates the company is the entrepreneur, who is the one-to-one manager and the residual risk bearer. Alchian & Demesetz calls the entrepreneur the employer, but this does not explain the management of large companies, where corporate governance is carried out by managers who are separate from the company's securities holders.

Fama (1980) considers the concept of corporate ownership irrelevant and explains it as follows. Management is a workforce with a special role, coordinating the operation of inputs and fulfilling contracts concluded between inputs, so it is present as a decision maker. It explains the role of risk takers by assuming that the company leases all other production factors and contracts are made at the beginning of the production periods, while payments are due at the end of these periods. In this context, he assumes two scenarios. 1. If production factors have to be paid always at the end of the period, the risk taker does not have to invest anything at the beginning of the period, it is assumed that this is guaranteed by concluding a fund at the beginning of which capital and technology can be obtained. 2. When a committed fund is created by issuing bonds and ordinary shares, bonds embodying a combination of risk-taking and ownership of capital bear a lower risk than ordinary shares. Thus, the company is the set of contracts that record how to combine inputs to generate outputs and how to distribute revenues from outputs between inputs. In this contractual relationship, Fama (1980) says the ownership of the company is an irrelevant concept.

Fama (1980) separates company management and risk-taking as well as securities ownership and corporate governance. In theory the classical company is the entrepreneur who is in one person a manager and has a risk taking role in the company analysis. He sees the disadvantage of management and risk-taking in that both of its services appear on a market that offers alternatives. Risk takers have markets for their services, capital markets; where they can switch teams with low transaction costs, many companies distribute their funds among the securities, so as not to be overburdened by a company's assets. The task of the management of the company is to control the contracts between the factors of production and the viability of the company. For the manager market, past failures and successes of the company leader provide information, so in the present situation the success / failure of the team managed by it influences its future salary, thus becoming interested in the success of the company. Fama's comments on the viability

of separating securities ownership and corporate governance are as follows. The external manager's labor market has a significant impact on companies to select and pay managers based on performance, if the corporate reward system is not performance-sensitive, then the company loses its managers. On the other hand, the internal monitoring of managers by their colleagues is also significant. It is in the interests of senior management to pursue policies that give the manager the most positive signal to the labor market. He asks the question how to discipline the top management, the board assigned to it is the Board of Directors, but how to set it up to perform its task properly. Management by securities owners does not seem to be a good solution because they share resources among many companies, so it is not in their best interest to be sure about the company's best destiny. Another scenario is that senior managers are best placed to manage the board because they are the most informed and sensitive critics of the company's performance and furthermore the board can be expanded with external expert directors. We can conclude that, the system of ownership unbundling and corporate governance is consistent with the pressure exerted by the managerial market and is also in the interest of the securities holders, and this may seem to be a good separation.

Jensen (2002) criticizes the interest-bearing theory, explaining that it contradicts the unequal purpose of organizations. In the following, I discuss the incompatibility of Jensen's (2002) value maximization versus interest-bearing theory. According to value maximization, managers have to make all their decisions to increase the company's long-term market value. The total value is the sum of the value of financial claims related to the company, including share capital, loan capital, preferred shares and guarantees. In contrast with this, stakeholder theory says managers need to make their decisions to take into account the interests of the company's stakeholders. According to Jensen (2002), who is the rival of the theory of interest and of the value maximization principle which, however, cannot be considered as a complete specification of the corporate circumstance or target function. It serves the individual interests of those who have embraced, including many outside companies, many corporate managers and directors. According to Jensen (2002), interest-bearing theory is inherently flawed because it violates the point that every organization should have a unified goal. He claims that if a company adapts the interest-bearing theory, it will be at a disadvantage in the race for survival, because the interest-bearing theory politicizes the company and empowers the managers to follow their own preferences when using the company's resources.

Jensen (2002) explains the misconception of interest-bearing theory with the following: it is impossible to maximize in more than one dimension at the same time unless the dimensions are monotonous transformations of one another. As an example he mentions if the manager gets the job to maximize current profit, market share, future profit growth, and anything else he likes, he is in a position where he cannot make a grounded decision –simply put he remains without a goal. This is explained by the fact that representatives of stakeholder theory often receive active support from managers who want to weaken the strength of the constraints of value-seeking, capital market empowerment, corporate governance which are products of the markets. He also argues that more political action limits the power of markets restricting the managers too. Such persons will continue to use the arguments of interest-bearing theory to legitimize their own position.

Stenberg (2009) makes critical statements against corporate definitions, corporate responsibility and conventional definitions of business ethics.

Corporate social responsibility advocates, as they see fit, generally do not support submitting corporate goals. CSR advocates clearly place social responsibility at the forefront of corporate and business interests pushing these into the background. While other CSR supporters seem to support the pursuit of corporate and business goals, the interests of stakeholders are prevalent against shareholders. If only shareholders do not agree into some extent of change - this is a direct violation of corporate governance, even if it was initiated by the company managers or the board of directors (Stenberg, 2009).

Conventional CSR and interest-bearing doctrine fit well according to Stenberg (2009) and serve well authoritarian and collectivist goals together. The dimensional connection of the two sides leads to superficial credibility, and the apparent generosity that they generate encourages people to accept the relationship uncritically.

Business ethics is about how we conduct business according to ethical expectations. This means that we follow the business goals and meet two well-defined limits. One such limit, which must be met due to the business objective, is to maximize shareholder value over the long term. Future long-term goals require conviction, and confidence is achieved through trust, and consequently compliance with constraints is a prerequisite for trust. As an example, that ownership value assumes ownership and the second limit involves the respect of the rights of the owners. In the light of these constraints, the business must be guided fairly in order to meet ordinary fairness and justice. As with business ethics, social responsibility also has a meaning but is very different from what it is conventionally assumed. When interpreted correctly, social responsibility does not apply to the responsibility of the institutions for the interest-bearers. Instead, he speaks more about the responsibility of the stake holders to reflect their appreciation of their business in their social activity. Social responsibility is manifested when individuals' values are reflected in their actions, whether they pursue their activities alone or in a community (Stenberg, 2009).

Corporate governance encompasses corporate social responsibility policies, procedure, and can be interpreted as the relationship between governors and stakeholders. The authors Angyal (2009) and Auer (2017) agree that the two phenomena coexist and are connected at several points. The goals of two phenomena are intertwined with compliance with other important requirements (environment, labor law) besides the primary corporate goal to maximize shareholder value.

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SCIENTIFIC PAPER

A NOTE ON THE DUTCH DISEASE

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Abstract: *Many resource rich countries are poor, where many resource poor countries are rich. One of the possible explanations of this paradox called the 'resource curse' is the Dutch Disease. This paper aims to analyse this phenomenon with the help of a simple macro-economic trade model. It presents a number of Dutch Disease Cases of which the 'Norwegian Case' provides an example containing an effective policy against the negative impact of Dutch Disease on the national economy.*

Keywords: *Dutch Disease, Resource Curse, Real Exchange Rate, Norwegian Case*
(JEL Classification: O11, O24, Q33)

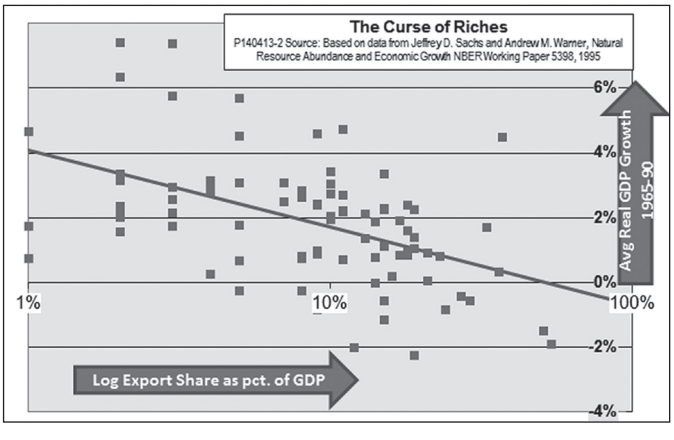
INTRODUCTION

Dutch Disease is one of the reasons for the Resource Curse. The resource curse implies that many export oriented resource rich countries are poor, where many resource poor countries are rich (Figure 1). This paradox is partly explained by the Dutch Disease. Another aspect of the resource curse is the social-economic impact of richness in point-source natural resources like oil and natural gas. Many point-source rich countries are characterized by a low Social Progress Index (Economonitor, 2014).

This note concentrates on the Dutch Disease as the driver of the resource curse. Generally it works as follows. The discovery of a country's reserve of a point-source resource generates a global demand for it, causing a rise of the real exchange rate of the country's currency. This makes imports relatively cheap in comparison with the home produced importables (goods that may be either imported or produced at home) which implies a deterioration of this sector's international competitiveness, causing it to shrink and even to disappear completely in an extreme case. This also explains the name "Dutch Disease", which was coined first by the Economist in 1977 referring to the discovery of a huge reserve of natural gas in the Netherlands at the end of the fifties, after which the manufacturing sector lost much of its competitiveness because of the appreciation of the Dutch Guilder (The Economist, 2014). An in depth analysis has been provided by Corden and Neary (1982). The aim of this note is to provide the essential insight in the phenomenon.

Another possible source of Dutch Disease is massive development aid, causing capital import on a large scale, which may increase the real exchange rate and thus provoking the downturn of industrial production that has to compete with imports.

Figure 1: Resource Curse.



Source: Economonitor: Ed Dolan's Econ Blog, April 21st, 2014.

The aim of this paper is to develop a macroeconomic model that explains Dutch Disease and can easily be used in university education to demonstrate its impact.

Cases of Dutch Disease

Dutch disease is not a scarce phenomenon. Table 1 shows a number of examples of Dutch disease covered by literature on the issue.

In theory, the cure for Dutch disease is quite simple: export of royalties by investing them abroad. This causes a fall in the real exchange rate and in that way the negative effects for the home production of importables is avoided. In practice, this can be realized by a 'wealth fund' in which the royalties accumulate. The wealth fund should be invested abroad in order to generate the lowering effect on the real exchange rate. This is called the Norwegian Case after the country that implemented it successfully.

Table 1: Examples of Dutch disease

- Australian gold rush in the 19th century, first documented by Cairns in 1859
- Australian mineral commodities in the 2000s and 2010s
- Signs of emerging Dutch disease in Chile in the late 2000s, due to the boom in mineral commodity prices
- Azerbaijani oil in the 2000s
- Canada's rising dollar hampered its manufacturing sector from the early 2000s until the oil price crash in late 2014/early 2015 due to foreign demand for natural resources, with the Athabasca oil sands becoming increasingly dominant.
- Indonesia's greatly increased export revenues after the oil booms in 1974 and 1979
- Nigeria and other post-colonial African states in the 1990s
- The Philippines' strong foreign exchange market inflows in the 2000s leading to appreciation of currency and loss of competitiveness
- Russian oil and natural gas in the 2000s
- Gold and other wealth imported to Spain and Portugal during the 16th century from the Americas
- The effect of North Sea Oil on manufacturing sectors in Norway and the UK in 1970-1990.
- Post-disaster booms accompanied by inflation following the provision of large amounts of relief and recovery assistance such as occurred in some places in Asia following the Asian tsunami in 2004
- Venezuelan oil during the 2000s. Using the official exchange rate, Caracas is the most expensive city in the world, though the black market exchange rate is said to be as much as hundred times as many bolivares to the dollar as the official one. Being a large exporter of oil revenues also keeps the currency's value above what it would otherwise be.

Source: Wikipedia: "Dutch Disease". For references, see site.

A Dutch Disease Model

Percentage growth in production y equals the growth rate of non-tradables ynt, the production of home consumed exportables xh plus the growth rate of the production of home produced importables mh plus growth rate of exports x multiplied by its initial shares in total production α, β, γ and $(1 - \alpha - \beta - y)$[1]

$$y = \alpha y_{nt} + \beta x_h + y m_h + (1 - \alpha - \beta - y)\, x.$$

The production of non-tradables y_{nt} and exportables x_h, goods that can be exported or consumed at home, consumed at home are assumed to be non-price elastic; they are assumed to only react to a relative change in the income *y,* so:

$$y_{nt} = \delta y,$$
$$x_h = \varepsilon y,$$

with δ and ε for the income elasticities of y_{nt} and x_h with respect to y respectively. Home produced importables mh are influenced by the change in the real exchange rate *c*, which is the relative change of the real value of the home currency expressed in the foreign currency.

$$mh = -\mu c,$$

with $-\mu$ for the elasticity of m_h with respect to *c*. this implies that if the real exchange rate increases, the home production of importables decreases as a consequence of imports being cheaper than the home produced substitutes. The sudden increase of exports is represented by $\underline{x}$, so:

$$x = \underline{x}.$$

The real exchange rate c reacts to the sudden change in export as follows:

$$c = \lambda\,(x - k),\ \lambda > 0;$$ (see appendix),

with λ for the elasticity of *c* with respect to the growth rate of exports *x* and the percentage change of capital export k. Finally, initial and continuing equilibrium on the trade balance is assumed, which means that the growth rate of exports *x* plus the relative change of the real exchange rate of the home currency expressed in the foreign currency equals the percentage growth of imports *m* plus capital export *k* as a percentage of imports.[2]

$$x + c = m + k.$$

[1] In this paper with 'growth rate' the year to year percentage growth is meant.

[2] Here I am assuming that in the initial situation (before the export boom) there was equilibrium on the capital account. A deficit on the capital account is shown here a percentage of total import value expressed in the foreign currency.

Capital export k is assumed to be an exogenous variable. The idea behind this is that the government may develop a policy to export more capital or there may be exogenous capital import because of development aid.

$$k = \underline{k}.$$

From the above it follows:

$$y = \frac{1-\alpha-\beta-\gamma(1+\mu\lambda)}{1-\alpha\delta-\beta\varepsilon}\underline{x} + \frac{\gamma\mu\lambda}{1-\alpha\delta-\beta\varepsilon}\underline{k}, \text{ with } \alpha\delta+\beta\varepsilon<1.$$

Finally, some idea could be formed of the wider problem of the resource curse by taking into account the income distribution. Booming exports of the point resource cause a rise in the income of a small group of mine owners and other stakeholders, where the decrease of the production of importable causes a decrease in the income of a relatively large group of people. A rough indication for the changing income distribution i may be:

$$i = x - m_h$$

The higher i the more unequal the income distribution is.

Some preliminary conclusions:

1. If $\underline{x} > 0$, $\underline{k} = 0$, $\alpha + \beta + \gamma(1+\mu\lambda) < 1$, the positive exports shock x has a positive impact on production y.
2. If $\underline{x} > 0$, $\underline{k} = 0$, $\alpha + \beta + \gamma(1+\mu\lambda) > 1$, the positive exports shock x has a negative impact on production y.
3. If $\underline{x} > 0$, $\underline{k} = 0$, $\alpha + \beta + \gamma(1+\mu\lambda) = 1$, the positive exports shock x has no impact on production y.
4. If $\underline{x} > 0$, $\underline{k} = 0$, $\alpha + \beta + \gamma(1+\mu\lambda) < 1$, the positive impact of the exports shock x on production y is strengthened by capital export k.
5. If $\underline{x} = 0$, $\underline{k} < 0$, the import of capital $\underline{k}$ has a negative impact on production y.

Model Examples

In order to facilitate computations in Excel the model is rewritten as follows:

$$\begin{aligned}
&y - \alpha y_{nt} - \beta x_h - \gamma m_h - (1-\alpha-\beta-\gamma)\,x = 0,\\
&\delta y - y_{nt} = 0,\\
&\varepsilon y - x_h = 0,\\
&m_h + \mu c = 0,\\
&x = \underline{x},\\
&c - \lambda x + \lambda k = 0,\\
&k = \underline{k},\\
&x - m + c - k = 0,\\
&i - x + m_h = 0.
\end{aligned}$$

So:

$$\begin{bmatrix}
1 & -\alpha & -\beta & -\gamma & -(1-\alpha-\beta-\gamma) & 0 & 0 & 0 & 0\\
\delta & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0\\
\varepsilon & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & 1 & 0 & \mu & 0 & 0 & 0\\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & -\lambda & 1 & \lambda & 0 & 0\\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0\\
0 & 0 & 0 & 0 & 1 & 1 & -1 & -1 & 0\\
0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 1
\end{bmatrix}
\begin{bmatrix} y\\ y_{nt}\\ x_h\\ m_h\\ x\\ c\\ k\\ m\\ i \end{bmatrix}
=
\begin{bmatrix} 0\\ 0\\ 0\\ 0\\ \underline{x}\\ 0\\ \underline{k}\\ 0\\ 0 \end{bmatrix}, \text{ and:}$$

$$\begin{bmatrix} y\\ y_{nt}\\ x_h\\ m_h\\ x\\ c\\ k\\ m\\ i \end{bmatrix}
=
\begin{bmatrix}
1 & -\alpha & -\beta & -\gamma & -(1-\alpha-\beta-\gamma) & 0 & 0 & 0 & 0\\
\delta & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0\\
\varepsilon & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & 1 & 0 & \mu & 0 & 0 & 0\\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & -\lambda & 1 & \lambda & 0 & 0\\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0\\
0 & 0 & 0 & 0 & 1 & 1 & -1 & -1 & 0\\
0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 1
\end{bmatrix}^{-1}
\begin{bmatrix} 0\\ 0\\ 0\\ 0\\ \underline{x}\\ 0\\ \underline{k}\\ 0\\ 0 \end{bmatrix}.$$

Some examples are presented in Table 2.

Table 2: Examples

Ex.	x	k	α	β	γ	δ	ε	μ	λ	α+β+γ(1+ μλ)	γμλ	y
1.	20	0	0.3	0.2	0.3	0.50	0.5	0.40	0.5	< 1	>0	> 0
2.	20	0	0.3	0.2	0.4	0.50	0.5	0.80	1.0	> 1	>0	< 0
3.	20	0	0.3	0.2	0.4	0.75	1.0	0.67	1.0	≈1	>0	≈ 0
4.	20	20	0.3	0.2	0.3	0.50	0.5	0.40	0.5	< 1	>0	> 0
5.	0	-20	0.3	0.2	0.3	0.50	0.5	0.40	0.5	> 1	>0	< 0

The outcomes of the examples are presented in Table 3.

Table 3: Outcomes of Examples 1-5.

Example	y	y_{nt}	x_h	m_h	x	c	k	m	i
1.	3.73	1.87	1.87	-4.00	20.00	10.00	0.00	30.00	24.00
2.	-1.07	-0.53	-0.53	-16.00	20.00	20.00	0.00	40.00	36.00
3.	0.00	0.00	0.00	-13.33	20.00	20.00	0.00	40.00	33.33
4.	5.33	2.67	2.67	0.00	20.00	0.00	20.00	0.00	20.00
5.	-1.6	-0.8	-0.8	-4	0.00	10.00	-20.00	30.00	4.00

From the results in Table 3 it is quite clear that controlling the real exchange rate c by way of capital exports generates the highest increase in income y and has a moderate impact on the income distribution i (Example 4: The Norwegian Case). Example 5 shows the impact of large scale development aid. Because of the increase of the real exchange rate c by 10%, home consumption of importables mh decreases by 4%, where imports m increases by 30%, resulting in a decrease of national income y by 1.6%.

CONCLUSIONS

Dutch disease may have disruptive consequences for an economy. Because of the global increase of demand for localized resources the appreciation of the real exchange rate may cause the decline of other sectors and increase the disparity in the income distribution. It can be partly cured by investing royalties abroad through a wealth fund causing a decrease in the real exchange rate of the home currency, but this may be difficult because of political interests. This may also moderate the growing inequality of the income distribution as a result of the booming exports sector, in this way partly preventing the sorrow situation of a resource curse. Further large scale development support may cause Dutch disease because it may generate an increase of the real exchange rate as well.

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APPENDIX

Growth rates x of exports and m of imports are assumed to be related to the percentage change c of the real exchange rate as follows (with $-\varphi_1$ for the elasticity of x with respect to c, φ_2 for the elasticity of m with respect to c, $\underline{x}$ for the exogenous percentage increase of exports, and k for the exogenous capital export as a percentage of total imports):[3]

$x = -\varphi_1 c + \underline{x}$
$m = \varphi_2 c$
$k = \underline{k}.$

Because of the assumption of initial and continuous trade balance equilibrium:

$$x + c = m + k, \text{ so: } \varphi_2 c + \underline{k} = (1 - \varphi_1)c + \underline{x}, \text{ so: } c = \frac{1}{(\varphi_1 + \varphi_2 - 1)}(\underline{x} - \underline{k}),$$

and $c = \lambda(\underline{x} - \underline{k})$, with $\lambda = \frac{1}{(\varphi_1 + \varphi_2 - 1)}$.

In the case of Dutch Disease $\varphi_1 + \varphi_2 > 1$ so: $\lambda > 0$

[3] It is assumed that in the initial situation the capital balance is in equilibrium.

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SCIENTIFIC PAPER

EVALUATION OF CROP AND IRRIGATION WATER REQUIREMENTS FOR SOME SELECTED CROPS IN APULIA REGION –SOUTHERN ITALY

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Abstract: *Nowadays, nearly 90% of global water consumption is caused by irrigation activities, and more than 40% of the crops are produced under irrigated conditions. This study is an endeavour to estimate the irrigation water requirement (IWR) and crop water requirement (CWR) for some selected crops (Pepper, Eggplant, Potato, Soybean, Maize, Wheat Melon, Lettuce, Sunflower, Broadbean, Citrus, Cherry, Olive tree, Sugarbeet, Artichoke, Wine Grapes, Carrot…etc.) in Sothern Italy. The selected districts (Sant' Arcangelo) have been taken as a case study area. Demanded meteorologically (rainfall, temperature, humidity, wind speed, sunshine hours) and crop data (crop coefficient and crop calendar) have been collected for 30 years period from 1981 to 2011. FAO CROPWATv8.0 software has been applied for requisite calculation of CWR and IWR along with the developing of cropping patterns. The FAO Penman-Monteith equation is used for estimating the reference evapotranspiration (ET0) by using meteorological data in the framework of CROPWAT model as it regarded as a good evaluator for a wide variety of climatic conditions. The analysis indicates that FAO Penman-Monteith suits very well for the study area and can be successfully used for the estimation of reference evapotranspiration. The important results in this study indicate that the IWR is very low from November to April (wintertime) due to higher rainfall intensity in these months and from month May to October a considerable amount of water is required for irrigation.*

Keywords: *Irrigation Water Requirement , Crop Water Requirement , FAO Penman-Monteith, CROPWAT.*
(JEL Classification: Q25, Q24,Q10)

INTRODUCTION

Agriculture is expected to feed an estimated population of over 9 billion people by the year 2050 through a 50% increase over the current food production level, with 80% of the increase stemming from production intensification which is essentially possible thanks to irrigation (Report, 2017). At the same time, agriculture is responsible for about70% of the total water withdrawals worldwide and it is the first sector to be put under significant pressure due to increasing water scarcity (Hanjra & Qureshi, 2010). Information needs for agricultural decision making at all levels are increasing quickly due to increased demands for agricultural products and increased pressures on land, water, and other natural resources(Bruinsma, 2009). The agricultural sector is the most water-consuming in the world, reaching more than70% of the withdrawal in many areas of the world and especially in the Southern Mediterranean countries, on the other hand in many countries, particularly those situated in the arid and

semi-arid regions of the world, this dependency can be expected to intensify, due to the increasing demand for agricultural products(Dubois, 2011). Thus, the contribution of irrigated agriculture to food production is substantial and the expansion of irrigated agriculture will surely result in higher yield and production. According to it, irrigation is required to satisfy the water demand during the driest periods of the year, especially in the semi-arid Mediterranean climate (R. G. Allen, L. S. Pereira, D. Raes, & M. J. F. Smith, Rome, 1998).

Climate change has previously caused significant impacts on water resources, hydropower, food security, human health particularly for African nations, along with the entire world (Magadza & Assessment, 2000). Studies on climate impacts like (temperature, precipitation, rainfall, evapotranspiration, and soil characteristics) and adaptation strategies are progressively becoming main areas of scientific concern, e.g. impacts on the production of crops such as wheat and rice (Aggarwal, Kalra, Chander, & Pathak, 2006; Dhungana, Eskridge, Weiss, & Baenziger, 2006; Gbetiobouo, Hassan, & Agricultural Sciences, 2004; Hoogenboom & meteorology, 2000), industry (Harle, Howden, Hunt, & Dunlop, 2007) and the natural landscape (Dockerty et al., 2006). water resources in the river basin catchments (Chang, Knight, Staneva, & Kostov, 2002; Herrera□Pantoja & Hiscock, 2008; Wilby & Harris, 2006),crop productivity and soil water balance have been studied with crop growth models by using parameters from different climate models (Kang, Khan, & Ma, 2009; Stöckle, Donatelli, & Nelson, 2003).

The objectives of this study are to estimate the CWR which are " the depth of water [mm] needed to meet the water consumed through evapotranspiration (ETc) by a disease-free crop, growing in large fields under non-restricting soil conditions including soil water and fertility, and achieving full production potential under the given growing environment" (Pereira & Alves, 2005). In addition to evaluate the IWR based on soil and water resources to assess of the irrigation potential (Margat, Frenken, & Faurès, 2005) and developed cropping pattern in the study area for the selected crops to ensure the optimum use of available irrigation water and on the other hand to Estimate if there is a Salinity problem on the study area.

METHODOLOGY

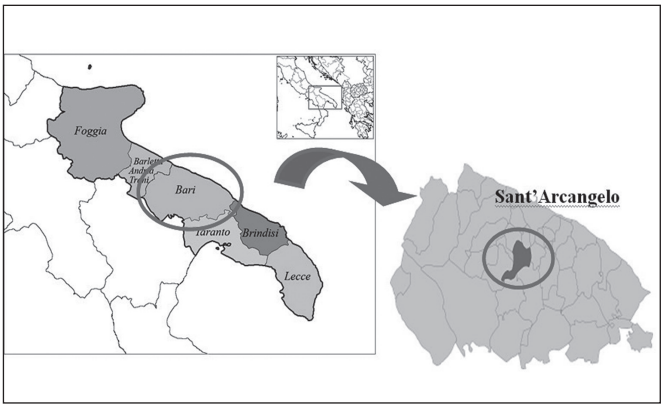
In this study we estimate the CWR and IWR and to developed cropping pattern in the study area for the selected crops to confirm the optimum use of available irrigation water and the optimum use of the available land. Thus, assessment of evapotranspiration loss, effective rainfall and the percentage of the total area covered by each crop are very essential. Once more, to ensure the minimum loss of irrigation water crop coefficient at different stages with their stage lengths and various climatic parameters are adjusted for the study areas we start with the description of the study area.

Description of the study area :

The project area, Sant' Arcangelo, located in the municipality of Sannicandro, province of Bari in the Apulia region (Southern Italy), at approximately 40.99° N latitude and 16.80° E longitude with an average altitude about 183 m above sea level. The study area is characterised by semi-arid Mediterranean climatic conditions, with hot and dry summer season and moderately cold and wet winter.

The total gross surface area under consideration is about 164 ha, of which 7% is occupied by roads and buildings, which reduce the net irrigable area to 153 ha. Major land use is for agricultural purposes: olives, orchards, almonds and horticultural crops are widespread, and, in some areas, high quality vineyards can be found. The location of study area is shown in figure 1.

Figure 1. Location of the study area in Apulia region



Data collections and Data Processing

Crop water requirements

Crop water requirement can be defined as the amount of water needed to maintain an optimal moisture condition in the crop rooting depth, to compensate for water lost mainly through the process of evapotranspiration (ET). The main factors affecting ET are the weather parameters, crop characteristics, management and environmental conditions. Crop water requirement and net irrigation requirements are calculated through the following steps:

- Estimation of reference evapotranspiration (ETo) using climatic data of project area.
- Estimation of crop evapotranspiration (ETc) considering crop coefficient (Kc) and reference evapotranspiration.
- Determination of effective precipitation (Peff) from the precipitation data for the specific area.
- Estimation of net irrigation requirement (NIR) as a difference between Crop evapotranspiration and effective precipitation.

CROPWAT is a program developed by the Land and Water Development Division of FAO for the calculation of crop water requirements and irrigation requirements

based on soil, climate and crop data. In addition, the program allows the development of irrigation schedules for different management conditions and the calculation of scheme water supply for varying crop patterns. CROPWAT can also be used to evaluate farmers' irrigation practices and to estimate crop performance under both rainfed and irrigated conditions.

Cropping pattern

According to soil and climate data given for our project area, the following crops (21) are taken into consideration for the determination of crop water requirements and cropping pattern :

- Tree crops: citrus, olives, peach, cherry and grapes.
- Field crops: sugar-beet, wheat, sunflower, maize and soybean.
- Horticultural crops: tomato, eggplants, potato, lettuce, pepper, carrots, watermelon and Artichoke.

The main crops growing parameters are given in table 1 as they were used in CROPWAT software for the estimation of crop water requirements, irrigation requirements and crop response to water curves.

Crop coefficient (Kc)

Crop coefficient Kc is the ratio of ETc to the reference ETo and it expresses the difference in evapotranspiration between the cropped area and the reference grass surface. This coefficient combines differences in soil evaporation and crop transpiration rate between the crop and the reference grass surface (FAO, 2004).

Kc represents an integration of four primary characteristics, which distinguish the crop from reference grass which has a constant appearance and a complete ground cover:

I Crop height
II Canopy resistance
III Albedo of solar radiation from the exposed soil
IV Evaporation from exposed soil.

Factors determining the crop coefficient are: Climate (arid climate and higher windy speed- greater Kc), Soil evaporation (depends on soil wetness), Crop type (taller crops and closer spacing-greater Kc) and Crop growth stages (initial, crop development, mid-season, and late season).

Mean monthly crop coefficients (Kc) for fully grown crops, are given in Table2 elaborated at the University of Bari and adjusted by CIHEAM-IAMB, represent average values in the Apulia conditions.

Table 1. The main crop growing parameters : Kc , root depth, development stages, depletion fraction, yield response function and crop height

		Crop															
Crop characteristics		Citrus	Cotton	Faba Bean	Grapes	Maize	Olive	Peach	Pepper	Potato	Spring Wheat	Sugar Beet	Sun-flower	Tomato	Water Melon	Winter Barley	Winter Wheat
Kc	I	0,75	0,35	0,5	0,3	0,3	0,65	0,55	0,6	0,5	0,3	0,35	0,35	0,6	0,4	0,3	0,7
	II	0,7	1,2	1,15	0,85	1,2	0,45	0,9	1,05 115	1,15	1,15	1,2	1,15	1,15	1	1,15	1,15
	II	0,75	0,7	1,1	0,45	0,6	0,65	0,65	0,9	0,75	0,25	0,85	0,35	0,8	0,75	0,25	0,25
Root. depth (m)	Initial	1,2	0,3	0,3	1,5	0,3	1,5	1,5	0,25	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
	Total	1,2	1,4	0,7	1,5	1,5	1,5	1,5	0,8	0,6	1,2	1	1,3	1,2	1	1	1
Depletion fraction	I	0,5	0,65	0,45	0,35	0,55	0,65	0,5	0,3	0,35	0,55	0,55	0,55	0,4	0,4	0,55	0,55
	II	0,5	0,65	0,45	0,35	0,55	0,65	0,5	0,3	0,35	0,55	0,55	0,55	0,4	0,4	0,55	0,55
	II	0,5	0,65	0,45	0,35	0,55	0,65	0,5	0,3	0,35	0,55	0,55	0,55	0,4	0,4	0,55	0,55
Yield Response function	I	1,2	0,2	0,2	0,85	0,4	0,7	1,1	1,4	0,45	0,2	1	0,2	0,4	0,45	0,2	0,2
	II	1,2	0,2	0,2	0,85	0,4	0,7	1,1	0,6	0,8	0,2	1	0,5	0,4	0,7	0,6	0,6
	II	1,2	0,5	0,85	0,85	1,5	0,7	1,1	1,2	0,7	0,65	1	0,9	1,1	0,8	0,5	0,5
	IV	1,2	0,25	0,2	0,85	0,5	0,7	1,1	0,6	0,2	0,55	1	0,9	0,6	0,3	0,4	0,4
	Total	1,2	0,85	1,05	0,85	1,25	0,7	1,1	1,1	1,1	1,15	1	0,95	1,05	1,1	1	1,05
Crop Height (m)		1,5	1,4	0,8	1,2	2	3	3	0,7	0,6	1	0,7	1,5	0,6	0,4	1	1

Table 2. Mean monthly crop coefficient (Kc) values for ETc estimate of some important crops grown in Southern Italy

Crops	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Tree Crops											
Citrus	0,75	0,75	0,7	0,7	0,7	0,65	0,65	0,65	0,65	0,65	0,7	0,7
Cherry	-	-	-	0,75	0,9	0,95	0,95	0,9	0,86	-		-
Olive tree	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,,5	0,5
Peach	-	-	0,53	0,71	0,81	0,86	0,86	0,84	0,78	on		-
Grapevine	-	-	-	0,48	0,59	0,68	0,68	0,68	0,68	-		-
Vegetables Crops												
"Autumn Sugar Beet"	0.5	0,5	0,5	0,87	1,20	1,30	1,30	-	-	-	0,4	0,4
Spring Sugar Beet	-	0,35	0,62	1,10	1,20	1,24	1,24	0,95	-	-	-	-
Artichoke	1.25	115	095	-	-	-	0,6	0,7	08	105	1,22	1,3
Carrot	-	-	-	-	-	-	0,4	0,7	0,9	1	1,05	1,00
"Cereals (durum wheat)"	0.8	10	11	115	085	035	-	-	-	-	0,4	0,6
Broad bean	0 8	0 9	0 95	095	0 9	-	-	-		-	0,4	0,65
Sunflower	-	-	-	04	085	1,20	1,02	0,45	-	-		
Lettuce	1	1	0 9	-	-	-	-	-	-	-	0,75	0,9
Maize	-	-	-	0,45	0,6	1,05	1,2	0,6		-		
Eggplant	-	-	-	0,30	0,45	0,7	1	1,15	1,00	-		-
Early Potato	0,5	0,8	1,1	1,15	0,9	-	-	-	-	-	-	-
"Common Potato"	-	-	0,5	0,8	1,1	1,15	-	-	-	-	-	-
Tomato	-	-	-	0,5	0,87	1,2	1,1	0,8	-	-	-	-
Pepper	-	-	-	0,64	0,75	1	1	0,8	-	-	-	-
Soya	-	-	-	0,4	0,51	0,9	1	0,4	-		-	
Watermelon*	-	-	-	0,45	0,85	1	0,8	-	-	-	-	-

Reference Evapotranspiration (ET0)

Reference evapotranspiration represents the amount of water lost by evapotranspiration process from "a hypothetical reference crop with an assumed crop height of 0.12 m, a fixed surface resistance of 70 s/m and an albedo of 0.23" and maintained under optimal water and nutrient conditions (FAO 56, 2004).

The reference surface closely resembles on extensive grass surface of uniform height, actively growing, completely shading the ground and with adequate water content. The requirements that the grass surface should be extensive and uniform result from the assumption that all energy fluxes are one-dimensional upwards. The fixed surface resistance of 70 s/m implies a moderately dry soil surface resulting from about a weekly irrigation frequency.

ET_o provides a standard to which: (i) ET at different periods of the year or the other regions can be compared, and (ii) ET of other crops can be related.

There are numerous methods for estimation of reference evapotranspiration. They all rely on climatic parameters. The most commonly used methods are FAO Penman-Monteith, Hargreaves-Samani, and FAO Penman-Monteith with only measured air temperature data.

FAO Penman-Monteith method

The Penman-Monteith approach is a reliable physically-based method. This method is recommended as a standard method for the estimation of reference evapotranspiration. It shows the best performance under both humid and arid conditions. The main climatic factors required for this equation are air temperature, humidity, wind speed and solar radiation.

Although, many areas of the world have few meteorological stations that measure all of these variables, the cost of such stations is decreasing, and it is likely that use of Penman-Monteith approach will spread even to developing regions. Knowing that a standard set of measured input data is available, the reference evapotranspiration (ETo) can be calculated by the standardized form of the Penman-Monteith equation (1):

$$ET_o = \frac{0.408\Delta(R_n - G)\ \frac{}{T+273}u_2(e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)} \qquad \text{Eq (1)}$$

where:

- ET_o, the reference evapotranspiration (mm day^{-1})
- R_n, the net radiation (MJ m^{-2} day^{-1})
- G, the soil heat flux density (MJ m^{-2} day^{-1})
- T, the mean daily air temperature at 2 m height (^oC)
- Δ, the slope of the saturated vapour pressure curve (kPa$^oC^{-1}$)
- γ, the psychrometric constant (66 Pa $^oC^{-1}$)
- e_s, the saturated vapour pressure at air temperature (kPa)
- e_a, the actual vapour pressure (kPa)
- U_2, the wind speed measured at 2 m height (m s^{-1})

FAO Penman-Monteith method with only measured air temperature data

This method is recommended by the FAO when only air temperature data are available. The equation used for the estimation of reference evapotranspiration is the same as in the case of standard Penman-Monteith approach, explained previously. However, the missing weather parameters have to be estimated.

Wind speed is fixed to 2 m/s (average value of 2000 weather stations around the globe); more accurate data could be used when available.

Solar radiation is estimated as Equation (2):

Eq (2)

Where:

- K_{Rs}, empirical radiation adjustment coefficient, between 0.16 for "interior" and 0.19 for "coastal" areas

$$R_s = k_{Rs}\sqrt{(T_{\max} - T_{\min})}R_a$$

- T_{max} and T_{min}, maximum and minimum air temperature (°C)
- R_a, extra-terrestrial radiation (MJ m^{-2} day^{-1})

Assuming that T_{dew} is close to T_{min} at a reference site (at sunrise), actual vapour pressure (e_a) is estimated as Equation (3):

Eq (3)

The mean saturation vapor pressure (es) is computed as the average between the saturation vapor pressure at maximum and minimum air temperature.

$$e_a = e^o(T_{\min}) = 0.611\exp\left[\frac{17.27T_{\min}}{T_{\min} + 237.3}\right]$$

CROPWAT software for the estimation of crop water requirements and irrigation scheduling

CROPWAT software (version 8.0 for Windows), developed by the FAO, is used to estimate ETc and simulate various irrigation scenarios considering optimal and limiting water supply. CROPWAT is a computer program for the calculation of crop water requirements and irrigation scheduling based on soil, climate and crop data.

Reference evapotranspiration, estimated by CROPWAT, uses the FAO Penman-Monteith approach when only air temperature data were available. The results of estimation of weather variables and reference evapotranspiration are given in Table3 on a monthly basis.

Table 3. Weather parameters considered for the estimation of reference evapotranspiration, (CROPWAT 8.0)

Country: Italy							Station: Sant Arcangelo
Altitude: 183 m	Latitude: 40.99 °N						Longitude: 16.80 °E
Month	Min Temp	Max Temp	Humidity	Wind	Sun	Rad	Eto
	°C	°C	%	Km/day	hours/day	MJ/M²/day	mm/day
January	3.6	10.0	82	173	3.3	6.2	0.80
February	4.6	11.7	81	173	4.0	8.7	1.14
March	5.9	14.2	79	173	5.3	12.9	1.77
April	8.5	17.8	77	173	6.7	17.4	2.63
May	12.2	22.7	76	173	8.3	21.4	3.69
June	15.4	27.0	75	173	9.7	24.0	4.60
July	17.7	32.5	71	173	12.0	26.8	5.79
August	17.9	32.3	71	173	11.2	24.0	5.33
September	15.1	25.7	76	173	7.8	16.7	3.37
October	11.9	20.4	79	173	5.6	11.1	2.02
November	7.9	15.4	80	173	4.4	7.5	1.22
December	5.0	11.2	83	173	3.2	5.6	0.80
Average	10.5	20.1	77	173	6.8	15.2	2.76

CROPWAT allows the development of irrigation schedules for different management conditions and the calculation of scheme water supply for varying crop patterns. The program can also be used to evaluate farmers' irrigation practices and to estimate crop performance under both rainfed and irrigated conditions.

All calculation procedures used in CROPWAT 8.0 are based on the two FAO publications of the Irrigation and Drainage Series, No. 56 "Crop Evapotranspiration - Guidelines for computing crop water requirements" and No. 33 "Yield response to water".

The development of irrigation schedules in CROPWAT is based on a daily soil-water balance using various user-defined options for water supply and irrigation management conditions. Scheme water supply is calculated according to the cropping pattern defined by the user, which include in this paper, up to 21 crops.

Simulation of different irrigation scenarios and generation of crop response to water curves

The crop response to water curves have been generated applying different irrigation scenarios in CROPWAT program starting from full irrigation that corresponds to maximum (optimal) yield and then reducing progressively irrigation input until reaching rainfed conditions. Soil water balance is calculated on a monthly basis and it is expressed in terms of water depletion in the effective root zone.

When the root zone water depletion (Dr), is lower than readily available water (RAW), which is predetermined fraction of total available water (TAW) and threshold for water stress, then ETc is considered through Ks-reduction coefficient (0-1), accounted for water depletion below optimum yield threshold (RAW) as shown in figure 2, Ks is calculated by the following formula (4):

$$K_S = (TAW - Dr)/(TAW - RAW) \quad \text{Eq (4)}$$

where:

- Dr, Root Zone Soil Water Depletion
- TAW, Total Available Water
- RAW, Readily Available Water – a fraction of TAW and threshold for water stress

Whenever soil water depletion exceeds a predetermined optimum yield threshold of RAW (which can be considered either constant during the whole season or variable for different growth stages) crop evapotranspiration is adjusted for water stress conditions using Ks Equation (5):

$$ET_a = ET_{c,\,adj} = K_s * K_c * ETo \quad \text{Eq (5)}$$

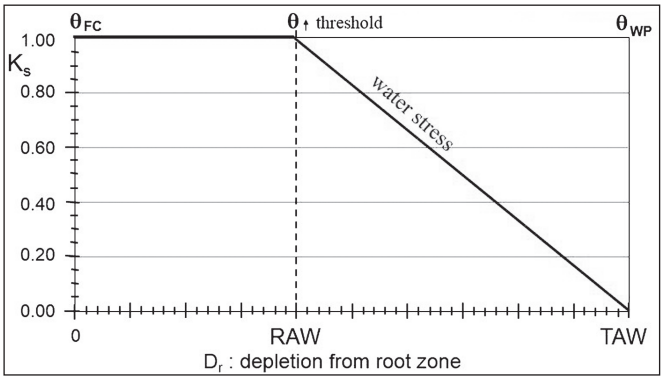
A simple, linear crop-water production function (CWPF) was applied to predict the reduction in crop yield when irrigation water was not adequate to cover crop water requirements and when crops suffer water stress Equation (6):

$$(1 - Y_a/Y_m) = K_{y*}(1 - ET_a/ET_c) \quad \text{Eq (6)}$$

where:

- K_y: yield response factor (dimensionless)
- ET_a : actual crop evapotranspiration (mm/day)
- ET_c : maximum crop evapotranspiration (mm/day)
- Y_a : actual yield (%)
- Y_m : maximum yield (100 %)

Figure 2. Water stress coefficient, Ks (Source: FAO 56, 1998)



Evapotranspiration (ETc)

Crop evapotranspiration (ETc) is defined as "the amount of water lost by evapotranspiration process from disease-free, well-fertilized crops, grown in large fields under optimum soil water conditions, and achieving full production under the given climatic conditions" (FAO 56, 2004).

Estimation of crop evapotranspiration relies on the so-called two-step approach where, in the first step, a reference evapotranspiration (ETo) is determined and then, in the second step, the crop evapotranspiration (ETc), under standard conditions, is calculated as a product of reference evapotranspiration and crop coefficient (Kc) as Equation (7):

$$ET_c = ET_{0*}K_c \quad \text{Eq (7)}$$

The main factors affecting the crop evapotranspiration are:

- Weather parameters (radiation, air temperature, humidity and wind speed)
- Crop (type, variety, development stage)
- Management and environmental conditions (soil salinity, land fertility, application of fertilizers, the presence of impenetrable soil horizons, control of diseases and pests, soil management…) (R. Allen, L. Pereira, D. Raes, & M. Smith, 1998).

The reference evapotranspiration term refers primarily to different climatic conditions, while the crop coefficient accounts mainly for the specific crop characteristics.

RESULTS AND DISCUSSIONS

Irrigation water requirements:

Determination of the dry, normal and wet year:

In order to estimate the rainfall deficit for irrigation water requirements, a statistical analysis needs to be made from long-term rainfall records(30 years). Defined as the rainfall with a respectively 20, 50, and 80% probability of exceedance, representing a wet, normal and dry year. The three values are useful for the programming of irrigation supply and simulation of irrigation management conditions, especially the results of the dry year that are

used for the determination of design of irrigation system capacity.

The precipitation with the probability occurrence of 80% refers to a dry period and it is considered for the estimation of irrigation requirements and calculation of specific continuous discharge after the determination of the cropping pattern. For the calculation of this probability of occurrence we used the following procedure:

An estimate of the respective rainfall data can be obtained by computing and plotting probabilities from the rainfall records. The different steps involved are:

Tabulate yearly rainfall totals for a given period (1981-2011).

Arrange data in descending order of magnitude (Table 4).

Tabulate plotting position according to: $F_a = 100\,\frac{m}{(N+1)}$ Eq (8)

Where:

- Fa is the plotting position of the probability of exceedance (%),
- N is the number of records (years)
- m is the rank number.

Table 4. Calculation of precipitation with the probability of exceedance of 80%

Rank	Year	Annual Precipitation (mm)	Fa (%)	
1	1990	737	3,23	
2	1994	727	6,45	
3	1984	645	9,68	
4	1993	641	12,90	
5	1987	629	16,13	
6	1986	612	19,35	Wet Year P20% = 604,2mm
7	1991	575	22,58	
8	1997	572	25,81	
9	2000	566	29,03	
10	2005	561	32,26	
11	1981	556	35,48	
12	1992	546	38,71	
13	1983	543	41,94	
14	1989	541	45,16	
15	2001	540	48,39	Normal Year P50% = 524,8 mm
16	2002	534	51,61	
17	1982	525	54,84	
18	2007	516	58,06	
19	1988	512	61,29	
20	1985	483	64,52	
21	2006	483	67,74	
22	2008	475	70,97	
23	2004	470	74,19	
24	1996	467	77,42	Dry Year P80% = 466,2 mm
25	2003	466	80,65	
26	1999	466	83,87	
27	1998	438	87,10	
28	1995	435	90,32	
29	2009	404	93,55	
30	2010	357	96,77	

$$P_{20\%} = (20 - 22.58) \times \frac{(612 - 575)}{(19.35 - 22.58)} + 575$$

$$P_{50\%} = (50 - 51.61) \times \frac{(540 - 534)}{(48.39 - 51.61)} + 534$$

$$P_{80\%} = (80 - 80.65) \times \frac{(467 - 466)}{(77.42 - 80.65)} + 466$$

Using linear interpolation, we find the following values:

Determination of the monthly values for the dry year:

$$P_{i,dry} = P_{i,avg}\,\frac{P_{dry}}{P_{avg}} \qquad \text{Eq (9)}$$

The determination of monthly values for the dry year is done according to the following relationship Equation 9:

Where:

: The monthly rainfall (dry year) for month i.
: Average monthly rainfall for month i.
: Average yearly rainfall (=534 mm).
: Yearly rainfall for the dry year.

Table 5. Monthly precipitation values for the dry year

Month	Pavg_year	Pdry_year
1	74	65
2	64	56
3	57	49
4	37	32
5	27	23
6	21	19
7	9	8
8	17	15
9	40	35
10	51	45
11	60	52
12	77	67
Total	534	466

Determination of the effective rainfall

The Effective rainfall is divided two parts. The first part of the total rainfall infiltrates along the effective root depth and it is used by the plant to satisfy its related crop water requirements. The other part of rainfall is lost by leaf interception, evaporation, surface runoff and/or deep percolation. We choose the formula developed by the USDA Soil Conservation Service for the estimation of effective rainfall on a monthly basis.

$P_{eff} = P_{month} * (125 - 0.2 * P_{month}) / 125$ for P_{month}<=250 mm, and

$P_{eff} = 125 + 0.1 * P_{month}$ for P_{month}>250 mm.

For decade (10 days) estimations are applied the following formulas:

$P_{eff} = P_{dec} * (125 - 0.6 * P_{dec}) / 125$ for P_{dec}<=(250/3) mm, and

$P_{eff} = 125/3 + 0.1 * P_{dec}$ for P_{dec}>(250/3) mm.

The results of effective rainfall estimation for the study area are shown in the table below (Table 6) taken from CROPWAT software:

Table 6. Monthly effective rainfall values for the average year (Created By Cropwat Software)

Station: Sant Arcangelo		Eff.rain method [USDA S.C.Method]
Months	Rain	Eff.rain
	mm	mm
January	74.0	65.2
February	74.0	57.4
March	74.0	51.8
April	74.0	34.8
May	74.0	25.8
June	74.0	20.3
July	74.0	8.9
August	74.0	16.5
September	74.0	37.4
October	74.0	46.8
November	74.0	54.2
December	74.0	67.5
Total	534.0	486.9

Net irrigation requirements

Net irrigation requirements (NIR) represent the amount of water that crops need to satisfy the water losses by crop evapotranspiration after subtracting the amount of effective rainfall (Peff) Equation (10).

$$NIR = ET_c - P_{eff} \quad \text{Eq (10)}$$

NIR and GIR should be estimated for both average(Table 7) and dry year(Table 8): Figure 3and 4also show the NIR and GIR for each crop for average and dry year respectively.

Gross irrigation requirements

To account losses and irrigation efficiency we have to apply gross irrigation requirements; the gross irrigation requirement (GIR) is the amount of irrigation water that should be applied at the head of irrigation field in order to satisfy the NIR, it is obtained by dividing the amount of the net irrigation requirement (NIR) for each crop by the application efficiency (Ea) of the irrigation method Equation(11).

$$GIR = \frac{NIR}{E_a} \quad \text{Eq (11)}$$

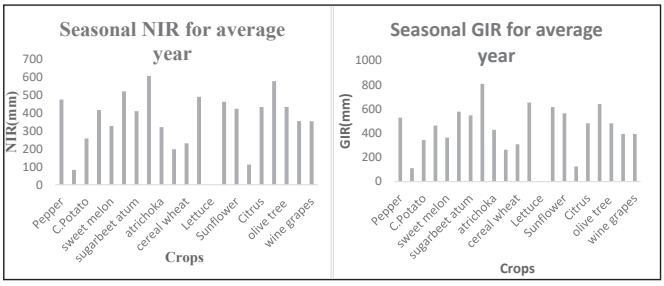
In this study, we are going to account for different efficiencies 90% and 75% which correspond to drip irrigation and sprinkler irrigation respectively.

For average year

Table 7. Seasonal ETc, Peff , NIREa and GIR for average year

	Etc (mm)	Effrain (mm)	Net Irrreq (mm)	Ea	GIR (mm)
Pepper	579	104	475	0,9	527,8
E.Potato	221,5	138,7	82,8	0,75	110,4
C.Potato	367,4	109,3	258,1	0,75	344,1
Soybean	515,1	99,3	415,8	0,9	462,0
Sweet melon	413,9	86,5	327,4	0,9	363,8
Tomato	619,1	99,1	520	0,9	577,8
Sugarbeet autumn	604,9	194,6	410,3	0,75	547,1
Sugarbeet Springs	734,8	129	605,8	0,75	807,7
Artichoke	632,7	311,6	321,1	0,75	428,1
Carrot	355,6	157,8	197,8	0,75	263,7
Cereal wheat	429,4	198,3	231,1	0,75	308,1
Eggplant	577,3	87,5	489,8	0,75	653,1
Lettuce	135,5	135,5	0	0,9	0,0
Maize	542,4	80,4	462	0,75	616,0
Sunflower	512,5	89,7	422,8	0,75	563,7
Broad bean	299,2	186,9	112,3	0,9	124,8
Citrus	738,3	305,3	433	0,9	481,1
Cherry	826,5	249,3	577,2	0,9	641,3
Olive tree	677,5	244,2	433,3	0,9	481,4
Peach	536,5	181,7	354,8	0,9	394,2
Wine grapes	531,9	178,2	353,7	0,9	393,0

Figure 3. Seasonal NIR and GIR for average year

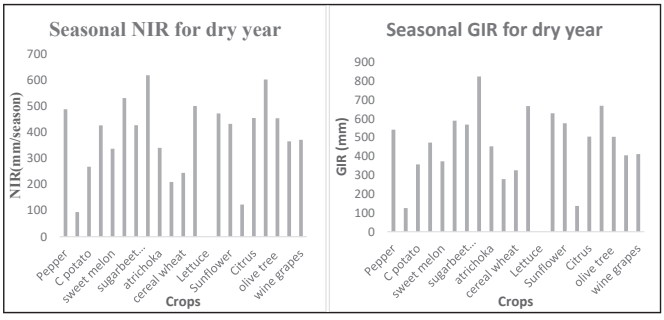


For dry year

Table 8 Seasonal ETc, Peff , NIREa and GIR for dry year

	Etc(mm)	Effrain (mm)	Net Irrreq(mm)	Ea	GIR (mm)
Pepper	579	91,5	487,5	0,9	541,7
E Potato	221,5	127,3	94,2	0,75	125,6
C potato	367,4	99,5	267,9	0,75	357,2
Soybean	515,1	89,2	425,9	0,9	473,2
Sweet melon	413,9	77,3	336,6	0,9	374,0
Tomato	619,1	88,5	530,6	0,9	589,6
Sugarbeet autumn	604,9	178,4	426,5	0,75	568,7
Sugarbeet Springs	734,8	117	617,8	0,75	823,7
Atrichoka	632,7	292,7	340	0,75	453,3
Carrot	355,6	146,2	209,4	0,75	279,2
Cereal wheat	429,4	185	244,4	0,75	325,9
Eggplant	577,3	77,1	500,2	0,75	666,9
Lettuce	135,5	135,2	0,3	0,9	0,3
Maize	542,4	70,8	471,6	0,75	628,8
Sunflower	512,5	80,7	431,8	0,75	575,7
Broad bean	299,2	176,1	123,1	0,9	136,8
Citrus	738,3	284,2	454,1	0,9	504,6
Cherry	826,5	225	601,5	0,9	668,3
Olive tree	677,5	224,1	453,4	0,9	503,8
Peach	536,5	171,7	364,8	0,9	405,3
Wine grapes	531,9	161	370,9	0,9	412,1

Figure 4. Seasonal NIR and GIR for dry year



Salt balance

In an irrigation project, the determination of the irrigation requirements should take into account the leaching fraction necessary to remove salts from the soil. The simplified salt balance involves several assumptions:

- The only source of salt is irrigation water.
- No capillary rise.
- No deep percolation and runoff (efficient irrigation).
- All salts are highly soluble and do not precipitate.
- The amount of salt supplied by rainfall is negligible.
- The amount of salts supplied by fertilizers and exported by crops are negligible.

The electrical conductivity of irrigation water in the study area is EC_{iw} = 0.8 dS/m. So, the average concentration of salts in irrigation water is:

0.8*0.64 = 0.512 Kg/m^3 (640mg/l = 0.640 Kg/m^3=1 dS/m).

The calculation of the quantity of water supplied by irrigation is carried out from the value of the gross irrigation requirement for an average year, and it is about 4196.24 m^3/ha/year.

$$QS_{iw} = Q_{iw} * S_{iw}$$

where

QS_{iw} : Quantity of salts in irrigation water (kg/ha/year)
Q_{iw} : Quantity of water supplied (m^3/ha/year)
Siw : Salinity of water (kg/m^3)

The quantity of salt provided by irrigation water is 4196.24*0.512 = 2148.47 kg/ha/year

The soil porosity is given by the following formula:

where

The bulk density of soil ρ_h is 1247 Kg/m^3 So, n = 0,52

The specific density of soil ρ_s is 2600 Kg/m^3.

The total volume of one hectare of land equals 10000m^2*soil depth (m).

Knowing the effective soil depth is 0.7 m, the total volume of soil is 7000m^3.

If the porosity is equal to 0.52, that means that 52% of the total volume of soil is occupied by pores. So, the amount of water necessary to bring the soil to saturation is

7000 m^3 * 0.52= 3640 m^3/ha

Considering the cropping pattern and the crop salt tolerance (FAO No.29 revised), it is acceptable to reduce yield by 25% which correspond to EC of soil saturation paste equal to: 4dS/m (4 * 0.640 = 2.56 kg salt/m3).

3640 (m^3/ha/year) * 2.56 (Kg/m^3) =9318.4 Kg salt/ha

The number of years required to reach this level of salinity is:

$$N = \frac{9318.4(kg/ha)}{2148.47(kg/ha/an)} = 4.34\,years$$

So, we could have some salinity problems after about 4.3years of irrigation. In reality, it is expected that during the winter season, the rainfall will remove the salts from the soil. Otherwise we should take into account the determination of leaching requirements then also thinks about the necessity of a drainage system.

CONCLUSIONS

The one-years long research developed both theoretical significance of the discipline and applied methodology. Firstly, a major contribution of the paper is the estimation of the CWR and IWR for some selected crops as well as developing cropping pattern for the study area using CROPWATv8.0. We had seen IWR is very low from November to April (wintertime) due to higher rainfall intensity in these months and from May to October a considerable amount of water is required for irrigation. Secondly ,the total effective rainfall estimated by CROPWAT was 486.9 mm. The results showed that the lowest values of effective rainfall were in July and August 8.9-16.5 respectively(Summertime).Finally, By studying the Salt balance, we have seen some salinity problems after about 4.3years of irrigation but in reality, on the winter season the rainfall will remove the salt from the soil.

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SCIENTIFIC PAPER

LUXURY WINE: ANALYZING MOTIVATIONS OF LUXURY WINE BUYERS IN THE US MARKET

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Abstract: *The purpose of this research study was to describe motivations and demographics of luxury wine buyers in the US market. An online survey was completed by 1081 US wine consumers, of which 473 were designated to be luxury buyers based on price spent on wine. Standard demographic and wine consumer scales were utilized for profiling. Results show that the luxury wine buyer is more likely to be male, aged 30 to 50, with a higher income and education level. Motivations of the luxury wine buyer are different than the non-luxury wine buyer, and reasons for purchasing luxury wine go beyond mere collecting. This research is one of the first to analyze the luxury wine consumer in the US market, and provides useful information for wine marketers and researchers on the profile of the luxury wine buyer in America.*

Keywords: *Luxury Marketing, US Wine Market, Consumer Behavior, Agribusiness, Commerce.*
(JEL Classification: M31)

INTRODUCTION

The luxury market has been growing at a healthy pace for the past several decades, increasing from €77 billion in 1995 to €253 billion in 2015 (Bain, 2016). The growth is spurred by a variety of reasons, including globalization, cultural trends, luxury highlighted by the media, and the mounting number of wealthy people in the world (Seo and Buchanan-Oliver 2015; Kapferer and Bastien 2012).

As an agricultural product, wine has seen similar growth in luxury, primarily via luxury pricing, with the top fifty most expensive wines all priced at over $1,000 per bottle, and the most expensive over $65,000 per bottle, depending on vintage (WineSearcher, 2020). The trend is illustrated in increasing prices achieved at wine global auctions, with the Wine Spectator Auction Index showing over a 300% increase in value from 1997 to 2015 (Wine Spectator, 2017).

The growth of the luxury wine market gives rise to questions regarding the types of consumers purchasing these high-priced wines and their reasons why. As the US is currently the largest wine consuming nation in the world in both quantity and value (Nielsen, 2017), a research study was designed to discover more about the type of consumer who purchases wine priced at over $50, $100, $200, and $1000. The results provide a demographic profile of the luxury wine buyer in America, as well as insights into their values and motivations for purchasing high-priced wines.

REVIEW OF THE LITERATURE

Luxury has been defined as "anything that is desirable and more than necessary and ordinary (Heine, 2013, p. 40)." The research literature also identifies several key attributes that define a luxury product. These include: high price,

high quality with authenticity, a sense of scarcity, beautiful aesthetics that appeal to hedonists, providing a sense of privilege because it is special, and possessing a high degree of symbolism often derived from heritage (Vigneron and Johnson 2004; Kapferer and Bastien 2012; Hartman et al 2016; Sjostrom et al 2016; Beverland, 2005; Miller and Mills 2012; Dubois et al 2005; Hennigs et al 2012). More recently, the concept of sustainability has been added to the luxury criteria because of growing interest by consumers (Hartman et al 2016; Kapferer and Bastien 2012; Verain et al 2016).

There have been a variety of consumer behavior studies regarding luxury products, but most conclude that consumers differ by country and that not all of the luxury attributes listed above are important to all consumers (Hartmann et al, 2016; Heine et al 2014; Dubois et al 2005; Rod et al 2015; Hennigs et al 2012; Stiehler and Steihler 2016; Kapferer and Laurent 2016). For example in a study of 1275 consumers in 10 countries, the authors (Hennigs et al. 2012) found that that in the USA, India, Brazil and Italy consumers are more concerned with the hedonic, material, and affective aspects of luxury. German consumers were more interested in quality and performance, where French consumers valued luxury products because they were exclusive and high-priced. In the Czech Republic, researchers (Rod et al. 2015) analyzed demographic factors and found that younger, more highly educated consumers with higher incomes were more likely to buy luxury goods.

Despite difference by nationality, luxury researchers have developed several consumer luxury segmentations. In a large study of 1848 management students in 20 countries researchers (Dubois et al. 2005) were able to identify three types of luxury consumers: Elitists who believe luxury is only for the few; Democratic – who believe luxury is for the many; and Distant – who believe luxury is in a different world where they don't belong. A group of researchers (Heine et al. 2014) developed a simpler segmentation of: Aspirers who buy to enhance their social image and are price sensitive; and Connoisseurs who buy for enjoyment and sharing, and are not price sensitive. There is also a group of consumers who avoid luxury products, because they perceive them as wasteful (Dubois and Laurent 1994; Bryson et al. 2013). Another study (Wiedmann et al. 2009) of 750 consumers identified ten values associated with luxury: quality, uniqueness, sensory pleasure, aesthetics, excitement, hedonism, materialism, usability, self-identify, and positive recognition from cohorts.

In the wine industry there have been several luxury research studies. One of the oldest was a study of 110 consumers in Australia (Beverland, 2004) where the findings showed that consumers used criteria such as high quality, handcrafted, proven track record, and ability to sell well at auction as important decision factors in luxury wine purchases. Interestingly they were not that concerned with the taste of the wine because many saved it in collections, which would later be sold, traded, or consumed on a special occasion. In a study of luxury wine producers in four different nations (Beverland, 2004b) results showed that producers were concerned with high quality, being authentic to what the land and vintage gave them to craft the wine, and having limited production. They primarily based their marketing message on heritage, family history, quality and scarcity. Additional research by Beveraland (2005, 2006) further highlighted the importance of authenticity for luxury wine and focusing on hand-crafted methods. Downplaying the use of technology in winemaking in order to be perceived as creating an authentically crafted product from the land was also identified in other luxury wine research studies (Heine et al. 2016). In the southern hemisphere, researchers (Sjostrom et al. 2016) found that higher-priced wine in the Australian market had five important elements: luxury, limited production/edition, antique/old (back vintage), premium price and premium.

Luxury wine is usually produced in a region known for its long history of fine wine production, and therefore has a sense of heritage and "sacred vineyards," such as Grand Cru designated vineyards in Burgundy (Yeung and Thach 2019). In addition, no expense is spared in the production of these wines, such as uses of the highest quality oak barrels for aging. Furthermore, they are generally distributed in a very careful manner, often utilizing an allocation system whereby restaurants, wine retailers, and end-consumers are only allowed to purchase a limited number of bottles each year (Beverland, 2005; Sjostrom et al. 2016).

Interestingly, luxury wine can be crafted as still dry, semi-sweet, or sweet wines, as well as sparkling wines. A major priority is that they have the ability to age, and can increase with price on the secondary market for trading (Yeung and Thach 2019; Beverland, 2004). Therefore, dry red Bordeaux or Napa Valley wines, dry white Burgundy, semi-sweet German Rieslings, sweet Madeira's or Ports, and sparkling Champagnes can all be classified as luxury wine – as long as they meet the other criteria of high price, scarcity, heritage, ability to age, and so forth. Indeed, in a review of the top ten most expensive wines in the world, three are dry white wines; five are dry red wines; and two are sweet wines, including a German Trockenbeerenauslese Riesling from Egon Muller Scharzhofgerger winery and a J.S. Terrantez from Madeira, Portugal (Winesearcher.com, 2020). Of these, the most expensive is Domaine de la Romanee-Conti from the Romanee Conti Grand Cru vineyard in Burgundy, France at an average price of $20,708 per bottle.

The concept of luxury wine pricing has also been examined in the research literature, but there is no conclusive agreement on the actual price point of luxury wine (see Table 1).

Table 1: Luxury Wine Pricing from Previous Studies

Study	Pricing
Geene (1999)	Icon wine as above $50
Cholette and Castaldi (2005)	Luxury $25 to $50, Super Luxury $50 to $100, and Icon over $100
Sjostrom et al (2014)	Australian wine price segments: $0-$24.99, $25-$49.99, $50-$99.99, and $100+.
Jarett and Jarvis (2016)	Ultra-Premium wines $70 - $99 AUD ($51 - $72 USD); Luxury/ Icon wines $100 AUD ($73 USD)
Brager (2016)	Nielsen Wine Scan Data – Most expensive is $25+

METHODOLOGY

A quantitative research methodology was used to obtain an online sample of US wine consumers. The survey was developed using standard wine consumer scales, wine pricing, and demographic questions. A panel data provider, Survey Sampling International, was commissioned to collect a representative sample of American wine consumers by insuring that all 50 states were represented and that the gender matched US wine consumption statistics (Nielsen, 2016).

The survey was launched in the spring of 2016 over a two-week period. A total of 1081 usable surveys were received. Of these 473 consumers had purchased a bottle of wine for $50 or more, which was used as a price point for luxury wine purchases, based on the literature review. Statistical analyses were performed on this portion of the sample using SPSS and Excel.

RESULTS

Gender - We first analyzed whether having purchased a bottle of wine over $50 (Yes = 1, No = 2) and gender (Male = 1, Female = 2) are independent of one another. A chi-square test of independence was performed. The relation between these 2 variables was significant, X2 (1, N = 1081) = 30.97, p <.000. Luxury purchasers were more likely to be male (57.5%) than female (42.5%). The results of the crosstabs are reported in Table 2.

Table 2. Luxury Wine Buyer by Gender

			Gender		Total
			Male	Female	
Have you ever spent $50 for a bottle of wine?	No	Count	246	362	608
		% within over $50	40.5%	59.5%	100.0%
		% within gender	47.5%	64.3%	56.2%
		% of Total	22.8%	33.5%	56.2%
	Yes	Count	272	201	473
		% within over $50	57.5%	42.5%	100.0%
		% within gender	52.5%	35.7%	43.8%
		% of Total	25.2%	18.6%	43.8%
Total		Count	518	563	1081
		% within over $50	47.9%	52.1%	100.0%
		% within gender	100.0%	100.0%	100.0%
		% of Total	47.9%	52.1%	100.0%

Income - Our second analysis looked at whether having spent over $50 for a bottle of wine (Yes = 1, No = 2) and Income (9 ranges) are independent of one another. First, a chi-square test of independence was performed. The relation between these 2 variables was significant, X2 (8, N = 1081) = 92.33, p <.000. Luxury purchasers were more likely to be found in the upper income ranges, such as $70,000 - $99,999, $100,000 - $149,999, $150,000 and $199,999, and over $200,000. A t-test was also run to determine if the mean between the 2 groups, those who spent over $50 and those who never had, were different. The mean of 5.6 for those who had was significantly higher than the mean 4.4 for those that had not T (1079, N = 1081) = 9.78, p<.000. Table A1 in the appendix describes these results in more detail.

Education Level - Our next analysis looked at whether having spent over $50 for a bottle of wine (Yes = 1, No = 2) and Education (6 ranges) are independent of one another. First, a chi-square test of independence was performed. The relation between these 2 variables was significant, X2 (5, N = 1081) = 25.43, p <.000. Luxury purchasers were more likely to be found among those that had graduated from college or completed their graduate degree, but interestingly not for those that had some graduate school but had not completed their degrees. The results of the cross tabs are reported in Table 2. A t-test was also run to determine if the mean for education between the 2 groups, those who spent over $50 and those who never had, were different. The mean of 4.1 on the 6-point scale for those who had purchased was significantly higher than the mean 3.8 for those that had not, T (1079, N = 1081) = 4.03, p<.000. Table A2 in the appendix describes these results in more detail.

Age - Our final analysis for demographic variables considered whether having spent over $50 for a bottle of wine (Yes = 1, No = 2) and age (5 ranges) are independent of one another. First, a chi-square test of independence was performed. The relation between these 2 variables was significant, X2 (4, N = 1081) = 28.70, p <.000. Luxury purchasers were more likely to be found among those in middle age categories, ages 30 to 50. The results of the cross tabs are reported in Table 3 in the appendix. A t-test was also run to determine if the mean for age between the 2 groups, those who spent over $50 and those who never had, were different. The mean of 3.1 on the 6-point scale for those who had purchased was significantly lower than the mean 3.3 for those that had not, T (1079, N = 1081) = 4.03, p<.000.

Motivations – Next we analyzed whether having purchased a bottle of wine over $50 (Yes = 1, No = 2) and nine motivations for drinking wine (Yes = 1, No = 2) are independent of one another. A chi-square test of independence was performed. Due to space limitations, the crosstabs are not reported here for the nine motivations, but the findings are summarized in Table 5, with the six motivations that were significant listed first.

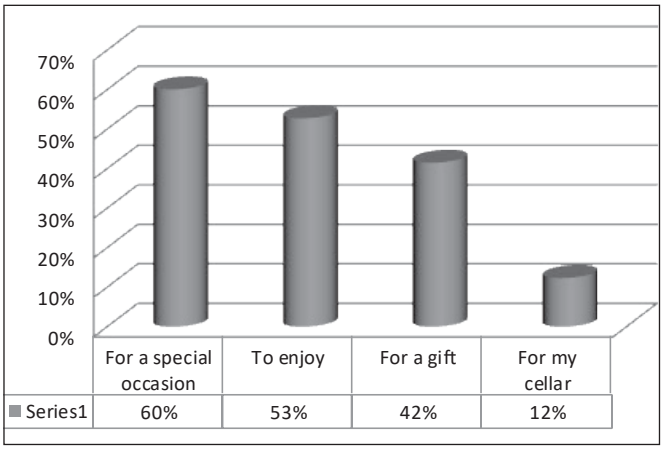
Table 5: Luxury Wine Buyers and Motivations for Drinking Wine

Motivation (I drink wine because…)	Results of X2 analysis - SIGNIFICANT	Summary of Group Differences
Wine tastes good	X^2 (1, N = 1047) = 39.27, p < .000	Luxury purchasers (N=476) were more likely to (53.6%) than non purchasers (N= 671) (46.4) to drink because wine taste good.
Wine goes well with food	X^2 (1, N = 1047) = 74.73, p < .000	Luxury purchasers (N=476) were more likely to (53.6%) than non purchasers (N= 671) (46.4%) to drink because wine goes well with food.
Wine helps me relax	X^2 (1, N = 1047) = 18.95, p < .000	Luxury purchasers (N=476) were less likely to (47.0%) than non purchasers (N= 671)(53.0%) to drink because it helps them relax.
Wine helps me socialize with friends	X^2 (1, N = 1047) = 39.27, p < .000	Luxury purchasers (N=476) were less likely to (48.6%) than non purchasers (N= 671)(51.4%) to drink because it helps them socialize with friends.
Wine is for romance	X^2 (1, N = 1047) = 35.96, p < .000	Luxury purchasers (N=476) were more likely to (60.6%) than non purchasers (N= 671)(39.4%) to drink because wine is for romance.
I can analyze and compare it with friends	X^2 (1, N = 1047) = 19,20, p < .000	Luxury purchasers (N=476) were more likely to (69.6%) than non purchasers (N= 671)(30.4%) to drink because they can analyze and compare wine with friends.

Motivation (I drink wine because…)	Results of X^2 analysis – NOT SIGNIFICANT	Summary of Group Differences
Wine helps me socialize with family	X^2 (1, N = 1047) = 6.97, p < .008	Luxury purchasers (N=476) were less likely to (46.9%) than non purchasers (N= 671) (53.1%) to drink because wine helps them socialize with family.
For health reasons	X^2 (1, N = 1047) = 2.99, p = .084	Luxury purchasers (N=476) were no different (46.9%) than non purchasers (N= 671) (53.1%) to drink wine for health reasons.
Wine helps me sleep	X^2 (1, N = 1047) = 1.17, p = .280	Luxury purchasers (N=476) were no different (45.7%) than non purchasers (N= 671) (54.3%) to drink because it helps them sleep.

Luxury Rationale - we also asked respondents the reason they purchased wine over $50, providing four reasons and allowing them to select all that applied. Results are illustrated in Figure 1 and show that special occasions, selected by 60% of the luxury wine buyers, was the most important reason, followed by enjoyment (53%), to give as a gift (42%) and for their cellar (12%).

Figure 1: Reasons for Buying Luxury Wine



DISCUSSION, LIMITATIONS AND FUTURE RESEARCH

In analyzing the results of this research there are both expected and unexpected findings. As many would expect the demographic profile of the American luxury wine consumer is more likely to be male, aged 30 to 50, with a higher level of income and a bachelor's or graduate degree. Interestingly this supports older research on demographics of American wine consumers, though not luxury consumers (Wine Market Council, 2000).

What may be more interesting is that the luxury wine consumer is motivated not only by wine that tastes good and goes well with food, but is more interested than the non-luxury wine consumer in wine for romance, to socialize with friends, and to help with relaxation. He is also much more likely to drink wine because he enjoys analyzing it and comparing it with friends. This supports the findings of Beverland (2004), showing that luxury wine buyers often buy for their collection, rather than to drink the wine. However, though this study also showed that 12% of the luxury buyers did purchase for their cellar, 53% were more concerned with enjoying the wine – perhaps in socializing with friends. This suggests that the American luxury wine buyer may be more interested in drinking wine in social circles, rather than just buying for a collection.

This study provides some implications for marketers in terms of consumer demographics they may want to profile in advertisements or online videos. It also highlights the need to focus on social occasions, including romance and comparing wine with friends. At the same time it has limitations in that it is based on a representative sample of American wine drinkers, rather than a random sample. In addition, the price point of wine over $50 as luxury, may be too low. Given that wine is sold at much higher prices, future research may want to provide higher ranges and segment consumers based on these responses to see if the profile of the luxury

consumer could be refined further. Finally other behavioral or psychographic scales could be used to further define the luxury wine consumer, as well as an analysis of the different styles of luxury wine they purchase, such as dry, semi-sweet, sweet, or sparkling.

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APPENDIX

Table A1: Luxury Wine Buyers by Income

				Approximate annual household income before taxes								
			Less than $20,000	$20,000 - $29,999	$30,000 - $39,999	$40,000 - $49,999	$50,000 - $69,999	$70,000 - $99,999	$100,000 - $149,999	$150,000 and $199,999	Over $200,000	Total
Have you spent over $50 for a bottle of wine?	No	Count	77	73	76	65	105	106	77	20	9	608
		% within over $50	12.7%	12.0%	12.5%	10.7%	17.3%	17.4%	12.7%	3.3%	1.5%	100.0%
		% within annual household income	80.2%	72.3%	75.2%	58.6%	58.0%	48.2%	43.5%	37.0%	22.5%	56.2%
		% of Total	7.1%	6.8%	7.0%	6.0%	9.7%	9.8%	7.1%	1.9%	0.8%	56.2%
	Yes	Count	19	28	25	46	76	114	100	34	31	473
		% within over $50	4.0%	5.9%	5.3%	9.7%	16.1%	24.1%	21.1%	7.2%	6.6%	100.0%
		% within Annual household income	19.8%	27.7%	24.8%	41.4%	42.0%	51.8%	56.5%	63.0%	77.5%	43.8%
		% of Total	1.8%	2.6%	2.3%	4.3%	7.0%	10.5%	9.3%	3.1%	2.9%	43.8%
Total	Count	96	101	101	111	181	220	177	54	40	1081	
	% within over $50	8.9%	9.3%	9.3%	10.3%	16.7%	20.4%	16.4%	5.0%	3.7%	100.0%	
	% within annual household income	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
	% of Total	8.9%	9.3%	9.3%	10.3%	16.7%	20.4%	16.4%	5.0%	3.7%	100.0%	

Table A2: Luxury Wine Buyer and Education

			Highest level of formal education						Total
			Some high school or less	High school graduate	Some college	College graduate	Some graduate school	Completed graduate school	
Have you ever spent over $50 for a bottle of wine?	No	Count	6	92	165	206	37	102	608
		% within over $50	1.0%	15.1%	27.1%	33.9%	6.1%	16.8%	100.0%
		% within education	85.7%	71.3%	60.4%	51.0%	60.7%	49.3%	56.2%
		% of Total	0.6%	8.5%	15.3%	19.1%	3.4%	9.4%	56.2%
	Yes	Count	1	37	108	198	24	105	473
		% within over $50	0.2%	7.8%	22.8%	41.9%	5.1%	22.2%	100.0%
		% within education	14.3%	28.7%	39.6%	49.0%	39.3%	50.7%	43.8%
		% of Total	0.1%	3.4%	10.0%	18.3%	2.2%	9.7%	43.8%
Total		Count	7	129	273	404	61	207	1081
		% within over $50	0.6%	11.9%	25.3%	37.4%	5.6%	19.1%	100.0%
		% within education	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	0.6%	11.9%	25.3%	37.4%	5.6%	19.1%	100.0%

Table A3: Luxury Wine Buyer and Age

		Age Category						
			21 to 29	30 to 39	40 to 50	51 to 69	70+	Total
Have you ever spent over $50 for a bottle of wine?	No	Count	57	102	115	262	72	608
		% within over $50	9.4%	16.8%	18.9%	43.1%	11.8%	100.0%
		% within age group	58.2%	48.1%	47.1%	61.4%	72.0%	56.2%
		% of Total	5.3%	9.4%	10.6%	24.2%	6.7%	56.2%
	Yes	Count	41	110	129	165	28	473
		% within over $50	8.7%	23.3%	27.3%	34.9%	5.9%	100.0%
		% within age group	41.8%	51.9%	52.9%	38.6%	28.0%	43.8%
		% of Total	3.8%	10.2%	11.9%	15.3%	2.6%	43.8%
Total		Count	98	212	244	427	100	1081
		% within over $50	9.1%	19.6%	22.6%	39.5%	9.3%	100.0%
		% within age group	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	9.1%	19.6%	22.6%	39.5%	9.3%	100.0%

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SCIENTIFIC PAPER

HOW TO IMPROVE THE PERFORMANCE OF AGRICULTURE IN MONGOLIA BY ICT

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Abstract: *Agriculture is one of the most important sectors for the Mongolian economy. Also, self-sufficient food is a significant target that has a vital role in the food safety of people in Mongolia. But due to climate change, not proper management, and lack of technology, the Mongolian agricultural sector is facing several issues. So this article aims to find some potential solutions to improve this situation, especially for the crop production sector in Mongolia. To define the current situation of Mongolian agriculture, we used statistical data and reports and recent scientific articles as well as online sources. The current situation of Mongolian agriculture is defined using SWOT analysis reported by the Ministry of Food, Agriculture, and Light Industry of Mongolia. Based on this research, we discuss the possibility of using a drone to improve the performance of agriculture in Mongolia. As a result, a drone is effective in enhancing the performance of agriculture performed by householders. Also, two effective models that are based on ICTs to address soil erosion and harvest losses issues in Mongolia are defined in this article.*

Keywords: *Agriculture technology, Drone, ICT, IoT, NDVI.*
(JEL Classification: Q16)

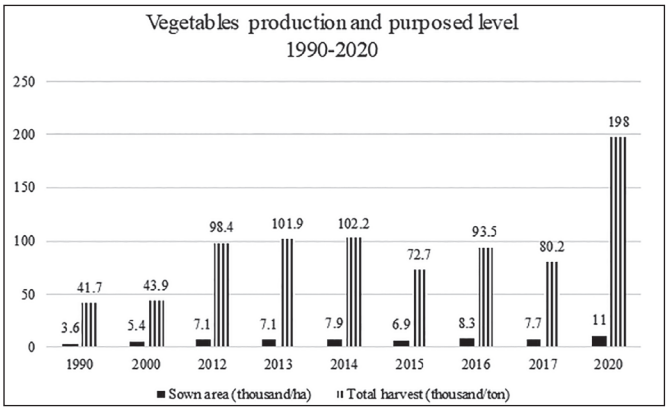
INTRODUCTION

The purpose of this article is to find some possible solutions to improve Mongolian agriculture by Information Communication Technologies (ICTs). In Mongolia, the agricultural sector consists of two subsectors, namely, animal husbandry and crop production. This sector is contributing 10.8 percent of the Gross Domestic Product (GDP), and 55.8 percent of the total labor force is working in the sector. In 2018, approximately 511.8 thousand hectares cultivated area was used for crop production, with 7.1 percent of this presently under irrigation. This land, both irrigated and non-irrigated, is used by 1,422 farm companies and 15,862 householders to produce agricultural goods for domestic consumption (NSO, 2018).

The principal crops are wheat and potatoes, which are widely grown in all regions and cover more than half of the country's cultivated area. Cereals, fodder plants, oil crops, vegetables, and some fruits cover the rest of the area. Mongolia's 2030 Sustainable Development Vision set a goal to be self-sufficient in grain, potatoes, and vegetables by 203. However, Mongolia depends on imports for more than 20 percent of their food goods. The primary imported goods are all type of rice, vegetables, fruits, leguminous plants, eggs, and food oil are imported from other countries, particularly China, 100%, 43.5%, 92.9%, 100%, 49.7%, and 92.7%, respectively (MOFALI, 2019). Hence, the Ministry of Food, Agriculture, and Light Industry of Mongolia aims to increase vegetable production for the domestic market. The target number of the harvest of vegetables is 198 thousand tons in 2020 (MOFALI, 2018) (Figure 1).

From this background, this article focus on finding some potential solutions based on ICTs to increase vegetable production in Mongolia. As the tendency of the World, The

Figure 1. Information of vegetables production between 1990 and 2017, and purposed level by 2020



Source: http://mofa.gov.mn/exp/blog/8/71# (MOFALI, 2018)

Table 1: SWOT analysis of crop production sector in Mongolia

	Strengths	Weaknesses
Internal factors	Adapted seed sorting Produced agrotech Implemented mechanisms	Technology is old and harmful for resources Financial ability of farmers Unstable production Weak market, quality of seed supply
	Opportunities	**Threats**
External factors	Resource of arable land Demand for market Encourage of the Government Interests of farmers	Climate change Input depends on import Shortage of labor Soil erosion Limited export condition

Source: Master plan of Mongolian agriculture 2011-2021 (MOFLI, 2011)

Food and Agriculture Organization of the United Nations has reported ICTs in agriculture can potentially contribute to improving both the productivity and sustainability performance of the agriculture and food sector towards the realization of the Sustainable Development Goals. For example, the precision application of agrochemicals can reduce the amounts of pesticides and fertilizers. At the same time. increasing yields and reducing possible negative side-effects on soil and water, better weather, and market data enables more effective farm production decisions, reducing waste and loss on the farm (FAO, 2017).

Section 2 mentions materials and methods. This section includes (1) existing problems in Mongolian agriculture, (2) related works to use ICTs to improve the productivity of agriculture, (3) the outline of the result of our research to estimate the growth stage of rice by using a drone. Based on the discussion in section three, we discuss the possibility of using a drone for vegetable farming and the possibility to develop automation systems based on IoT for agriculture in Mongolia in section 4. Finally, the conclusion is mentioned in section 5.

MATERIALS

Existing problems in Mongolian agriculture

The Mongolian government has reported "Master plan of Mongolian agriculture 2011-2021" that define the current situation and display a plan of Mongolian agriculture (MOFALI, 2011). In this master plan, strengths, weaknesses, opportunities, and threats (SWOT) analysis of the crop production sector is presented in the table(Table 1). There are many positive factors, such as the huge arable land, interests of farmers, and lots of needs in the domestic market. From this analysis, two major issues that might be solved by ICTs discussed in this article.

These issues are soil erosion and harvest losses in the crop production sector. The soil erosion is a less-discussed form of Mongolia agriculture even soil is a crucial point of agriculture. The soil erosion is increasing continuously because of the intensive use of soil and less maintenance for soil, especially the agricultural area. The arable soils of Mongolia comprise dark chestnut and chestnut soils, which are typical of soils that evolved with steppe vegetation. These soils are inherently fertile but shallow soils, with an average depth of 30 cm. Because of their light texture, moisture retention is low, and the soils are susceptible to erosion (B. Batkhuyag & Kh.Batnaran, 2018). The foremost need for this issue is to develop a database of soil information about Mongolian farming regions for farmers. The information about soil ranging from the type of soil, what crops would be suitable, how long it can be used for farming to how to maintain this soil should be provided for farmers. Based on this background, this article also focuses on to develop a model using IoT for soil information databases for farming five regions in Mongolia.

Another issue is the harvest losses. It is often said that crop production in Mongolia mostly depends on the weather condition, also B.Batkhuyag & Kh.Batnaran (2018) presented that in the extreme continental climate, with long cold winters and low precipitation, it is considered as one of the critical factors to agricultural production in Mongolia. The crop yield in any given area can fluctuate up to 50% due to weather conditions of given year and season, and it might even be lost altogether (Bolormaa, Lkhagvasuren, Gantuya, Gnakhuyag, & Altanzul, 2018). So, to monitor the crop field and to increase the vegetable production, we need to implement ICTs for crop field. Also, lack of irrigation and less automation system might be another cause of this issue because irrigated fields occupy only 7.1 percent of the total cultivated area.

A large number of crops are wheat and potatoes, which are widely grown in all regions and covers more than half of the country's cultivated area. For example, the total cultivated area is 511.8 thousand ha, 71.7 percent for wheat, 14 percent for industrial crops, 9 percent for fodder plants, 25 percent for potatoes, 1.7 percent for vegetables, 0.8 percent for fruits and 0.2 percent for medical plants (NSO, 2019). It can be concluded that other (except wheat and potatoes) crops production efficiency in Mongolia is relatively low because the

production depends mainly on rainfall and weather. Therefore, farmers do not have the technology to increase their crop productivity. In addition, decreasing the labor force can be impacted by this issue. In fact, nowadays, young people do not want to work in the farming field, and most youths leave for the city. Due to decreasing labor, many automation systems and robots are introduced in developed countries, especially Japan, and it can bring some benefits from automation for agriculture.

Related works to use ICTs to improve the productivity of agriculture

In this subsection, we discuss relevant prior research on two aspects. The first involves agricultural drones, while the second aspect focuses on sensors in agriculture.

Drones in agriculture

Last decade, drones were applied in many studies. The use of drones in agriculture is extending at a brisk pace in crop production, early warning systems, disaster risk reduction, forestry, fisheries, as well as in wildlife conservation (FAO and ITU, 2018). In this study, we focus on to improve productivity in a crop field. For example, crop production: using GPS and sensors for collecting relevant data in the field, a drone can do soil health scans, monitor crop health, assist in planning irrigation schedules, apply fertilizers, estimate yield data and provide valuable data for weather analysis (Marthinus, R., & Tania, P., 2017). Also, many studies focused on the growth condition of crops using a drone in recent years. For instance, a study introduced a complete system that combines the UAV platform, a UAV-borne crop-growth sensor, and a ground-based data processor. The system can continuously and conveniently obtain the NDVI and RVI values of the crop canopy online (as well as growth indices including LNA, LAI, and LDW) with high throughput and is not limited by the terrain (Jun, et al., 2017). Also, Frank Veroustraete said that the ability of a drone is inspected in-progress crops from about 100 meters height using the Normalized Difference Vegetative Index (NDVI) or near-infrared (NIR) sensors (Veroustraete, 2015). It seems that agricultural drones will be continuously used in agriculture in the future.

Table 2. Detectable wavebands of Sequoia.

Waveband	Wavelength(nm)	Band width(nm)
Green (G)	550	40
Red (R)	660	40
Red Edge (RE)	735	10
Near InfraRed (NIR)	790	40

Sensors in agriculture

Jhonattan et al. (2019) presented a case study of sensing, smart and suitable technologies applied for the agri-food sector: an intelligent greenhouse, a sun tracker trajectory, a hexapod robot for field monitoring and an agricultural drone. And Jirapond et al. (2019) introduced a system optimally watering crops based on wireless sensor networks. So they illustrated this optimal watering system can reduce costs and improve the productivity of farming. In general, sensors can detect events, acquire data, measure changes that occur in a physical environment, and collect information that is processed by a control system. Some of the most common applications of sensing technologies are in monitoring systems, control systems, autonomy, and optimization. Also, due to the importance of sensing technologies, there are efforts to improve sensing systems to increase their processing capability and reduce the size, energy consumption, and costs. Moreover, there is research that Brazilian researchers Dieisson, et al. (2018) surveyed to define leader countries in the smart farming research filed.

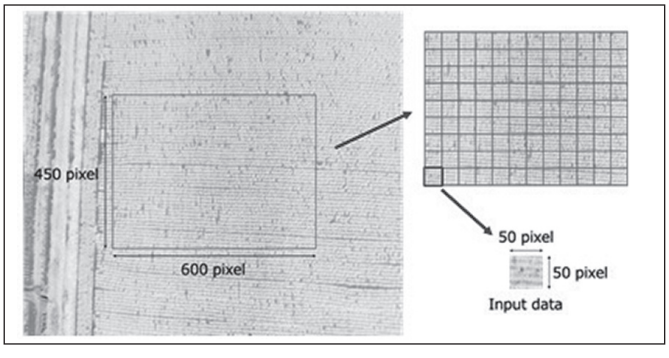
As a result of this study, China, the United States, South Korea, Germany, and Japan have contributed the most significant number of scientific studies to this field. Leadership in publishing SF research is associated with how much countries spend on R&D annually. Countries that invest more in R&D have the highest number of publications and become leaders in smart agriculture technologies in the future.

RESEARCH METHODOLOGY

We performed research to evaluate the effectiveness of estimating the growth condition of rice by a drone (Murata, Ito, Takahashi, Hatano, 2018). We used NDVI (Normalized Difference Vegetation Index) images and realized higher accuracy classification of the growth stage of rice. To take NDVI images, we used a drone (Phantom 3) and Sequoia (Parrot SEQUOIA). Table 2 shows detectable wavebands of Sequoia. Sequoia. It can get four wavebands, Green, Red, Red Edge, and Near-Infrared. Equation (1) shows NDVI.

In this study, paddy's growth stages are categorized in six, such as (a) Transplanting stage, (b) Tillering stage, (c) Panicle forming stage, (d) Booting stage, (e) Heading stage, (f) Ripening stage. We used Deep Learning to detect the growth stage using a drone and multi-spectrum camera.

Figure 2. Mesh division



We divided the NDVI images into a rectangular mesh and used them as input to Deep Learning. We used the center of the NDVI images so that NN (Neural Network) doesn't learn features of footpath between rice fields. The size is 600 pixels ×450 pixels. To increase training data, we cut the images to 50 pixels ×50 pixels (Figure 2). It seems that this cutting has an advantage of detailed growth stage classification. We randomly selected 30 pairs (Red and Near Infrared) of captured images par a day and created NDVI images. Processing above, the number of images is 12×9×30=3240. We took care of making sure there was no footpath in the center of images.

We implemented some experiments using Deep Learning in Python using Keras, a deep,learning library. We used CNN (Convolutional Neural Network) as a Deep Learning model, cross-entropy function as error function, Adadelta as Optimizer, accuracy as metrics, hold-out as validation methods. Training data is 80 % of all data, and test data is 20 %. We also used early stopping, monitoring loss of training data. It reduces the effect of over-fitting. Table 3 shows other parameters of Deep Learning. All of the above settings are common in the following three experiments. It shows a detail of CNN. The first two Dropout rates are 0.25, and the last one is 0.5. Most of the Activation function is ReLU (Rectified Linear Unit), and the last one is the Softmax function.

Table 3. Parameters of Deep Learning.

Parameter	The number of parameters
Training data	64800
Test data	16200
Mini-batch size	32
Epoch	50
Class	5

Table 4. Shooting height and image resolution of Sequoia.

Shooting height (m)	Image resolution (cm/pixel)
30	3.7
60	7.4
100	12.4

As mentioned in, we classified the growth stages of paddy rice by CNN using images taken at 60 m and 100 m high. In this paper, we refer to images by scaling the images captured at 30m high to images with a resolution of 60 m and 100 m as Artificial height images. Table 4 shows the image resolutions of these heights. We also refer to Images captured at 60 m and 100 m high as Natural height images. We conducted two experiments of classification using Artificial height images and Natural height images. To confirm the classification accuracy of the growth stage using the data of 2018, we conducted a pre-experiment using images taken at 30 m high.

Table 5 shows the classification accuracy of the train data and test data of each height. The results indicate that the classification accuracy is almost the same as the previous experiment. Table 6 shows classification accuracy when inputting each Artificial height image into the model after learning. The results indicate that accuracy is much higher than when inputting natural height images (Table 6)

As a result, (1) there is no difference between two heights (60 meters and 100 meters), (2) the learned model from Natural height can accept the Artificial height images.

Table 5. Classification accuracy.

Height (m)	Accuracy of train data (%)	Accuracy of test data (%)
60	86.1	86.5
100	86.5	87.8

Table 6. Classification accuracy inputting Artificial height images.

Height (m)	Accuracy (%)
60	99.6

RESULTS AND DISCUSSION

Possibility to use a drone in Mongolia for vegetable farming

National Statistics Office, (2018) companies cultivated vegetables in 2.1 thousand ha while householders cultivated in 6.7 thousand ha. Average vegetable farming size between 500 ha and 1000 ha for a company, and it is approximately 0.2 ha for a householder. According to the result, to estimate the growth stage of rice using drones from different height, the accuracy does not be affected by the height under 100m. As our experience, a drone with a fully charged battery can fly 20 minutes and can cover 1.5 ha at the height is 30m. If the height is 100m, the cover area can be ten times wide, 15 ha. Using these parameters, we can estimate the required flight of the drone, as described in Table 7. If we use 30m, only the size of the vegetable field of the householder is realistic. However, if we use 100m, the vegetable field of the householder is also the target of growth stage estimation by drone. The field owned by a company. The current drone technology cannot be applicable. If the drone technology, especially battery technology, is progressed, the wider area is the target of precise farming using drones.

From an economic perspective, using drones can be cheaper than other technologies as satellites. The cost of pictures taken by satellites is expensive. The average price of a picture is about $500, and If we need 10 pictures to see the trend of NDVI, it costs about $5,000. Analysis cost of pictures to calculate NDVI and estimate the content amount of protein are additional. In some cases, such additional cost requires $80 thousand to $100 thousand (Murata, Ito, Takahashi, Hatano, 2018).

For drones, the average price of a drone is $2,000 for

taking pictures in the normal zone, the price of a drone for professional is around $5,000, and an agricultural drone price starts around $30 thousand.

Table 7. Calculation of the required the number of drone (or flights)

	Example of dimension of the farm land	The number of drones to cover the area (30m)	The number of drones to cover the area (100m)
0.2 ha	40 m x 50m	1	1
33.3 ha	500m x 600m	22	2
500 ha	2,000m x 2,500m	333	33
1,000 ha	3,300m x 3,300m	667	67
2,000 ha	5,000m x 4,000m	1,333	133

Possibility to use a drone in Mongolia for vegetable farming

This article offers two potential solutions based on the Internet of things for vegetable production.

The first solution is to develop a soil information database to protect and recover soil erosion in farming regions. It should be developed the following steps (Figure 3):

1. Gathering information about soil from the farming regions
2. Develop sensor networks
3. Taking information (images, sensor data) by drone
4. Analyze data by AI (CNN, RNN, Reinforce Learning)
5. Develop a map of soil distribution
6. Construct a QA system using AI

The QA system is essential for farmers in different situations, so that it should be designed for the universal uses for farmers.

The second solution is to design and develop a fully automatic system for crop field. It should improve not only productivity in the crop field but also reducing costs and labor. To develop this system, we should follow these steps (Figure 4):

1. We can design and develop a node system by sensor networks in the crop field to gather data such as temperature, humidity, and soil moisture. Also, a drone in which a multispectral camera can take NDVI photos.
2. We design and develop a monitor system, and it can help estimate field variables ranging from growth stage, soil status, atmospheric conditions to a biomass of plants. Also, it would be interactions with the user, which should be interfaced with smartphone and web application.
3. We can design and develop a growth model that is demanded data storage from collected data (Han and Kamber 2006). Then we can analyze the information to splay pesticide and insecticide automatically and calculate the amount of pesticide to maximize taste and crop yield.

Figure 3. Overview of soil information database

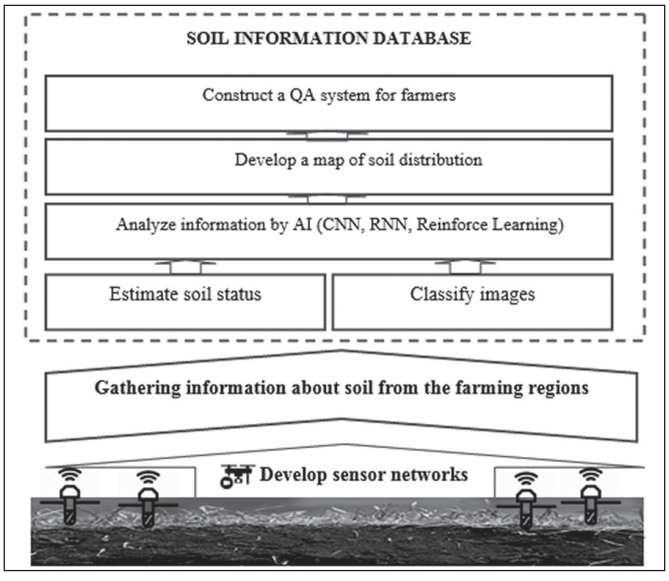
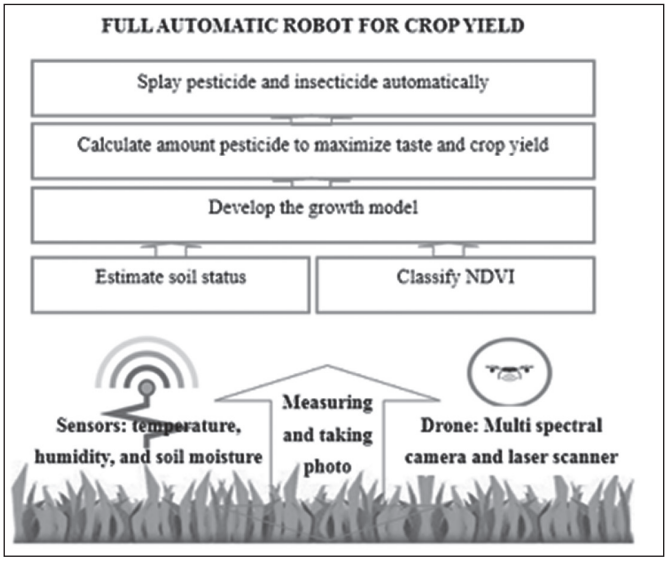


Figure 4. Overview of the fully automatic robot for crop yield



CONCLUSIONS

ICTs are applied in agriculture to improve crop production and quality in many developed countries. Also, it can reduce the cost of crop production. In this article, we aimed to present some possible solutions based on ICTs for Mongolian agriculture. So, we defined the current situation of Mongolian crop production using some reports and statistics data. Also, we mentioned that drone and sensor technologies bring many benefits from reducing costs and controlling real-time data in many agricultural countries.

We analyzed the possibility of using a drone to improve the performance of agriculture in Mongolia based on the result of our previous research to estimate the growth stage of rice by drone with a multi-spectrum camera. Thus, a drone is effective in improving the performance of agriculture performed by

householders. Besides, two models of the automatic system based on ICTs are offered for soil erosion and harvest loss issues in this article. Finally, we suppose that these systems can bring many benefits from reducing costs and sharing real-time information for Mongolian crop production.

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SCIENTIFIC PAPER

SEGMENTING HUNGARIAN PEOPLE BASED ON HEALTHY EATING

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Abstract: *Relying on customer trends healthy eating, which is one aspect of healthy lifestyle is becoming more and more popular. The aim of this study was to understand the healthy eating style of Hungarian adult consumers. An online empirical research with a sample of 1563 respondents (58.7% females and 41.3% males) was conducted in November 2018. Considering healthy eating two factors, namely the choice of healthy foods and the avoidance of unhealthy foods could be distinguished. A hierarchical cluster analysis was conducted to segment consumers. Four groups of consumers were identified: unhealthy food avoiders (20.3%), rejecters (11.8%), neutrals (26.2%) and healthy food choosers (14.7%). Unhealthy food avoiders are seniors. Rejecters are blue collar workers and have financial problems. Healthy food choosers live in families with children over 10 and do not have weight problems. This study is useful for the health sector and the government since targeted marketing programs can be planned to change eating behavior. To decrease overweight and obesity is the goal of all society, especially in developed countries. To increase the well-being of people and their quality of life educating social marketing campaigns are necessary with the aim of raising their awareness and explaining the basic principles of a healthy diet..*

Keywords: *healthy eating, perception, segmentation*
(JEL Classification: 112, M30, M39)

INTRODUCTION

Researchers (törőcsik, 2014) identified the 'extension of health market', as one of the major trend in the 21st century. Households spend higher and higher amount of money the prevention and development of health and healing in case of illnesses. Dudás (2011) identified the elements of conscious consumer behavior and health consciousness is one aspect of that which means an approach, or a behavior and an activity to be healthier in the long run. One element of health consciousness is healthy and moderate food intake. Considering the most up-to-date food trends it can be said that plant based diet is becoming more and more popular. Previously meat was an important source of nutrient but nowadays there are a lot of skepticism about it such as healthiness, environmental and sustainability issues. There is a great demand for local fresh fruit and vegetable since vegetables become the main dishes. Vegetable symbolizes freshness, innocence and health (trendinspiracio.Hu/aktualis-trendek-2019/). Health and healthy eating is an important topic for people. Relying on the most up-to-date researches of gfk hungary research institute (2019) hungarian consumers put more emphasis on the healthiness of food products. People eat regularly especially older people however younger people do not pay attention to eat regularly. Most of the hungarians eat three times a day and breakfast and lunch are the most important occasions of eating. When they purchase food products four aspects are the most important: taste, healthiness, ingredients and previous positive experiences (gfk research institute, 2019).

Considering the eating behavior of hungarian people the results of the hungarian diet and nutritional status survey (otáp - országos táplálkozás és tápláltsági állapot vizsgálat, 2014) can show a good overlook (nagy et al. 2017). The results of the latest survey show that hungarian adults are not so healthy. Mainly females had increased their fat intake especially their saturated fat intake. The fiber intake had shown a decreasing and added sugar intake had shown an increasing tendency. The vitamin intake was inappropriate of adults and the population could decrease their salt-intake but it

was still above the norm by 2.5 Times. Considering fruit and vegetable (without potato) consumption females (346 g/day) were in a better situation than males (330 g/day) but it was still below the suggested level (400g/day). Cereals (86.3 Kg/capita/year) fruit and vegetable together with potato (81.8 Kg/capita/year) were the most important sources of food intake in 2017. People consumed more pastry (bakery products with white meal) and flavored cereals and sweeteners (egészségjelentés, 2017; ksh, 2018).

The inappropriate eating habits are responsible for overweight and obesity which are considered to be the world's epidemic. Relying on the most up-to-date statistics of world health organization (who) in 2017 the average body mass index (bmi) of hungarian adult population was 27.52 Kg/m2, which was a little bit lower among females (26.65 Kg/m2) than among males (28.39 Kg/m2). 30% Of the total population is obese. According to ncd risc living in rural areas have a higher level of average bmi than people living in cities. Relying on the health survey of ksh (central statistical office) from 2014, more than half of the entire hungarian population (54%) was overweight ($25 \leq bmi < 30$) or obese ($bmi > 30$). This rate was higher in case of men (62%) than in case of women (49%). Based on age it can be said that 23% of young females were overweight or obese and 39% of young males. As people are getting older their bmi is increasing, too. 53% Of middle aged females and 71% of middle aged males had problems with their weight. Among older people weight problems were even more common, 65% of elderly women and 72% of elderly men suffered from overweight and obesity (european health interview survey, 2014).

In this paper the healthy eating style of hungarian people is analyzed from a marketing viewpoint. After the theoretical background the result of an empirical quantitative study is presented.

MATERIALS AND METHODS

Perception of healthy eating can be defined as 'the public's and health professionals' understandings, views, attitudes and beliefs about healthy eating and healthy foods (Paquette, 2005: 15). Taking into consideration healthy eating or healthy diet the WHO principles are the following:

- Fruit, vegetables, legumes, nuts and whole grains should be the most important sources of nutrients. At least 400 g (i.e. five portions) of fruit and vegetables per day should be consumed.
- Less than 10% of total energy intake should come from free sugars.
- Less than 30% of total energy intake should come from fats. Unsaturated fats are preferable to saturated fats. It is suggested that the intake of saturated fats be reduced to less than 10% of total energy intake and trans-fats to less than 1% of total energy intake. In particular, industrially-produced trans-fats are not part of a healthy diet and should be avoided.
- Less than 5 g of salt per day should be consumed (who.int/news-room/fact-sheets/detail/healthy-diet).

More authors (Paquette, 2005 and Lake et al. 2007) found that healthy eating influence food intake. Fruits and vegetables are important elements of healthy eating. Naturalness, fat, sugar and salt contents are other important aspects of healthy eating perception. Dutta-Bergman (2004) developed a scale containing 11 items to measure healthy eating one aspect of health consciousness. The scale contains attitude statements related to intention to eat nutritious foods with vitamins, calcium, fiber and avoid unhealthy foods with high cholesterol, fat, salt and sugar content.

More international researches focused on segmenting people based on their healthy or unhealthy eating behavior (André et al. 2017; Heerman et al. 2017, Psouni et al. 2016; LV et al., 2011). Some papers concentrated on children (Sabbe et al 2008) or adolescents (Cuenca-García et al. 2013, MATIAS et al. 2018) and clustered youths based on eating behavior and physical activity or sedentary behavior. These studies analyzed the demographics of each group and found gender differences. WAH (2016) and LV et al. (2011) also emphasized the healthy eating behavior of women and the unhealthy eating behavior of men. Males consume more calorie-rich food, junk food and oily food with carbohydrate. Females care more about their body weight and eat less and eat more fruit and vegetable (WAH, 2016). GRACA et al. (2015) highlighted that meat was more important for males and females were willing to adopt a more plant-based diet to be healthier.

Among international researches more empirical results could be found that investigated a special consumer group (Tanton et al. 2015; André et al. 2017; Benedet et al. 2017). Tanton et al. (2015) analyzed the eating behavior of British university students whose lifestyle is considered to be risky when it comes about eating. The researchers used the consumption of snacks, convenience, and fast foods and fruit and vegetable. They identified four segments: risky, mixed, moderate and favorable eating behavior. The majority of university students had an unfavorable eating behavior. Anrdé et al. (2017) categorized senior Norwegian citizens (65+) based on similarities of food consumption. They distinguished people with unhealthy food pattern (21.5%) and people with healthy food pattern (78.5%). The first group of people consumed a larger amount of food and beverages such as chocolate/candy, pasta, sausages, sugar free and sugary soft drinks, whole milk, juice, white bread and semi-grain bread. The second group of people consumed more fruit, vegetable, boiled potato, oily fish, whole-grain bread and water. Benedet et al. (2017) used clustering of four unhealthy food habits (low intake of fruits, low intake of vegetables, high intake of candy, and high intake of fried snacks) among Brazilian workers. They found that unhealthy food habits were more frequent among women workers with a lower education level, and those living without a partner. Heerman and his co-authors (2017) identified eating styles from six eating behaviors (frequency of eating healthy food, frequency of eating unhealthy food, breakfast frequency, frequency of snacking, overall diet quality and problem eating behaviors) and tested their association with BMI among adults. Four eating styles were identified and defined by healthy vs.

unhealthy diet patterns and engagement in problem eating behaviors. Unhealthy and unhealthy problem eating groups had significantly higher BMI than healthy eaters. Psouni et al. (2016) investigated the patterns of eating and physical activity attitudes and behaviors in relation to BMI. They also identified healthy and unhealthy group of Greek people. Healthy people were related to healthier exercise and eating behavior. They had normal BMI. Unhealthy people were related to lower level of exercise and healthy eating. They belonged to the overweight category considering their BMI.

The relevance of this topic can be explained by an initiation of SZONDA IPSOS in 2007. The research institute investigated the Hungarian population based on health styles (smoking, alcohol consumption, physical activity, nutrition and control weight) in a longitudinal study. A similar research was conducted in Netherland (Vries et al. 2008). They identified clusters based on five important preventive health behaviors, namely non-smoking, alcohol use, fruit consumption, vegetable consumption and physical exercise. They distinguished healthy, unhealthy and poor nutrition cluster. They found a strong relationship with cluster membership and the level of education. The higher the education, the healthier the behavior was. LV and his co-authors (2011) conducted a similar survey among Chinese adults (aged 18 and 64). They identified three distinct health-related lifestyle clusters: an unhealthy (25.7%), a moderately healthy (31.1%) and a healthy (43.1%) group. Tobacco use, physical activity, fruit and vegetable consumption and out-of-home eating were analyzed among lifestyle variables. Men were more likely than women to have unhealthy lifestyles. Adults aged 50 and 64 were more likely to live healthy lifestyles. Adult aged 40 and 49 were more likely to follow an unhealthy lifestyle. They also highlighted the relationship with cluster membership and the level of education and asset index.

The aim this research was to explore the perceptions of healthy eating in Hungary there are some educational initiatives and programs by health government, and public education connected to eating behavior (school lunch reform and school fruit program) and physical activity (obligatory PE lessons every day). At the same time the attitude and behavior of Hungarian people have been changing slowly and there is a major gap between the recommendation and actual eating habits.

Based on the literature review the following marketing research problem has aroused: to identify the components of healthy eating and to identify homogenous consumer groups based on the results of factor analysis, and characterize them based on demographics. The main research questions were the following:

a) What kind of factors can be distinguished based on healthy eating?

b) Is it possible to segment consumers based on healthy eating?

c) Is it possible to profile each segment based on demographics (gender, age, family lifecycle, residence, occupation, income level, and BMI)?

To answer the research questions three hypotheses were defined:

H_a: Different factors can be distinguished based on healthy eating.

H_b: Consumers can be grouped into homogeneous groups based on healthy eating.

H_c: It is possible to profile each segment based on demographics (gender, age, family lifecycle, residence, occupation, income level, and BMI).

Measurement and specification of scales

The method of primary research was the survey method. In the questionnaire we mainly used metric scales, but we made transformation and recoded some variables into non-metric scales.

- Examining healthy eating the scale developed by Dutta-Bergman (2004) was used. Response categories ranged from 1 'totally disagree' and 5 'totally agree'. The scale contained 11 items. The following attitude statements were included in the questionnaire:
  1. I try to avoid foods that are high in fat.
  2. try to avoid foods that are high in cholesterol.
  3. Nutrition information determines what I buy.
  4. I make a special effort to get enough fiber.
  5. I am concerned about how much sugar 1 eat.
  6. I try to avoid foods with a high salt content.
  7. I try to select food fortified with vitamins.
  8. I use a lot of low calorie products.
  9. I try to avoid foods with high additives.
  10. I am careful what I eat to keep weight in control.
  11. I am concerned about getting enough calcium.
- Gender was measured on nominal scale.
- Age was measured on ratio scale and we recoded into nominal scale to categorize respondents into three categories, youths (18-34), middle-aged (35-50) and seniors (51+).

The other demographic variables were measured on non-metric, categorical scales.

Sample design and data analysis

To answer the research questions the author chose single cross-sectional research method. The authors used the quota sampling design. A proportional sampling technique based on gender was chosen. Originally the researcher planned to question the same number of people in each gender group, which meant 50% of males and 50% of females. The planned size of the sample was 1000 respondents.

The empirical research was conducted in November 2018. To obtain the primary information, the online questionnaire was sent to different social media groups. Finally 1563 people could be reached with the survey and were willing to fulfil the whole questionnaire. Actually the researcher could not maintain the planned sample design. The ratio of males to females is 41.3% to 58.7%. Based on age three generations were investigated: 60.9% youths (18-34 years), 25.3% middle-aged (35-50 years) and 13.8% senior people (above 51 years). The

sample can be characterized with the following demographics and health state characteristics (Table 1).

Table 1: Basic demographics of the sample

Residence:	villages 33.7%	towns 20.5%	cities 34.6%	capital city 6.9%
Occupation:	white collar workers 34.9%	blue collar workers 23.3%	students 30.3%	unemployed 1.6%
	dependents 2.3%	retired 5.0%	other 3.0%	–
Family lifecycle:	single 36.5%	lived in relationship without children 31.8%	lived in relationship with children under 10 15.0%	lived in relationship with children over 10 16.8%
Income level:	financial problems 8.6%	low income 13.0%	do not complain 40.4%	can save money 21.3%
	live in financial prosperity 14.5%	–	–	–
BMI category:	underweight 5.9%	normal weight 50.9%	overweight (less than 10 kg plus) 31.7%	obese (more than 10 kg plus) 11.4%

Source: Own research

The sample was not a representative one the authors would like to emphasize this study is an exploratory one and the main conclusions are true for this sample only.

The data analysis was conducted with the help of SPSS 23.0 software. To answer the research questions multivariate statistical analysis was conducted. To answer the first research question the authors used factor analysis. The method of factor extraction was the principle component analysis. The number of factors was determined by the priori determination (3) and approaches based on the eigenvalues (5), the scree plot (5) and the percentage of variance accounted for (5). The number of factors was determined by the eigenvalues. The benchmark of factor loading above 0.4 was applied as a criterion for item inclusion in each factor (TSOGAS et al. 2010: 4.). The rotation of factors was assessed by the method of Varimax. To answer the second research question the method of cluster analysis, especially the method of Ward's hierarchical cluster analysis, namely the agglomerative clustering was used (Malhotra, 2018). Since the aim was to emphasize the main differences square Euclidean distance was used to measure the distances. After investigating the pre-conditions, the researchers considered different cluster solutions, but finally they decided to apply the three cluster solution. In the next step they considered these three clusters as nominal variables. In order to answer the third research question to analyze the connection between cluster membership and basic demographics Chi-square analysis was conducted. In this case the authors took into consideration the expected value and the condition of variables measured on nominal scales.

RESULTS AND DISCUSSION

Healthy eating

In connection with healthy eating 11 statements were examined. In this case the value of Cronbach was 0.921, which means that this scale is consistent. The values of indicators proving the appropriateness of factor analysis were appropriate (KMO: 0.921, Bartlett's Test: 6586.563, Sig. 0.000). The number of factors was determined by Scree-test that is two factors could be distinguished that explained 63.173% of the total variance.

The first factor contained five variables which represented a conscious behavior and the choice of nutritious foods that are good for the body:

- I try to select food fortified with vitamins. 0.828
- I make a special effort to get enough fiber. 0.801
- I try to avoid foods with high additives. 0.760
- I am concerned about getting enough calcium. 0.758
- I am concerned about how much sugar I eat. 0.568

The total variance explained by this factor was 31.723% and the value of Cronbach was 0.867.

The second factor contained six variables which represented a conscious behavior the refusal of unhealthy foods which are harmful for the body:

- I try to avoid foods that are high in cholesterol. 0.832
- I use a lot of low calorie products. 0.806
- I try to avoid foods that are high in fat. 0.726
- I try to avoid foods with a high salt content. 0.686
- Nutrition information determines what I buy. 0.554
- I am careful what I eat to keep weight in control.0.551

The total variance explained by this factor was 31.450% and the value of Cronbach was 0.863. It can be stated that different factors can be distinguished based on healthy eating, namely the choice of nutritious food and the refusal of unhealthy foods.

Consumer groups based on healthy eating

In the next step using the results of factor analysis were used for clustering. Relying on the results of Elbow criterion and Agglomeration schedule the four cluster solution was chosen. Count and frequency in case of each cluster was the following: 1st cluster 317 people (20.3%), 2nd cluster 185 people (11.8%), the 3rd cluster 409 people (26.2%) and 230 people (14.7%). In order to make a typology for the different clusters analysis of the means was necessary. The method of one way ANOVA was used to check the category means of healthy eating factors (choice of healthy foods - CHF, refusal of unhealthy foods - RUF) in case of each cluster and significant differences (FCHF: 509.468, p: 0.000, 2:0.472; FRUF: 748.369, p: 0.000, 2: 0.568). There were significant differences between groups in case of all variables. To test the homogeneity of variables Post-Hoc tests (Dunnett T3 and LSD) were conducted. Relying on the results there were statistically significant differences among variables.

1. Unhealthy food avoiders (20.3%): they try to eat in a healthy way and they typically refuse unhealthy foods such as foods with high cholesterol value, fat and salt content. They prefer

low calorie foods and make their purchasing decision based on nutrition. They pay attention on their weight.
2. Rejecters (11.8%): they could not be characterized by choice of healthy foods or refusal of unhealthy foods. They have a negative attitude towards the aspects of healthy eating.
3. Neutrals (26.2%): are neutral when it comes about healthy eating.
4. Healthy food choosers (14.7%): could be characterized by the choice of healthy foods. They put an emphasis on eating foods with vitamin, fiber, calcium (Table 2).

Table 2: Results of cluster analysis

Hierarchical cluster analysis 4 cluster solution		Choice of healthy foods	Refusal of unhealthy foods
Cluster 1: Unhealthy food avoiders; 20.3%	Mean	0.063	1.191
	N	317	317
	Standard deviation	0.777	0.471
Cluster 2: Rejecters; 11.8%	Mean	-1.506	-0.558
	N	185	185
	Standard deviation	0.361	0.618
Cluster 3: Neutrals; 26.2%	Mean	0.269	0.0454
	N	409	409
	Standard deviation	0.644	0.402
Cluster 4: Healthy food choosers; 14.7%	Mean	0.644	-1.274
	N	230	230
	Standard deviation	0.955	0.471
Count	Mean	0.000	0.000
	N	1141	1141
	Standard deviation	1.000	1.000

Source: Own research, n=1140 respondents

It can be stated that consumers can be grouped into homogeneous groups based on healthy eating factors (choice of healthy foods, refusal of unhealthy foods). Four groups of consumers were identified: unhealthy food avoiders (20.3%), rejecters (11.8%), neutrals (26.2%) and healthy food choosers (14.7%).

Profiling consumer groups

In order to analyze the connection between cluster membership and basic demographics cross tabulation (Chi-square analysis) was conducted. The relationship with cluster membership and gender, generation, occupation, family lifecycle, income level, and BMI were analyzed. Significant relationships in case of generation (χ^2=15.944; p=0.01), residence (χ^2=23.168; p=0.02), occupation (χ^2=77.203; p=0.00), family lifecycle (χ^2=18.446; p=0.03), income level (χ^2=25.549; p=0.01) and BMI (χ^2=20.389; p=0.01) were found. However these connections were very weak (Cramer's $V_{generation}$=0.08; Cramer's $V_{residence}$=0.08, Cramer's $V_{occupation}$=0.15, Cramer's $V_{family\ lifecycle}$=0.07, Cramer's V_{income}=0.09, Cramer's V_{BMI}=0.07 (Table 3).

Relying on the results of adjusted standardized residuals it can be stated that unhealthy food avoiders are seniors. Rejecters are blue collar workers and have financial problems. Healthy food choosers live in families with children over 10 and do not have weight problems (Table 3).

Table 3: Clusters and basic demographics

Demographics		Adjusted standardized residuum				
		unhealthy food avoiders	rejecters	neutrals	healthy food choosers	Sign. relations with clusters
Age	senior	2.2	-1,5	0.5	-2.0	unhealthy food avoiders
Occupation	blue collar	-0.6	3.5	-0.6	-1.5	rejecters
	other	-1.8	-2.1	-0.1	4.2	healthy food choosers-
Family lifecycle	family with children over 10	-0.9	-0.5	-0.6	2.2	healthy food choosers-
Income level	financial problems	-2.4	2.0	-0.5	1.7	rejecters
BMI	normal	-0.2	-1.2	-0.8	2.4	healthy food choosers

Source: Own research

It is possible to profile each segment based on demographics, especially based on age, occupation, family lifecycle, income level and BMI. Unhealthy food avoiders are seniors. Rejecters are blue collar workers and have financial problems. Healthy food choosers live in families with children over 10 and do not have weight problems.

Discussion

More international studies focused on clustering adult population based on healthy eating or lifestyle. Benedet et al. (2017) concentrated on unhealthy food habits and Anrdé et al. categorized senior Norwegian citizens based on similarities of food consumption. This research focused on the healthy eating style of Hungarian adults. Considering healthy eating two factors were identified: choice of healthy foods and refusal of unhealthy foods. The first behavior was referring to eating healthy, nutritious foods and the second one meant avoiding junk foods. A hierarchical cluster analysis was conducted to segment consumers based on their healthy eating (choice of healthy foods, refusal of unhealthy foods). Four groups of consumers were identified: unhealthy food avoiders (20.3%), rejecters (11.8%), neutrals (26.2%) and

healthy food choosers (14.7%). Unhealthy food avoiders try to eat in a healthy way and they typically refuse unhealthy foods such as foods with high cholesterol value, fat and salt content. They prefer low calorie foods and make their purchasing decision based on nutrition. They pay attention on their weight. Rejecters could not be characterized by choice of healthy foods or refusal of unhealthy foods. They have a negative attitude towards the aspects of healthy eating. Neutrals are neutral when it comes about healthy eating. Healthy food choosers could be characterized by the choice of healthy foods. They put an emphasis on eating foods with vitamin, fiber, calcium. In order to profile each segment cross tabulation was conducted. There were statistically significant relationships in case of generation, residence, occupation, family lifecycle, income level and BMI. Unhealthy food avoiders are seniors. Rejecters are blue collar workers and have financial problems. Healthy food choosers live in families with children over 10 and do not have weight problems. WAH (2016) and LV et al. (2011) highlighted gender differences that females are more health-conscious, they eat less and smaller proportions and take care of weight control. However there were no gender differences in this empirical research. More studies (Benedet et al. 2017; Vries et al. 2008; LV et al. 2011) emphasized the importance of education level in healthy lifestyle. However in this study the level of education was not investigated. More researches (Psouni et al. 2017, Heerman et al. 2017) found that healthy eaters had lower level of BMI and they did not suffer from overweight and obesity. This is line with present results since people with normal weight are healthy food choosers.

CONCLUSIONS AND FURTHER RESEARCH

Present study is useful for the health sector (doctors, dieticians and food experts) and the government since targeted marketing programs can be planned to change eating behavior. In case of government social marketing programs would be necessary. Raising the health consciousness of neutrals and rejecters (38%) is also important. The barriers of healthy eating are the lack of support from others and knowledge, cooking skills, availability, willpower. Price (too expensive, preparation time and hedonics such as too boring, not tasty are also barriers to healthy eating (MARROW et al. 2016). In order to increase the quality of life and wellbeing of people it is necessary to improve their health. Health is not only the state of being free from illness or injury, but it is even a more complex category. A sound mind in a sound body should be emphasized in social marketing campaigns. To decrease overweight and obesity is the goal of all society (especially in developed countries where this phenomenon is considered to be an epidemic) that is why educating people and applying social marketing campaigns are necessary. Informing people about the correct eating habits and the principles of a balanced nutrition (food pyramid, WHO principles) should be communicated to people. Developing applications and smart equipment like smart plate, fork could help them to follow the basic principles of healthy eating. These applications could be developed with the cooperation of doctors, dietitians and nutrition consultancy. Educating people and changing their unhealthy habits is the interest of a society. Not only education but raising attention of people with emphasizing the consequences of bad eating habits should be in focus. The social marketing campaign aims to change people's attitudes and behavior. The behavior is driven by many factors and two factors – benefits and costs – are at the heart of the changing process. The non-profit managers seek to amplify benefits and reduce costs in order to get target publics to behave in certain ways such as eating healthy. Many times people have social support and a belief in the beneficial effects of behavior such as stopping eating snacks, but are unable to adopt it because they think they actually cannot succeed.

Finally the limitation of present study should be highlighted. The most important limitation is the non-representative sample. The author mainly concentrated on a regional sample, especially people living in the Western Pannon region and one third of the sample belong to the young generation. The limitation of this study is the self-declaration on healthy eating perceptions instead of objectively measured data (food diaries).

In the future the researcher would like to highlight other lifestyle differences. Another possible direction of this research is to analyze the consumption of different food products and conducting a cluster analysis based on consumption patterns. Thus the actual behavior and healthy eating patterns could be compared. It is also worth to analyze the barriers of healthy eating. There are some stereotypes like price, boredom, not tasty, etc. when it comes about healthy eating. Since a major part of the population can be characterized by low involvement when it comes about healthy eating their rejections and drivers should be identified.

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Applied Studies in Agribusiness and Commerce – APSTRACT
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SCIENTIFIC PAPER

DETERMINANTS OF CREDIT ACCESS OF COCOA FARMERS

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Abstract: *Access to credit is one of the critical areas that are of prime interest to development practitioners, agribusiness entrepreneurs and agricultural economists, mainly access to credit by farmers in order to increase their production and also reduce poverty. This study sought to analyze the determinants of credit access among cocoa farmers in the Asunafo North of the Ahafo Region of Ghana. The multistage sampling procedure was used to collect data from 100 cocoa farmers with the aid of a questionnaire. Sources of credit, factors influencing access to credit, and constraints to credit were analyzed with the aid of descriptive statistics, multiple linear regression, and Kendall's coefficient of concordance respectively. The results of multiple linear regression revealed that, age, marital status, education, experience, and family size were significant factors that influenced access to credit. The constraints analysis with the aid of Kendall's coefficient of concordance showed that, high interest rate was highly ranked with a mean score of 1.93 whilst the need for a guarantor was least ranked with a mean score of 7.40. Based on the results, the study recommended that a policy aimed at expanding formal and semi-formal financial institutions credit portfolio to embrace cocoa farmers by finding alternative to collaterals and also reducing the interest rate will improve credit access with a positive externality effect of poverty reduction among cocoa farmers in the study area.*

Keywords: *access to credit; sources of credit; constraints to credit; and interest rate*
(JEL Classification: Q14)

INTRODUCTION

Cocoa has been observed to be an essential cash crop in Ghana. The cocoa industry comes with exclusive characteristics involve small-scale farmers production of the beans; Licensed companies specialized in purchasing cocoa beans and development of warehouse for storing the beans, while Ghana Cocoa Board ensures the quality of the beans (Obuobisa, 2015). Ensuring that farmers have access to credit (Financial inclusion) will increase their tendency to expand their cocoa production, buy modernized equipment or tools to improve their production and consequently save in the long run to meet future needs that could be expensive.

Various factors have been identified as affecting access to credit by farmers. Amongst others are gender (Nyemeck, Gockowski, and Nkamleu 2008); age (Abdul, 2015); education (Abdul, 2015; Essien and Arene, 2014); marital status (Okunade, 2007); household size (Essien and Arene 2014; Chandio, Jiang, Rehman, and Liu 2017); experience in farming (Nouman, Siddiqi, Asim, and Hussain 2013); and awareness (Chenaa, Maria, and Teno, 2018). This study seeks to underscore the implications of these factors on accessibility to credit by cocoa farmers at the Asunafo North Municipality in the Ahafo Region of Ghana.

MATERIALS AND METHODS

Research Design

Descriptive and explanatory research designs were adopted. Descriptive statistics were used to describe the socio-economic characteristics of cocoa farmers, while multiple regression was applied to determine the factors that influence access to credit by cocoa farmers in the study location.

Population

The target population for the study was highly dependent on cocoa farmers in the Asunafo North Municipality in the Ahafo Region of Ghana. The population size for cocoa farmers in the study location was approximately 45,000.

Sample size

With the utilization of the formulae by (Israel, 1992) for the determination of sample size, 100 cocoa farmers were selected. The formula was given as:

$$n = \frac{N}{1+N\ e} \quad \text{.....[1]}$$

Where n = Size of the sample, N= Size of population, and e=Precision level

With the approximated cocoa farmers population of 45,000 at a precision level of 10%, the sample size was determined as:

$$n = \frac{45{,}000}{1+45{,}000\ (0.1)^2} = 99.77 \approx 100\text{.....[2]}$$

Sampling Procedure

The multistage sampling procedure was used to select the 100 farmers. The first stage involving the selection of three (3) communities. These communities were Mim, Gyaenkontabuo, and Asuadae. The second stage involved the number of farmers to be interviewed in each community; therefore forty-nine (49), twenty-eight (28), and twenty-three (23) farmers were interviewed in Mim, Gyaenkontabuo, and Asuadae respectively making the total number of respondents who are cocoa farmers (100).

Data Collection

The study relied extensively on primary data. The primary data was obtained via the administration of a structured questionnaire in the form of interviews to engender a response from farmers.

Data Analysis

Multiple linear regression was used to determine the factors influencing access to credit. The regression model was specified as:

$$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \text{.....[3]}$$

The description of the variables of the multiple linear regression is shown in Table 1 below.

Table 1: Description of variables

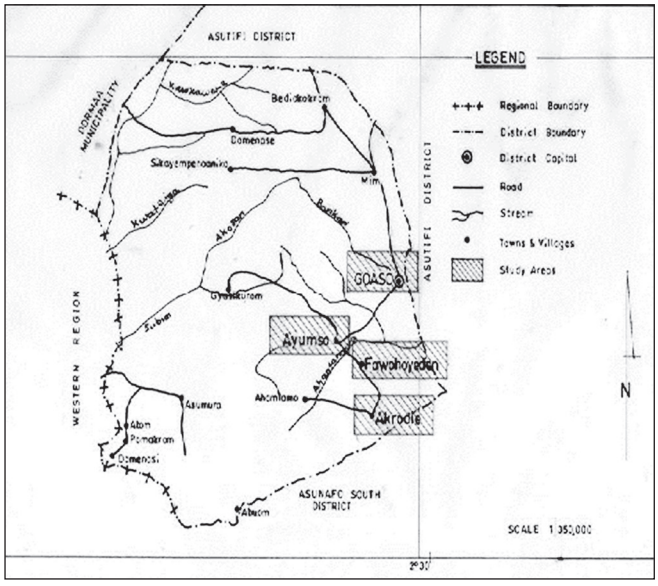
Variable	Variable Definition	Type of Variable	Description of Variables	A-priori Expectation
X_1	Gender	Dummy 1=Male 0=Female	Sex of farmer	+/-
X_2	Age	Continuous	Farmers age in years	+/-
X_3	Educational level	Years (Continuous)	Educational Level of farmer	+
X_4	Family size	Discrete Variable	Number of people	+/-
X_5	Farm experience	Years (Continuous)	Farmer's years of experience in farming	+
X_6	Marital status	Discrete variable	Marital status of farmer	+/-
X_7	Awareness	Categorical	Awareness of credit	+
Y	Dependent variable		Access to credit	
Bo			Constant	
βi			Independent Variable Coefficients	
E			Stochastic error term	

Source: Authors' Construct, 2019

Study location and size

Asunafo North Municipality is one of the six (6) Districts in the Ahafo Region of Ghana. In the year 2004, the Municipality was created as a result of the division of the Asunafo District. In the North-East, the Municipality shares border with Asutifi District, North-West Dormaa Municipality, South-West Juaboso-Bia and Sefwi-Wiawso; and for South-Eastern it shares boundaries with Asunafo South District. The Municipality has a land size of 1,412.0 km2 with an area of 578.63 km2 covered by forest (Okity, 2016). Figure 1 shows a map of the study area.

Figure 1: Asunafo North Municipality Map.



Source: (Okity, 2016).

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics

The socio-economic characteristics of respondents are shown in Table 2 below.

From Table 2, age is significant in determining the productivity of the labour force of farmers. The results from Table 2 above indicated that 47% of the cocoa farmers were within the age range of 31-45 years, 35% of the farmers were within the age range of 46-59 years whilst only 8% of the farmers were 60 years and above. This shows that respondents were mostly in their middle ages which implied that cocoa farmers were still in their economic active age which will have a positive effect on production if the right technologies and agronomic practices are not adopted.

The distribution in Table 2 above shows that the majority of the respondents were predominately males represented by 62% of whilst females accounted for 38%. This shows that farming or cocoa production in the study area is gendered in favour of males. However, the population of female participation in these production activities is encouraging. Females can also take up cocoa farming as their primary occupation in order to be empowered financially. Moreover, the results also showed that, women are more involved in post-harvest handling such as drying and fermentation in the cocoa value activities which attracted fewer rewards. Perhaps the females used the rest of their time to engage in domestic and reproductive activities, while males are more dedicated to productive activities.

Table 2: Socio-economic characteristics

Variable	Frequency (N)	Percentage (%)
Gender:		
Male	62	62.0
Female	38	38.0
Age:		
18-30	10	10.0
31-45	47	47.0
46-59	35	35.0
60 and above	8	8.0
Marital status:		
Single	12	12.0
Married	86	86.0
Divorced	2	2.0
Religion:		
Christian	70	70.0
Islam	28	28.0
Others	2	2.0
Educational status:		
Non formal	24	24.0
Primary	13	13.0
MSLC/JHS	34	34.0
Technical/SHS	21	21.0
Vocational	3	3.0
Tertiary	5	5.0
Family size:		
None	7	7.0
1-3	10	10.0
4-6	49	49.0
7 or more	34	34.0
Experience:		
1-5	3	3.0
6-10	12	12.0
11-15	18	18.0
16-20	40	40.0

Source: Field Data, 2019

The majority (86%) of the respondents as indicated in Table 2 above, were married, whilst 12% were single and only 2% were divorced. This indicated that the majority of the farmers in the study area were matured and had emotional support from their spouses in decision making and farming

activities which is very important to them. Furthermore, most (70%) of the respondents were Christians, 28% Islam, and 2% had other forms of religion that influence their production decision.

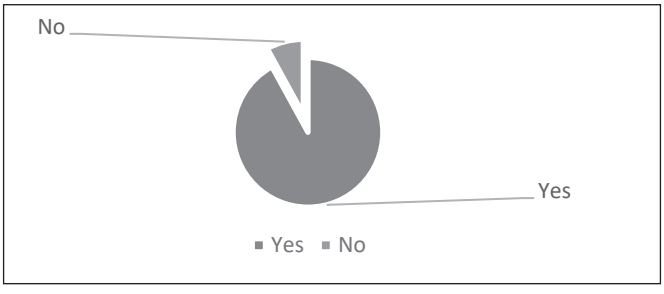
Education connotes capabilities and capacity to engage in management and productive activities and decision making in a higher form which influences access to credit. Concerning education, about 76% of the respondents as shown in Table 2 above, had formal education whilst only 24% of the respondents had no formal education. This indicates that the majority of the farmers attended school from primary, MSLC/JHS to SHS, which proves that the respondents are fairly educated. Hence their access to credit in the formal institution will be curtailed.

However, 49% of the respondents, as depicted in Table 2 above, had a family size range of 4-6, whilst 37% of the respondents had a family size of 7 or more. Only 7% of the farmers had a family size range of 1 to 3. This illustrates that the family size of cocoa farmers is relatively large; this is because in most farming communities, farmers rely on family labour for most of their farming activities. This helps them to cut down labour cost, increase their household expenditure, which may influence their decision to go for credit.

The majority (40%) of the farmers as shown in Table 2 above, had years of cocoa farming experience which ranges between 16 to 20 years. The relatively high number of experienced cocoa farmers suggests that cocoa production is a lifelong occupation that requires continuous practice that later translates into experience, which may influence their access to credits since the default rate will be low when a farmer is experienced.

Nonetheless, 92% of the respondents as indicated in Figure 2 below had access to credit whilst 8% had no form of credit access. This also corroborates the findings of (Dabone, Osei and Petershie 2014) who noted that most of the farmers (58%) had access to credit whilst 41.5% did not have access to credit.

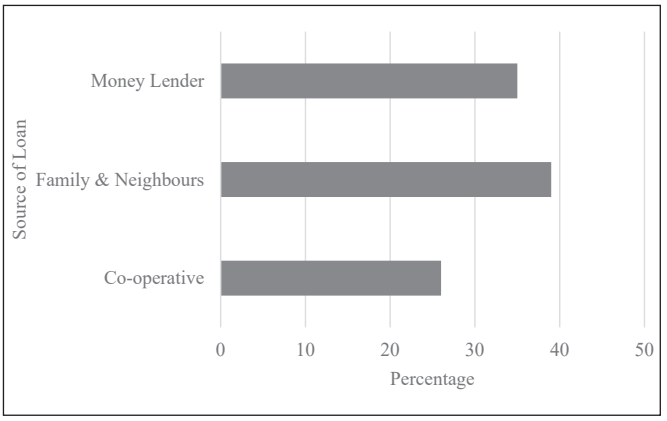
Figure 2: Access to credit



Source: Field Data, 2019

With regards to sources of credit, the majority of the farmers (39%) had a loan from their family and neighbours, 35% secured loans from money lenders, whilst the minority obtained loans from co-operatives (26%) as shown in Figure 3. Contrary to the results (Ijioma and Osondu 2015) reported that 30% of the respondents sourced their credit from friends, 14.44% from money lenders, 43.33% from corporative societies, and 12.22% from formal sources. These sources indicated that the farmers have access to credit from largely informal sources and one semiformal source. This is a wake-up call for semiformal and formal financial institutions in the study area.

Figure 3: Source of credit
Source: Field Data, 2019



Factors influencing access to credit

Table 3: Determinants influencing credit access

Variables	Coefficient	Standard Error	T-Value	Significance level
Constant	-20679.958	7172.020	-2.883	0.005***
Gender	2032.836	1615.455	1.258	0.211
Age	3303.181	1082.844	3.050	0.003***
Marital Status	-6131.478	1726.823	-3.551	0.001***
Education	2055.377	519.832	3.954	0.000***
Experience	-574.783	327.221	-1.757	0.082**
Awareness	5267.629	3986.194	1.321	0.190
Family Size	2355.151	256.650	9.177	0.000***
R^2	= 0.659	–	–	–
F-Value	= 25.379	–	–	–
Durbin-Watson	= 1.653	–	–	–

Source: Field Data, 2019
****1% Significance Level, **10% Significance Level***

Table 3 shows the R-squared for factors influencing access to credit. The explanatory variables jointly explained 0.659 or 66% of the variations that occurred in the dependent variable (access to credit). This implies that the model can also explain 34% of some factors. Durbin-Watson value of 1.653 shows clearly that, the predicted factors had no autocorrelation.

The results from the model indicated that gender had a positive coefficient but was not statistically significant; this corresponded with the a-priori expectation. The result is consistent with the study of (Nyemeck et al. 2008). He reported that gender was not statistically significant; therefore, this factor did not influence farmers' ability to access credit.

Age was positive and significant at a significance level of 1%. This implies that an increase in farmers' age increases the farmer's ability to access credit. The result is in line with the findings of Abdul (2015), who analyzed the factors influencing access to credit and how it affects food security. The findings of his study revealed that an increase in age increases the credit amount acquired by a farmer.

Marital status had a negative coefficient but was statistically significant at a 1% significance level. This implies that married farmers are less likely to get access to credit. The result was consistent with the a-priori expectation. The result corroborates the findings of (Okunade, 2007). His findings revealed that marital status was insignificant.

Furthermore, the coefficient of education was positive and significant at a significance level of 1%. This shows that, farmers who have attained education have higher chances of securing credit in comparison to farmers who had no formal education. The result was consistent with the findings of (Abdul, 2015), and (Essien and Arene 2014). They reported that education and access to credit were positively related lines with a-priori expectation.

Experience had a negative coefficient but was statistically significant at a 10% significance level. The results show that experience was contrary to a-priori expectation. This implies that the more one experiences in farming decreases one access to credit contrary to the study of (Nouman et al. 2013). Whose study revealed that, farming experience was positive but insignificant.

Awareness was positive but insignificant, implying that it had no association in accessing credit. However, it was consistent with a-priori expectation. The result was in line with the findings of (Chenaa et al. 2018) who observed that awareness was positive, with a coefficient of 8.908.

The coefficient of family size was positive and significant at a 1% significance level. Also, it was consistent with a-priori expectation. This implies that an increase in family size increases one's likelihood of seeking credit. Therefore, the higher the number of people in a family, the higher the demand for credit. The results were consistent with the study of (Chandio et al. 2017). The findings of their study show that household size was positive and significant.

Constraints to credit access

Table 4: Constraints in accessing credit

Constraints	Mean Rank	Rank
High interest rate	1.93	1
Provision of collateral	3.20	2
Cumbersome process	3.47	3
Distance to credit facility	4.10	4
Lack of education	5.29	5
Gender biases	5.88	6
Diversion of loan	6.59	7
Short payback period	7.33	8
Need a guarantor	7.40	9
N	100	
Kendall's W	0.531	
Chi-square (X2)	424.875	
Degree of freedom (df)	8	
Asymptotic Significance	0.000	

Source: Field Data, 2019

Table 4 presents the constraints in acquiring credit. The high rate of interest was the highest constraint to credit acquisition. Furthermore, the provision of collateral, and cumbersome process were observed as the second and third constraints in accessing credit. Distance to the credit facility, lack of education, and gender biases had 4th, 5th, and 6th rank respectively whilst diversion of loan, short payback period, and the need for a guarantor was observed as the least constraints in accessing credit.

Kendall's W of 0.531 shows that 53% of the farmers were in agreement with the ranked constraints. The null hypothesis was rejected in favour of the alternative. Therefore, there was an agreement in the ranked constraints. Farmers diverted loans because they had to pay for their children's school fees and sometimes pay for their health bills.

CONCLUSION AND RECOMMENDATIONS

Age, marital status, education, experience, and family size were factors that influenced the farmer's ability to access credit in the study location. It is recommended that: 1. Credit with education as delivery models in credit extension to farmers by financial institutions and players in credit administration be invigorated. This will not only elevate the skills of farmers in credit management but also improve loan repayments thereby sustaining cordial relationship of farmers with financial institutions.

2. Polices aimed that at expanding formal and semi-formal financial institutions credit portfolio to embrace cocoa farmers sought increasingly be sought.
3. Affordable interest rate regime for cocoa farmers should be the priority of government.
4. Workable collateral and guarantee systems on credit for cocoa farmers should the agenda of players in the financial service industry.

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Applied Studies in Agribusiness and Commerce – APSTRACT
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SCIENTIFIC PAPER

IMPACT OF CONSUMER INNOVATIVENESS ON SHOPPING STYLES: A CASE STUDY OF UNIVERSITY STUDENTS FROM PAKISTAN

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Abstract: *This study examines the effects of various types of consumers' innovativeness on the consumer shopping styles. The results highlight that social, hedonic and cognitive innovativeness have an impact on consumer shopping styles, but functional innovativeness doesn't influence consumer shopping styles. The study is based on sample of university students from Rawalpindi and Islamabad and its outcomes pave grounds for marketers to develop a better understanding for marketing new products and services. New product and services can be designed to magnetize innovative consumers. Integrated marketing communications should be planned according to the shopping styles of innovative consumers. Youngsters being a sizeable market segment in Pakistan, therefore, this study will guide the marketers to understand this segment better. This study discovers the association between different kinds of innovative consumer and consumer shopping styles.*

Keywords: *Consumer Innovativeness, Shopping styles, Social innovativeness, hedonic innovativeness, functional innovativeness, cognitive innovativeness*

(JEL Classification: M30, M37, M39)

INTRODUCTION

Purchasing behaviors are significant areas of attentions for researchers and marketers. The marketers' understanding of consumers helps them to meet their needs and wants. The consumer shopping styles has become important for the researchers as it varies from consumer to consumer. Various shopping styles have been grouped to form segments to be able to target different segments according to the needs. Consumer innovativeness asks for innovation thus compelling the producers to innovate. Marketer need to identify and understand the innovative consumers to be able to target them successfully.

Pioneering consumers are the ideal target market segment for new products as they like exclusivity and spread it to their communities. Identifying shopping styles is important for designing correct marketing plans. Social, functional, hedonic and cognitive innovativeness are types of consumer innovativeness.

Consumer shopping styles are intellectual traits adopted by consumers for purchase and consumption practices. These shopping styles make researchers aware of consumers' shopping behavior and assist them in targeting specific segments effectively. Research has been done to be able to differentiate dissimilar aspects of innovativeness. The consumer sensory inventory (CSI) is the most practiced and validated instrument to determine consumer shopping styles. CSI offers marketers an instrument to understand consumer shopping styles. The characteristics of shopping styles are quality consciousness, brand consciousness, novelty consciousness, recreational orientation, impulsiveness, price consciousness, confusion by over choice and brand loyalty orientation (Sproles & Kendall, 1986).

Consumer shopping styles are based on their individual personality traits. Understanding the shopping styles of diversified kinds of innovative consumers could help the marketer to prepare required marketing plans.

Objectives of Study

- To identify the prospective variations in shopping styles of four categories of innovative consumers.
- To understand various consumer innovativeness by examining its impact on consumer shopping styles.
- To investigate the association among consumer inherent innovativeness and shopping styles that could provide information to understand consumers' choices and sketching diverse consumer segments.

Research question

What is the impact of consumer innovativeness on the consumer shopping styles?

Rationale of the study

Innovative consumers are significant segment of the market as they first experience new products and help their promotion through purchase and use. This research seeks to investigate association of consumers' innovativeness with their shopping styles.

Significance of the study

This research study will add to consumer innovativeness and shopping styles in Pakistan. It will facilitate marketers to satisfy the requirements of innovative consumers as a specialized target market. Hence this research is essential for the following reasons:

- A true understanding of consumer shopping styles could help new product developers to develop new products and services according to the needs of innovative consumers.
- An understanding of the consumer shopping styles could assist salespersons to sell innovative products in an effective manner.
- An enhanced understanding of the consumer shopping styles could assist advertisers to efficiently promote to the different type of innovative consumers.

Delimitations

Students from the different universities of Rawalpindi and Islamabad are the participants in this research study. To understand the complete innovative consumers' segment, an in-depth research of the segment needs to be conducted.

Contributions

Research has not yet been done to investigate the impact of different type of consumer innovativeness on shopping styles.

LITERATURE REVIEW

Consumer innovativeness is usually defined as "consumption of newness" which is also termed as "life innovativeness" and it could also be described as "the ability to introduce newness in one's life" (Roehrich, 2004). This expression deals with new product adoption. When we combine innovativeness with consumer involvement, the association becomes powerful (Venkatraman, 1991). Companies develop and introduce new products regularly at a fast pace due to the quick development in technology that results in change in the consumer demands (Tellis, Yin, & Bell, 2009). The companies endeavor to recover quickly costs of new product development for short product life cycle. Innovative consumers are first to purchase and consume new products (Roehrich, 2004) as it gives them a pleasure of accepting the change and exploring new stuff (Cotte & Wood, 2004).

Shopping is not only done for obtaining goods (functional motivation), but also for fulfilling social and private (hedonic or cognitive) requirements (Geuens, Brengman, & S'Jegers, 2003). Functional, hedonic, social and cognitive values differ from each another (Sheth, Newman, & Gross, 1991). Consumer innovativeness should be measured with social, functional, hedonic and cognitive innovativeness (Vandecasteele & Maggie, 2010).

Social Innovativeness

Consumers express exclusivity by possessing novel products and services (Tian, Bearden, & Hunter, 2001). Innovative products are bought to impress others and improve their lifestyle as well as for functional values (Brown & Venkatesh, 2005). Social factor of consumer innovativeness is very important (Roehrich, 2004). Social rewards and social discrimination encourages new product adoption and. consumers can bring together authority, information, and social class by adopting innovate products (Fisher & Price, 1992). The desire for exclusive consumer products speaks volumes of a person's need for exclusivity, status and greed (Lynn & Harris, 1997). Consumers portray a sure uniqueness by possessing new products provided that newness or uniqueness is evident to others (Tian, Bearden, & Hunter, 2001).

Functional Innovativeness

Innovative consumers are concerned about the functionality or usefulness of new products (Venkatraman, 1991). Researchers have suggested utilitarian reason for gaining new products and services (Voss, Spangenberg, & Grohmann, 2003).

Hedonic Innovativeness

Products and services are bought to feel the pleasure of using new products (Brown & Venkatesh, 2005). Researchers have suggested a similar disparity in shopping standards practical causes for buying products versus emotional reasons (Babin, Darden, & Griffin, 1994).

Cognitive Innovativeness

Cognitive innovativeness can be defined as "the desire for new experiences with the goal of motivating the mind". Cognitive aspect of innovativeness is obvious

at comprehensive broad levels of consumer behavior (Venkatraman & Price, 1990). Cognitive innovators enjoy assessing information, discovering how new products and services work, finding out in-depth information about products, and studying ways and means of using them (Hirunyawipada & Paswan, 2006). The capacity of cognitive innovativeness plays an essential part in examining the shopping approaches (Hirschman, 1980). Cognitive consumers have been found old in age with high education (Venkatraman & Price, 1990).

Consumer Shopping Styles

Consumer shopping style is defined as "a mental orientation characterizing a consumer's approach to making choices". The CSI scale thus developed uses eight decision making dimensions to elucidate why shoppers perform in a particular manner. The dimensions of consumer style are quality conscious, brand consciousness, novelty/fashion conscious, recreation/hedonic conscious, impulsiveness/careless conscious, price conscious, confusion by over choice conscious and habitual/brand loyal conscious. The researchers confirmed that a consumer may exercise more than one shopping style across different consumption circumstances (Sproles & Kendall, 1986).

Quality Consciousness

Quality consciousness is defined as familiarity with the high quality products and an aspiration to select the best alternatives, at the time of purchase (Sproles & Kendall, 1986). A study revealed that 40%t of buyers rate themselves as sophisticated and quality buyers, as they consider quality an important factor while purchasing products (Kim & Shim, 2002). The outcome showed that quality consciousness is major characteristics for consumer shopping style. Top consumer innovativeness enhances perceived quality and purchase purpose of new products and services (V'olckner & Sattler, 2006).

Brand Consciousness

The brand conscious purchasers wish to buy renowned and superior brands (Sproles & Kendall, 1986). Brand consciousness positively influence buyers buying intentions (Hafstrom, Chae, & Chung, 1992). Promoting brand awareness is an approach to enhance buying behavior of the buyers (Park & Stoel, 2006). Innovative people find new products by distant brands so that they may seek products that come from known brand (Xie, 2008). They try new products in spite of having brand knowledge of the existing products. Consumer innovativeness is a feature which throws light on consumer response to brand extensions by known brands (Martínez & Pina, 2010). The brand awareness play an important role for consumers in their buying decision (Szakacs, Guth, & Vasa, 2012).

Novelty Consciousness

Novelty consciousness is defined as an understanding of the latest, thrilling product and the aspiration to acquire stylish products (Sproles & Kendall, 1986). Novelty is as an important factor in consumer shopping (Kim & Shim, 2002).

Recreational Orientation

Recreational oriented buyer is described as the buyers who acquire enjoyment from the shopping. Shopping is done for the sake of excitement (Sproles & Kendall, 1986)

Impulsiveness

Impulsiveness in buying is defined as making sudden, spontaneous, unintentional and carefree purchases (Sproles & Kendall, 1986). The good mood of buyers influence buying decisions and make buying experience to feel pleasure (Beatty & Ferrell, 1998)

Price Consciousness

Price conscious buyers get value by buying at discounted prices or selecting minimal price items (Sproles & Kendall, 1986). If product alternatives provide similar advantages, they acquire the lowest priced product (Janiszewski & Lichtenstein, 1999). The fluctuation of the price has an impact on buying decision of customers (Vasa, 2005). Price conscious buyers buy more regularly than others (Kim & Jin, 2006). Consumer are highly price sensitive regardless of their income class (Szakacs, Guth, & Vasa, 2012).

Confusion by Over Choice

Information overload and availability of many products confuse consumers (Sproles & Kendall, 1986). Products having wide range of quality, price and colors can also puzzle the consumers. They find it hard to decide, they remains in a fix (Evans-Correia, 1992).

Brand Loyal

Some consumers are typically connected to a specific brand of product or store (Sproles & Kendall, 1986). Consumers feel store image as a pivotal element of consumer shopping style because store attractiveness influences many consumers to visit the same store (Baker, Lavy, & Grewal, 1992). Extra risk taker consumers have an ideal approach towards known brands (Klink & Smith, 2001). Most Customers are habitually committed to a specific brand (Szakacs, Guth, & Vasa, 2012).

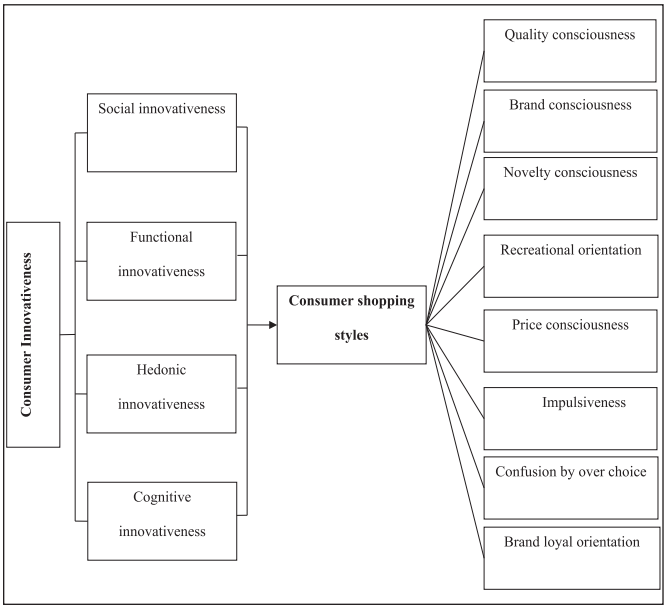
RESEARCH METHODOLOGY

This research is based on quantitative data collected from the students of the universities in Islamabad and Rawalpindi.

Proposed Theoretical Framework

This research paper studies the impact of consumer innovativeness on the consumer shopping styles. The conceptual model of the research is shown in figure 1.

Figure 1: Conceptual model



Hypotheses

This research tests five hypotheses as described below:

H_1: Consumer innovativeness has a significant impact on consumer shopping styles.

H_2: Social innovativeness has a significant impact on consumer shopping styles.

H_3: Functional innovativeness has a significant impact on consumer shopping styles.

H_4: Hedonic innovativeness has a significant impact on consumer shopping styles.

H_5: Cognitive innovativeness has a significant impact on consumer shopping styles.

Research Design

This is a quantitative research, conducted on the basis of primary data collected using an instrument adapted from CSI (Sproles & Kendall, 1986) and motivated consumer innovativeness (Vandecasteele & Maggie, 2010).

Population: The population of this research study is the young consumers in Pakistan.

Sample: The questionnaire was floated to 400 university students from universities located in the twin cities of Islamabad and Rawalpindi. Out of the 324 questionnaires received 23 were rejected due to incomplete information. Thus the response rate for this study was 75.25%. Out of these 301 respondents 77 were females (26%) and 224 males (74%).

Participants of study: University Students living in Islamabad and Rawalpindi participated in this research.

Instrument: The adapted questionnaire consists of 59 items to measure consumer innovativeness and consumer shopping styles. The questionnaire has 20 items to measure consumer innovativeness by social, functional, hedonics and cognitive innovativeness (Vandecasteele & Maggie, 2010). The questionnaire also has 39 items to measure consumer shopping styles by quality conscious, brand conscious, novelty conscious, recreational orientation, impulsiveness, price conscious, confusion by over choice and brand loyal orientation (Sproles & Kendall, 1986). The research instrument is based on Five-point Likert scales ranging from 1 (strongly disagree) to 5(strongly agree) was used. The scale was reduced to 43 most important items with the help of Factor analysis.

Data Collection: Self administrated questionnaire was distributed to the university students.

DISCUSSION

The data was analyzed using SPSS 14.0. Linear regression and correlation were computed to explore relationship between factors. The results of Cronbach Alpha and KMO turned out to be greater than 0.7 for all constructs, which shows the reliability of the data used and adequacy of the sample selected. The value of the Bartlett's test for all the constructs used was significant for $p<0.05$, thus confirming the sphericity of the data collected.

Table I:

Correlations

	Innovativeness			
	Social	Functional	Hedonic	Cognitive
Social innovativeness	1			
Functional innovativeness	.180	1		
Hedonic innovativeness	.329	.381	1	
Cognitive innovativeness	.265	.286	.391	1
Consumer Shopping styles	.520	.240	.391	.352

All the correlation coefficients are significant at the 0.01 level (2-tailed).

The correlation coefficient between consumer innovativeness and consumer shopping styles turned out to be 0.564 (significant at 0.01 level of significance– two tailed). Furthermore, the correlation between the individual types of consumer innovativeness with the consumer shopping styles, table I, also confirmed that there exists a significant positive correlation between consumer shopping styles and the various types of consumer innovativeness.

Table II:

Model Summary – relationship between consumer innovativeness and shopping styles

R	R Square	Adjusted R Square	Std. Error of the Estimate
.564(a)	.318	.316	.33469

a Predictors: (Constant), Consumer innovativeness
b Dependent variable: Consumer shopping styles

Table II - shows the impact of consumer innovativeness on consumer shopping styles. The consumer innovativeness, as used in the model, has 31.6% impact (value of R2) on the shopping style of the consumers.

Table III:

ANOVA (b)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	15.604	1	15.604	139.297	.000(a)
Residual	33.494	299	.112		
Total	49.098	300			

a Predictors: (Constant), Consumer Innovativeness
b Dependent Variable: Consumer shopping styles

Table III is the Anova table for the first regression. The results of this table shows the value of $F = 139.297$ ($p<0.001$). This confirms the fitness for prediction, of the model used.

Table IV:

Coefficients (a)

	Beta	*t*	Sig.
(Constant)		12.146	.000
Consumer innovativeness	.564	11.802	.000

a Dependent variable: Consumer shopping styles

Table IV shows the impact of consumer innovativeness on consumer shopping styles. The coefficient of consumer innovativeness is .564 which reveals that there is 56.4% variation caused by the consumer innovativeness in Consumer shopping styles. The value of $t = 11.802$ at .000 significance confirms the significance of the impact of the variable used. Thus the first hypothesis

H_1: Consumer innovativeness has a significant impact on consumer shopping styles has been accepted.

Table V:

Model Summary – relationship between consumer innovativeness types and shopping styles

R	R Square	Adjusted R Square	Std. Error of the Estimate
.592(a)	.350	.341	.32830

a Predictors: (Constant), social innovativeness, functional Innovativeness, hedonic innovativeness, cognitive Innovativeness

Table V – discloses the impact of social innovativeness, functional innovativeness, hedonics innovativeness and cognitive innovativeness on consumer shopping styles. The social innovativeness, functional innovativeness, hedonics innovativeness and cognitive innovativeness, as used in this model, has 34.1% impact (value of R2) on the shopping style of the consumers.

Table VI:

ANOVA (b)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	17.195	4	4.299	39.886	.000(a)
Residual	31.902	296	.108		
Total	49.098	300			

a Predictors: (Constant), social innovativeness, functional Innovativeness, hedonic innovativeness, cognitive Innovativeness
b Dependent Variable: Consumer shopping styles

Table VI is the Anova table for the regression. The results of this table displays the value of $F = 39.886$ ($p<0.001$). This confirms the fitness for prediction, of the model used.

Table VII:

Coefficients (a)

	Beta	*t*	Sig.
(Constant)		12.770	.000
Social innovativeness	.411	8.167	.000
Functional Innovativeness	.054	1.060	.290
Hedonic innovativeness	.172	3.126	.002
Cognitive Innovativeness	.161	3.083	.002

a Dependent Variable: Consumer shopping styles

Table VII explains the impact of social innovativeness, functional innovativeness, hedonics innovativeness and cognitive innovativeness on consumer shopping styles. The coefficient of social innovativeness is .411 which shows 41.1% variation caused by the social innovativeness in Consumer shopping styles using this model. The t value for this coefficient is 8.167 ($p<0.001$) which is highly significant. This significance value leads us towards the acceptance of the second hypothesis. This confirms that social innovativeness has a significant impact on consumer shopping styles. Hence the Second hypothesis

H_2: Social innovativeness has a significant impact on consumer shopping styles has been accepted

The coefficient of functional innovativeness is .054 which shows 5.4% variation caused by the functional innovativeness in Consumer shopping styles using this model. The t value for this coefficient is 1.060 which is not significant. This non significance value leads us towards the rejection of the third

hypothesis. This confirms that functional innovativeness has non-significant impact on consumer shopping styles. Thus the third hypothesis

H_3: Functional innovativeness has a significant impact on consumer shopping styles has been rejected.

The coefficient of hedonics innovativeness is .172 which reveals that there is 17.2% variation caused by the hedonics innovativeness in Consumer shopping styles. The t value for this coefficient is 3.126 ($p<0.001$) which is highly significant. The significant value guides us towards the acceptance of the fourth hypothesis. Hence this shows that hedonics innovativeness has significant impact on consumer shopping styles. Thus the fourth hypothesis

H_4: Hedonics innovativeness has a significant impact on consumer shopping styles has been accepted.

The coefficient for cognitive innovativeness is .161 which reveals that there is 16.1 % change caused by the cognitive innovativeness in consumer shopping styles. The t value for this coefficient is 3.083 ($p<0.001$) which is extremely significant. This significance value leads us towards the acceptance of the fifth hypothesis. Hence it confirms that cognitive innovativeness has significant impact on consumer shopping styles. Thus fifth hypothesis

H_5: cognitive innovativeness has a significant impact on consumer shopping styles

has been accepted.

This exercise leads us to a conclusion that the consumer innovativeness and its types social innovativeness, hedonic innovativeness, cognitive Innovativeness have significant positive impact on the consumer shopping styles. Furthermore, the results of this research revealed that the social innovativeness is the most significant type of consumer innovativeness on consumer shopping styles while the functional innovativeness is not significant in this regard.

The research conducted so far shows the impact of cognitive innovativeness on consumer shopping styles while this research paper has gone a step forward and the impact of social innovativeness, hedonic innovativeness, cognitive Innovativeness has been confirmed on consumer shopping styles.

Implications

The differences in shopping styles among different sort of innovative consumers found in this study added value to our knowledge about these marketing concepts. The results of this research have implications for academician and managers.

Academic implications

The models being taught to the marketing students at various levels in Pakistan are all imported from advanced countries. This study has been conducted in Pakistan and provides an opportunity to the academia to use indigenous model prepared in Pakistan, thus representing the relationship between the consumer shopping styles and its antecedents.

Managerial implications

The marketers need indigenous models for preparing the right strategies. With the help of this research paper

- A marketing strategy could be formulated on the relationship between consumer innovativeness and shopping styles for the Pakistani society.
- New product developers in Pakistan use this research to understand the importance of the new product appeal which works differentially to social, functional, hedonics and cognitive innovators.
- Marketers can also have an excellent understanding about which precise product appeal is needed for social, functional, hedonics and cognitive innovators and they should make the marketing plan according to these appeals.
- New product developers take lead from this research and design innovative products which can express social status because the study showed that social innovative consumers want to improve their social image.
- Innovative consumers are fascinated by the society based image of new products rather than the useful features so marketer should build brand characters that are appealing.
- Marketers can improve their products and services to provide happiness and joy to hedonic innovative consumers.
- Marketers can also convey comprehensive information about their products so that cognitive innovative consumers should have a better understanding of the products.
- Marketers can understand the importance and need to be cognizant of the differences and similarities in the shopping styles among various innovative consumers, to be able to use the right information in their promotional strategy to address the right target market.
- Marketers could also use this research paper to know the different buying behaviors across young Pakistani consumers and their right needs and requirements of innovative consumers in the country.
- Marketers can become familiar with the shopping style of innovative consumers as this could have an influence on the effectiveness of their marketing strategies
- Marketers can understand the need of clearly communicating the quality characteristics of the products in their marketing communications that are highly valued by the quality conscious innovative consumers.
- This research paper can help marketers to develop impressive shopping environments as innovative consumers enjoy shopping.
- Marketer must consider price conscious innovative consumers while designing the pricing strategies of the product.

Limitations of the study

The results this study can be partially generalized because it focuses on University students. This study has examined the consumer innovativeness as a general basis but it should also to be tested for different product lines.

Future research possibilities

This research paper has opened up new avenues for the researcher by exploring the association between the types of consumer innovativeness on shopping styles. Further research could be conducted to explore the impact of demographics and psychographic elements on the consumer shopping styles. It is further suggested that the consumer shopping styles of innovative consumers in Pakistani conditions should be compared with innovative consumers under different macroeconomic and cultural conditions of the world.

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SCIENTIFIC PAPER

THE CONNENCTION BETWEEN GLOBAL INNOVATION INDEX AND ECONOMIC WELL-BEING INDEXES

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Abstract: *We study the connection of innovation in 126 countries by different well-being indicators and whether there are differences among geographical regions with respect to innovation index score. We approach and define innovation based on Global Innovation Index (GII). The following well-being indicators were emphasized in the research: GDP per capita measured at purchasing power parity, unemployment rate, life expectancy, crude mortality rate, human development index (HDI). Innovation index score was downloaded from the joint publication of 2018 of Cornell University, INSEAD and WIPO, HDI from the website of the UN while we obtained other well-being indicators from the database of the World Bank. Non-parametric hypothesis testing, post-hoc tests and linear regression were used in the study.*

We concluded that there are differences among regions/continents based on GII. It is scarcely surprising that North America is the best performer followed by Europe (with significant differences among countries). Central and South Asia scored the next places with high standard deviation. The following regions with significant backwardness include North Africa, West Asia, Latin America, the Caribbean Area, Central and South Asia, and sub-Saharan Africa. Regions lagging behind have lower standard deviation, that is, they are more homogeneous therefore there are no significant differences among countries in the particular region.

In the regression modelling of the Global Innovation Index, it was concluded that GDP per capita, life expectancy and human development index are significant explanatory indicators. In the multivariable regression analysis, HDI remained the only explanatory variable in the final model. It is due to the fact that there was significant multicollinearity among the explanatory variables and the HDI aggregates several non-economic indicators like GII

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Keywords: *innovation, well-being, regression, HDI, global innovation index*

(JEL Classification: B41, I31, O31, Q55)

INTRODUCTION

The growth of the world is an incredibly spectacular process especially when it comes to the evolution of humanity from the prehistory to present days. This process, continuous innovations, developments completely changed the life of humanity. Against this background it is not surprising that the economics of development and innovation are included in the research areas of economics, administration and management sciences. Research, development and innovation (R&D&I) are closely related definitions, but it is important to differentiate them. R&D include 3 categories: basic research, applied research and experimental development. According to the National Research, Development and Innovation Office, 'R&D are regular creative works aiming at expanding knowledge and knowledge base' (the National Research, Development and Innovation Office, 2018). Regarding life cycle, innovation is made up of 3 sections: invention, innovation and diffusion. Invention is the act of discovering and creating novelties. Innovation is the placement and development of invention into business practice, and diffusion is the widespread adoption of inventions (Schumpeter, 1939). On this basis, it can be concluded that that R& D is first and foremost involved in invention.

A detailed definition of innovation first appeared in Schumpeter in 1939, since then the meaning and the underlying definition have changed to a large extent, perhaps due to changes in the macro and micro environment. Today, its interpretation in the Oslo Manual is the most widespread, that is: 'innovation is the implementation of

- a new or significantly improved product (good or service), or process
- or a new marketing method
- or a new organizational method
- in business practices, workplace organization or external relations." (Oslo Manual, 2006).

Effects of innovation

Innovation in any economy, whether natural or controlled, contributes significantly to higher standard of living.

These days, innovation performance is a key factor in maintaining competitiveness and the development of the national economy. In addition, innovation is the key to meeting the global challenges that global population faces (climate change, fossil fuels, sustainability (OECD, 2007).

Several studies demonstrate a strong, positive relationship between innovation and gross domestic product (Goliuk, 2017; Czarnitzki and Toivanen, 2013; OECD, 2007). According to the economic context of the topic, innovation-driven productivity gains are the basis for innovation-driven economic growth, which is expressed primarily in the output of GDP, in gross output (GO) (Gregersen-Johnson, 1997). Gurbiel's (2002) work illustrates the practical side of the process described above, whereby innovation and knowledge transfer are the basis for economic growth and sustainable development; value of R&D combined with an appropriate transfer process and infrastructure (which is represented in imports and FDI) is a direct cause of productivity growth. These results are qualified by Wang's (2013) empirical research, which found no positive correlation between innovation output and economic growth but may be limited by the fact that Wang only examined patent and trademark statistics over time directly from the Second World War.

Günday et al. (2009) assessed the impact of innovation on corporate performance, and their research suggests that innovation has a positive impact on higher market share, sales volume and exports. These results have been backed by several other empirical studies (Damonpour-Evan, 1984; Despande et al., 1993; Du-Farley, 2001; Canh et al., 2019). Applying basic macro and microeconomic knowledge, changes at the micro level (the impact of innovation on corporate performance) are reflected at national level (though in other indicators).

Measuring R&D and Innovation

Primarily, data on R&D were the base of the quantification and measurement of innovation until the end of the 70's. It is partly due to the interpretation of innovation in that period and the linear approach of innovation process. A more significant change occurred when not only technological novelty on the market, but also the latest categories of innovation (organization, marketing and procedure) and the relatively interpreted novelty (in a new organisation or business practice) became accepted categories (Szunyogh, 2010).

The publication of Oslo Manuals is a milestone in the measurement of innovation, the first edition was published in 1993 and there is an effort to provide a single framework for measuring innovation allowing international comparison. At the same time, a standard questionnaire survey was conducted in the Member States of the European Union, called CIS (Community Innovation Survey) (Sabadie-Kwiatkowski, 2016).

Since innovation has paramount importance in competitiveness, the measurement of innovation is reflected in the Global Competitiveness Report of the World Economic Forum, which includes innovation among the 12 areas used to measure competitiveness (institutions, infrastructure, macroeconomic environment, health and primary education. higher education and vocational training, commodity market efficiency, labour market efficiency, the development of financial markets, availability of technologies, market size, business sophistication, innovation). However technological innovation and knowledge are particularly taken into account in context of innovation to define the Global Innovation Index (Keresztes, 2013). Innovation index of GCI takes the following factors into consideration: innovation capacity, quality of scientific research institutes, corporate R&D expenditures, university-industry cooperation in R&D, state technology procurement, availability of researchers and engineers, number of patent applications (Schwab, 2017).

The European Union also measures the innovation performance of the Member States and publishes the European Innovation Scoreboard every year. The innovation index is based on 27 indicators looking into four dimensions. The first dimension is the framework conditions for innovation, including human resources, an enticing research system and an innovation-friendly environment. The second dimension is investment, which has two categories: finance and subsidy and corporate investments. The third dimension is innovation, which attempts to measure corporate innovation efforts with three categories: innovators, networking and intellectual property. The fourth dimension is the impact, which intends to quantify the market effects of innovation activity in two categories: effects on employment, effects on sales. After defining the scores for each Member State, it classifies the countries into four innovation performance categories: leading innovators, major innovators, moderate innovators and lagging innovators (European Union, 2018).

Bloomberg innovation index (BII) developed by Bloomberg L.P. is worth mentioning which evaluates the innovation performance of the countries on the basis of six criteria: R&D, production, high-tech enterprises,

those with secondary qualification, researchers and patents (Jamrisku – Lu, 2018).

The Global Innovation Index (GII) published in a joint publication of the World Intellectual Property Organization (WIPO), Cornell University and INSEAD, uses a more complex approach. The innovation index of 127 countries is calculated on a scale ranging from 0 to 100 using 81 indicators focusing on seven dimensions: institutional system, human resources and research, infrastructure, market development, business development, scientific and technological performance, creative performance (Cornell et. al, 2018). Table 1. shows the composition of the Global Innovation Index.

Table 1. The composition of Global Innovation Index

GLOBAL INNOVATION INDEX (Innovation Efficiency Ratio)
I. Innovation Input – Sub-Index
1. Institutions
a. Political environment
b. Regulatory environment
c. Business environment
2. Human capital and research
d. Education
e. Tertiary education
f. Research and development
3. Infrastructure
g. ICTs
h. General infrastructure
i. Ecological sustainability
4. Market Sophistication
j. Credit
k. Investment
l. Trade, competition and market scale
5. Business sophistication
m. Knowledge workers
n. Innovation linkages
o. Knowledge absorption
II. Innovation Output – Sub-Index
6. Knowledge and Technology Outputs
p. Knowledge creation
q. Knowledge impact
r. Knowledge diffusion
7. Creative Outputs
s. Intangible assets
t. Creative goods and services
u. Online creativity

Source: Cornell et al., 2018

Objectives

The aim of the research is to delve into the relationship between the Global Innovation Index and some important well-being indicators: GDP per capita measured at purchasing power parity in US Dollar, life expectancy, crude mortality rate, unemployment rate, human development index (HDI). In addition, we reveal whether the geographical location (7 regions under the United Nations classification) has an impact on the innovation index.

MATERIALS AND METHODS

Secondary data are the base of the study. The GII (Global Innovation Index) is from 'The Global Innovation Index 2018: Energizing the World with Innovation' published by Cornell University, INSEAD, and WIPO (Cornell et al., 2018). The following data are from the World Bank database: GDP per capita measured at purchasing power parity in US Dollar, life expectancy, crude mortality rate, unemployment rate (The World Bank, 2018). Data on the Human Development Index were collected from the database of the website of Human Development Reports of the United Nations Development Program (United Nations Development Program, 2018).

In the first step of the research we studied the relationship among our variables with simple Pearson's linear correlation. Afterwards, we continued to study the relationship with linear regression, but it is important to emphasize that we did not intend to reveal a causal relationship with regression, but to get a deeper understanding of the relationship between GII and well-being indicators. The nature of functional relationship between the result variable and the explanatory variable (linear, exponential, logarithmic, inverse) was tested. The condition of the regression error tag was tested with one-sample Kolmogorov-Smirnov test, and the homozygosity was tested with scatter plot. Whether there is a difference between the geographical regions in terms of the innovation index, we used the Kruskal-Wallis test and Dunn's post-hoc test. IMB SPSS 23 was used for the tests.

RESULTS

Geographical regions and the Global Innovation Index (GII)

Based on the United Nations classification, seven geographical regions were identified and divided into the following countries: EUR - Europe; NAC - North America; LCN - Latin America and the Caribbean; CSA - Central and South Asia; SEAO - Southeast Asia, East Asia and Oceania; NAWA - North Africa and West Asia; SSF - Sub-Saharan Africa. We studied whether there is a significant difference in GII among these regions. Table 2. shows the mean innovation index of the regions and how many countries there are in the regions in the sample.

Table 2. The mean and deviation of GII per region (n=126)

Region	N	Mean of GII	Deviation
NAC	2	56.3950	4.82954
EUR	39	46.6659	10.04034
SEAO	15	43.8833	11.21578
NAWA	19	33.7621	8.78049
LCN	18	30.3150	4.30719
CSA	9	28.2356	4.32029
SSF	24	24.5267	4.19485
Sum	126	36.6740	12.13085

Source: own calculation

Based on the Kruskal-Wallis non-parametric test it can be concluded that there is a significant difference between the regions ($p < 0.01$) and the difference between the Dunn post-hoc test is significant in the following cases: EUR – NAWA, EUR – LCN, EUR – CSA, EUR – SSF, SEAO – NAWA, SEAO – LCN, SEAO – CSA, SEAO – SSF, NAC – NAWA, NAC – LCN, NAC – CSA, NAC – SSF, NAWA – CSA, NAWA – SSF, CSA – SSF.

Table 3. Correlation of the factors studied (n=126)

		GII	GDP/ capita	Unem-ployment rate	Life expec-tancy	Mor-tality rate	HDI
GII	r	1	.713**	-.089	,782**	.141	.842**
	p		.000	.322	,000	.114	.000
	N	126	125	126	126	126	126
GDP/ capita	r	.713**	1	-.184*	,655**	-.191*	.750**
	p	.000		.040	,000	.033	.000
	N	125	125	125	125	125	125
Unem-ploy-ment rate	r	-,089	-.184*	1	-,012	.208*	.005
	p	.322	.040		,891	.020	.958
	N	126	125	126	126	126	126
Life expec-tancy	r	.782**	.655**	-.012	1	-.129	.912**
	p	.000	.000	.891		.148	.000
	N	126	125	126	126	126	126
Mor-tality rate	r	.141	-.191*	.208*	-,129	1	.032
	p	.114	.033	.020	,148		.722
	N	126	125	126	126	126	126
HDI	r	.842**	.750**	.005	.912**	.032	1
	p	.000	.000	.958	.000	.722	
	N	126	125	126	126	126	126

Source: own calculation
**p < 0.1; **p < 0.05, ***p < 0.01*

Revealing the functional relationship between GII and explanatory variables

In the first step of regression modelling, we tested whether there is a linear relationship between our explanatory variables and the innovation index, where no linear relationship was found, exponential, logarithmic and inverse function-like relationships were also studied. In terms of GDP per capita it was concluded that it has a linear relationship with the GII, the determination coefficient is r2 = 0.508, which means that 50.8% of the global deviation of the global innovation index can be explained by GDP per capita. Modelling can be considered accurate based on the standard error of estimation (SEE = 8.47). Furthermore, the F-test of variance analysis (ANOVA) confirms the existence of the relationship ($p < 0.01$) between the GDP per capita and the GII, the significance of variable defining the slope is lower than 5 % based on the t-probe, therefore GDP per capita affects GII. Based on OLS estimation, we get the following linear equation:

$$(1)\ GII = 27.567 + 0.000376 * GDP\ per\ capita$$

It may be considerable that the coefficient of GDP per capita as an explanatory variable is very low; it is due to the fact that GII is a variable measuring at a scale ranging from 0 to 100 while GDP per capita is a metric random variable of 10 thousand.

Regarding the connection between the unemployment rate as an explanatory variable and the GII as a result variable, there is neither a linear nor any other function-like relationship, but the linear relationship between life expectancy and GII can be verified. The determination coefficient in this case is r2 = 0.612, the model's accuracy is SEE = 7.587. The F-test of the variance analysis also confirms the existence of the relationship ($p < 0.01$) between life expectancy and GII, and the significance of the slope variable is less than 5% based on the t-test, thus life expectancy affects GII by the following equation:

$$(2)\ GII = -61{,}069 + 1{,}323 * life\ expectancy$$

Interpreting the equation, it can be concluded that there is a positive, linear, function-like relationship between life expectancy and GII. Of course, the innovation index cannot be explained by life expectancy, but if we rearrange the equation, we find the following connection:

$$(3)\ life\ expectancy = 1/1.323 * GII + 61.068/1.323,$$

that is, if GII increases by one unit, life expectancy increases by 0,756 years,

There is also no functional relationship between the mortality rate as an explanatory variable and the global innovation index as a result variable. The linear relationship between HDI and GII is significant with the determination coefficient of $r^2 = 0.708$. The model meets all the additional requirements and the relationship can be described by the following equation:

$$(4)\ GII = -16.417 + 70.582 * HDI$$

Overall, the linear function-like relationship was the most appropriate for all the acceptable models. Table 4 shows the characteristics of each linear model.

Table 4. Characteristics of the linear models (n=126)

	Coeffi-cient	r^2	corr. r^2	F -test sig.	t-test on dep. variable value/sig. lev.	Decision on the model
GDP/ capita	0.000376	0.508	0.504	0.000	11.263/ 0.000	Accepted
Unem-ployment rate	-0.192	0.008	0.000	0.322	-0.9914/ 0.322	Rejected
Life ex-pectancy	1.323	0.612	0.609	0.000	13.983/ 0.000	Accepted
Mortality rate	0.601	0.020	0.012	0.114	1.59/ 0.114	Rejected
HDI	70.582	0.708	0.706	0.000	17.345/ 0.000	Accepted

Source: own calculation

Multivariate regression modelling of GII

In the first step of GII's multivariate regression modelling, the previously adopted explanatory variables (GDP per capita, life expectancy, HDI) were included in the study. The first multivariate model induced some problems: on one hand, the coefficient of life expectancy, which had a significant explanatory power in the previously univariate relationship, was no longer significant in the multivariate model. Although the estimation errors had normal distribution, the standard deviation of the remaining factors in the model is far from constant, heteroskedasticity persisted, which distorted parameter estimates and doubted the results of the t and F-tests (Hunyadi - Vita, 2005; Ramanathan, 2003). To solve this problem we logarithmized (ten-logarithm of the result variable (GII)), our result variable (GII), although logarithmization defects the interpretation of the results, it is not a problem for us, since the purpose of multivariate regression testing is the estimation of GII (Sajtos - Mitev, 2007; Koop, 2007; Maddala, 2004). Afterwards, the multivariate regression was run again, but with the logarithmic global innovation index. In this case, the problem of heteroscedasticity disappeared, the coefficient of life expectancy and GDP per capita no longer had a significant explanatory power in the model, so life expectancy was removed in the first step. In this model, where we had only two explanatory variables, we still had no significant explanatory power for GDP per capita. There may be several reasons for this: on one hand, GDP per capita is a variable measured at a significantly higher interval, on the other hand there is significant multicollinearity in the model, as GDP per capita and HDI are strong ($r = 0.75$) and significant correlation ($p < 0.01$) exists. Therefore, we decided to remove GDP per capita from the model, so we returned to univariate regression, where our model was no longer affected by heteroskedasticity. The resulting final model is:

(5) $\lg GII = 2.048 + 1.995 * HDI$

With the model, we are able to explain 78% of the total variance of the global innovation index ($r2 = 0.780$, corrected $r2 = 0.778$). In the model, both the coefficient of constant and HDI had significant explanatory power. The standard errors of the estimation have normal distribution, which was tested with the Kolmogorov-Smirnov test ($p = 0.200 > 0.05$), and the standard deviation of the remaining factors can be considered constant based on scatterplot. Presumably, HDI remained in the final model, because there is a strong correlation between the explanatory variables, almost without exception and the effectiveness of the model is defected by multicollinearity and it was HDI that had the strongest correlation with GII. Although there is an assumption that GDP per capita would have been the indicator that explains the GII to the greatest extent, yet HDI had the greatest explanatory power. It is backed by by the composition of HDI and GII, because GII aggravates not only economic factors, HDI also considers other factors besides economic factors, which may have an underlying relationship with the innovation performance of a national economy.

CONCLUSION

As a conclusion, there are differences among the geographical regions in innovation performance of national economies based on the global innovation index. North American countries (USA and Canada) are in the top (56.4), but the European region also has a relatively high mean score (46.67), although it must be emphasized that there is a significant deviation among European countries (10.04) where Eastern Europe lag behind to a greater extent, but the two regions (NAC and EUR) do not differ significantly. Southeast Asia also represents a higher level of innovation performance (43.8), but there is also a significant deviation (11.22) and innovation performance among countries. There is no significant difference between this region and Europe. As a consequence, 3 regions (NAC, EUR, SEAO) have leading power in innovation.

Larger (significant) backwardness can be seen regarding North Africa and West Asia (33.76), with less and less deviation (8.78), followed by Latin America and the Caribbean (GII mean = 30.31, deviation = 4.31) then Central and South Asia (GII mean = 28.24, deviation = 4.32), while Sub-Saharan Africa (GII mean = 24.53, standard deviation = 4.19), has significant backwardness.

Our research highlighted that there is a correlation between the innovation performance of a national economy and GDP per capita at purchasing power parity, life expectancy and human development index (HDI). HDI had the strongest link with the innovation index (but the correlation coefficient with the innovation index is higher than 0.7 in all the three cases), and the multivariate regression analysis showed that HDI itself is the most suitable to estimate the innovation index (r2). = 0.78). Consequently, due to the fact that HDI aggregates three factors (GNI index, life expectancy index), these factors may also have a strong relationship with the innovation performance of a national economy. The research proved that the impact of education, the health of population and income are also reflected in innovation.

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ABSTRACT

Contents

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