The factors limiting the venison market in the Czech Republic and options for limiting their impact on the forestry

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Abstract: This article focuses on the development possibilities of the venison market in the Czech Republic. The main factors affecting the primary game market were investigated, both production limitations on the side of the hunters and on the side of the game production purchase prices. These factors were analysed in the context of the consumer prices of general meat production and the purchase prices of common meat (beef, pork). Furthermore, the size of the total game market was estimated, taking into account the export and import of this commodity. The potential venison market size for the Czech Republic was also established in the study. The gap between the development of the market consumer prices and purchase prices of the venison was analysed. The conducted research further revealed that the respondents do not perceive a relationship between the production of venison and the protection of forest ecosystems. With few exceptions, they do not realise that by buying and consuming venison, they can contribute to the support of forestry. Furthermore, the perception of the role of the forest environment in relation to game meat by the public does not correspond to the need to regulate the game density to limit damage to forest stands. The results of this research are recommendations which mainly consist in expanding the offer of the primary production to products significantly closer to the consumer market (moving from a producer market to a consumer market), and the implementation of activation campaigns (tastings, presentations of opinion makers). At the same time, our work revealed the need for further development, and by increasing the value for the customer who, with the appropriate marketing strategy, can perceive this product as a premium organic food through which they contribute to sustainable forest management.

Keywords: Czech venison; game meat; game density regulation; non-timber forest production; venison marketing

In the Czech Republic (CR), forests are traditionally (Papánek 1972; Šišák et al. 2006) and legislatively by the Forest Act (Act 289/1995 Coll.) characterised according to their functions – production and

non-production ones. It was only at the beginning of the new millennium when the term ecosystem service (ES) began to be used in Czech forestry, first as a synonym for functions, and later (with the development of ES classifications) specifically. The issue of non-production, especially non-wood production (NTFP) has been given a lot of attention in the CR (Šišák et al. 2016; Riedl et al. 2019b). However, these were mostly products related to gathering and harvesting (mushrooms and other forest fruits). Hunting is assessed in view of social importance (Krokowska-Paluszak et al. 2020; Frouz, Frouzová 2022) or in relation to forest protection (Stewart 2001; Apollonio et al. 2010), while a land's own game (as part of the NTFP) is given little attention. Game production can be classified as a supply activity within the framework of forest ecosystem services (MEA 2005), where the game production segment consists of the identification, commercialisation and reliable management of the related opportunities. Similarly, more recent classifications include game production among supply services, according to the TEEB (The Economics of Ecosystems and Biodiversity) in the subcategory of the food category, in the CICES (Common International Classification of Ecosystem Services) as a subcategory of the biomass production intended for nutrition (Maes et al. 2013).

More and more attention is also being paid to NTFPs due to the search for additional income from forestry and food resources (Olaussen, Mysterud 2012). The meaning and possibilities of using NTFPs differ significantly in individual countries. The importance of game within the NTFP is also evidenced by the fact that its value within the EU-28 amounts to 317 million EUR (UNECE 2018).

Venison is considered as a high-quality source of nutritional elements not only due to the beneficial high protein content and protein composition (Okuskhanova et al. 2017), but also for its antioxidant activity. This can be attributed to the specific peptides (APVPH I, APVPH II) detected in the enzymatic hydrolysates of venison protein, as suggested by the study of Kim et al. (2009). Deutz (2012) or Bureš et al. (2018) stipulate that venison is characteristic for its lower fat content compared to beef, pork, or lamb. Also, the nutritional value is considered high due to its high protein content, high amounts of minerals, vitamins, trace elements, and unsaturated fatty acids. In developed countries, venison is considered

as meat of higher quality compared to red meats from farm animals by people who are conscious of healthy eating (Köttl et al. 2014). Another aspect comes from experience from South Africa, where McCrindle et al. (2013) provided evidence that harvesting edible venison by-products (liver, kidneys, lungs, heart) to lower-class consumers (rural areas) appears to be culturally acceptable, affordable, accessible and safe. Edible by-products from game could increase the food security in rural communities, as well as with low-income commuters. Game meat production creates local supply hubs (hunting areas) that generically generate edible by-products of lower market value. The local rural communities may have access to the source of high-quality proteins for an affordable/bargain price.

Based on the above, it can be assumed that, in the case of venison, it is usually a very high-quality food. Since the current era brings a number of uncertainties for the Czech forestry industry and forest owners (climate change and the related bark beetle outbreaks, large price fluctuations on the wood market, high growth rate of inflation, etc.), game production may become more important. In this context, it is necessary to find answers to two basic research questions:

(*i*) What are the main (economic) limits limiting the development of the game market?

(*ii*) Are there any ways to increase the forestry income from game production?

State of the game market in the Czech Republic. There is a total of 6 884 619 ha of hunting land in the Czech Republic. Of this, agricultural land accounts for 56.7%, forest land accounts for 37.6%, water areas account for 1.4% and other areas account for 4.3%. Of the total acreage, 49 041 ha are for game reserves and 91 069 ha are for pheasantries. Hunting is managed in 5 786 hunting grounds. Of these, there are 200 game reserves and 286 pheasantries. The average hunting area is 1 190 ha, the average game reserve is 245 ha and the average pheasantry is 318 ha (Ministry of Agriculture 2021).

Like any market, the game market is determined by supply and demand. A number of factors are important for further development of the market in terms of the supply and demand. The domestic supply is directly determined by the volume of the game hunted and the volume of the net trade balance with the game. The Czech Republic is a net exporter of game, i.e. the game exports exceed game

imports (CZSO 2022b). The volume of the game hunted depends on the condition of the game, the planned hunting and the capacity of the hunters to effectively implement the hunting plan. Over 90% of all the harvested venison weight in the Czech Republic relates to the ungulate species (red deer, fallow deer, European mouflon, roe deer, wild boar) (CZSO 2021).

In the population of the Czech Republic, the level of game consumption is low in relation to other types of meat per person, amounting to approx. 1 kg per year (1.2% of the total annual meat consumption). This small value represents an obvious potential to increase domestic consumer demand (AKCR 2021).

In connection with the production and sale, i.e. the supply of game in the Czech Republic, it is necessary to emphasise the necessity of a significant reduction in the game density in connection with the restoration of Czech forests after the bark beetle outbreak (Stachova 2018; Ministry of Agriculture 2021). This is consistent with a general problem across the forestry sector across Europe, where the overpopulation of large herbivores poses a major risk to the main production function of the forest (Stewart 2001; Palmer, Truscott 2003).

MATERIAL AND METHODS

The works were methodically divided into two areas consisting of several steps, covering both official quantitative data and survey data. The synthesis of such diversified results then enables the research questions to be answered.

Acquisition and analysis of available official data. The data were obtained from the public databases of the Czech Statistical Office (CZSO), the Forest Inventory Office and the Forest Management Institute (UHUL) and the official Reports on the State of Forests issued annually by the Ministry of Agriculture (MAg). The analysis took place in the following steps:

(1) Analysis of the dynamics of development of domestic game production with a focus on the main species of ungulates: analysis of the data from the CZSO (CZSO 2022a). The data were put into the context of the dynamics of development of the selected species of ungulates in the Czech Republic and in the neighbouring countries (LDKČR 2021).

(2) Analysis of the development of the number of hunters and the related development of licences to hunters (hunting right holders): analysis of the data of the UHUL (2021) and the CZSO (2021, 2022a).

(3) Analysis of the dynamics of development of the trade balance (export – import) of game between the Czech Republic and other countries: analysis of MAg data (Ministry of Agriculture 2021), UHUL (2021) and Czech Statistical Office (2022b). Based on the analysis, the size and dynamics of development of the domestic game market were subsequently estimated using the relationship: market size = production – export + import.

(4) Comparison of the development of the game purchase prices compared to the development of the consumer price index in a comparable period: analysis of the CZSO data (CZSO 2022c) using the Laspeyres Index (Eurostat 2022).

Survey research. The survey was divided into two separate surveys. The first (step 5) was aimed at evaluating the public's opinion on game, the second (step 6) was aimed at analysing the consumer market.

(5) Poll survey investigating the attitude of the public and their perception of the function of the forest in relation to the wildlife: the research was carried out in 2018 through CAPI (Computer Assisted Personal Interviewing) by the STEMMARK agency. The Internet population aged between 15 and 75 years, the general population of the Czech Republic, was included in the sample. The collection of the field data took place between May 24 and June 4, 2018. The data analysis was carried out on a sample of 1 519 respondents. Selection characteristics: gender, age, education.

(6) Poll survey on the consumer market analysis: the survey was conducted in 2021 through the Internet data collection CAWI (Computer Assisted Web Interwiewing) by the Nielsen agency. The collection of the field data took place between August 24 and August 30, 2021. The data analysis was carried out on a sample of 523 respondents. The sample included an Internet population of 20+ of age, people (jointly) responsible for purchases who, at a minimum, visit a restaurant twice a month and eat meat. Selection characteristics: gender, age, education, region and size of the place of residence.

Synthesis of results. The described methodology can be summarised in a brief diagram (Figure 1).
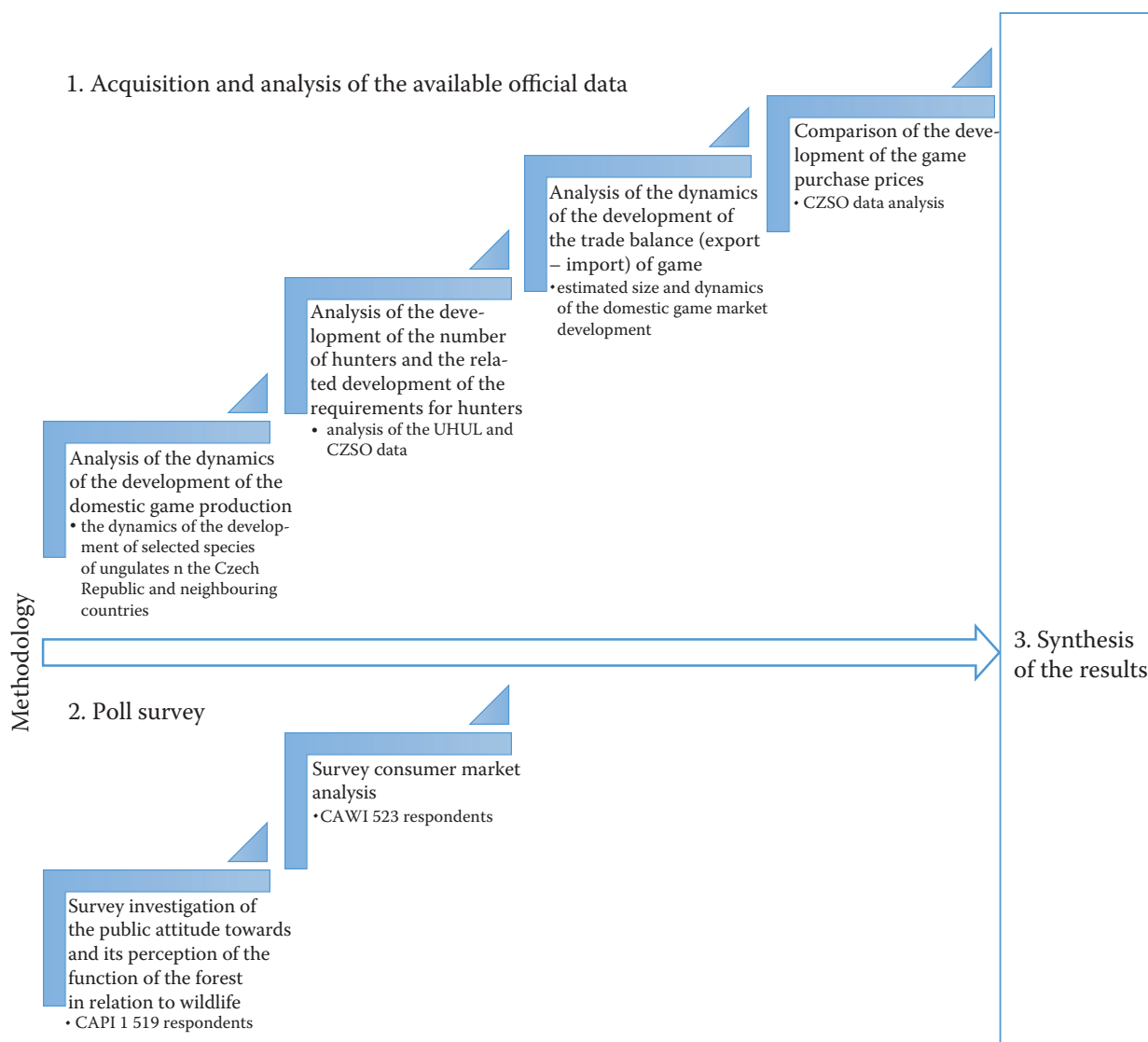
1. Acquisition and analysis of the available official data

Comparison of the deve-
lopment of the game
purchase prices
• CZSO data analysis

Analysis of the dynamics
of the development of
the trade balance (export
– import) of game
•estimated size and dynamics
of the domestic game market
development

Analysis of the deve-
lopment of the number
of hunters and the rela-
ted development of the
requirements for hunters
• analysis of the UHUL and
CZSO data

Analysis of the dynamics
of the development of the
domestic game production
• the dynamics of the develop-
ment of selected species
of ungulates n the Czech
Republic and neighbouring
countries

Methodology

3. Synthesis
of the results

2. Poll survey

Survey consumer market
analysis
•CAWI 523 respondents

Survey investigation of
the public attitude towards
and its perception of the
function of the forest
in relation to wildlife
• CAPI 1 519 respondents

Figure 1. Methodology diagram

CAPI – Computer Assisted Personal Interviewing; CAWI – Computer Assisted Web Interwiewing

RESULTS

Venison market in the Czech Republic.
As is clear from Table 1, the selected ungulates rep-
resent 92% of the total mass production of game
in the Czech Republic. A comparison of the devel-
opment of its production, the context of develop-
ment in the surrounding countries and the volume
and development of the market related to this pro-
duction, thus, represent fundamental factors in the
game production of the Czech Republic.

The total primary production and its develop-
ment over time can be aggregated from the data
obtained. From the graph (Figure 2) it is clear that
the production is increasing with interannual fluc-

tuations, especially in wild boar, when a record
catch of black game was recorded in 2017, which
was subsequently exceeded in 2019, and was in-
fluenced by the shooting fee per caught piece and
secondly, by the increasing damage to agricul-
tural production together with African swine fe-
ver. This record was exceeded in 2019 for similar
reasons. Every year following a record hunt, a de-
crease is recorded reflecting the reduced initial
conditions.

The supply side of the venison market in the
Czech Republic belongs to the broader context
of the venison market of the neighbouring coun-
tries. To compare the status and development dy-
namics, the basic development in the available time

Table 1. Ungulate species harvested in the Czech Republic (CZSO 2021)

| Harvest of ungulates (in pieces)	Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Red deer (*Cervus elaphus*)	21 511	20 958	23 092	23 578	23 361	23 978	26 152	27 878	28 287	29 017	29 842	30 792
Fallow deer (*Dama dama*)	1 393	13 131	14 591	16 404	16 761	18 968	20 402	23 069	23 800	28 978	30 982	33 250
European mouflon (*Ovis musimon*)	8 764	8 146	9 112	9 222	9 059	9 495	9 506	9 400	9 531	10 105	10 580	10 019
Roe deer (*Capreolus capreolus*)	131 873	113 913	108 591	105 680	100 348	99 828	100 834	103 455	102 229	103 018	105 570	107 433
Wild boar (*Sus scrofa*)	121 690	109 383	185 176	152 250	168 974	185 496	160 139	229 182	137 823	239 818	160 811	230 905
Game weight (in tonnes)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Red deer (*Cervus elaphus*)	1 613.3	1 571.9	1 731.9	1 768.4	1 752.1	1 798.4	1 961.4	2 090.9	2 121.5	2 176.3	2 238.2	2 309.4
Fallow deer (*Dama dama*)	392.8	393.9	437.7	492.1	502.8	569.0	612.1	692.1	714.0	869.3	929.5	997.5
European mouflon (*Ovis musimon*)	219.1	203.7	227.8	230.6	226.5	237.4	237.7	235.0	238.3	252.6	264.5	250.5
Roe deer (*Capreolus capreolus*)	1 978.1	1 708.7	1 628.9	1 585.2	1 505.2	1 497.4	1 512.5	1 551.8	1 533.4	1 545.3	1 583.5	1 611.5
Wild boar (*Sus scrofa*)	6 084.5	5 469.2	9 258.8	7 612.5	8 448.7	9 274.8	8 007.0	11 459.1	6 891.2	11 990.9	8 040.6	11 545.3
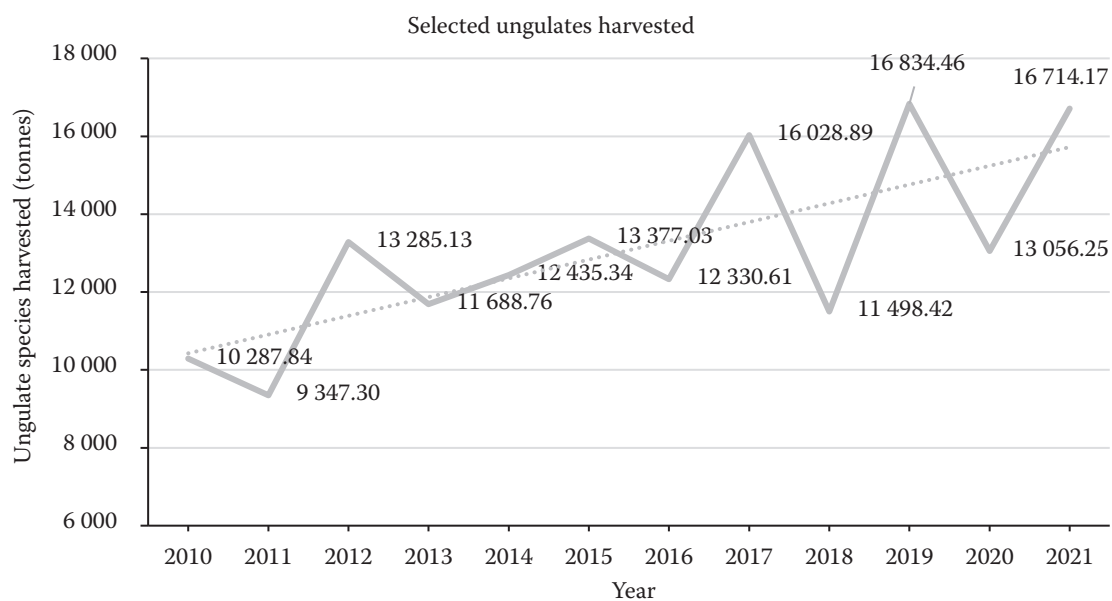
Figure 2. Ungulate species harvested in the Czech Republic in tonnes, adjusted dynamics (CZSO 2021)

series in the Czech Republic, Germany, Poland, Austria and Slovakia was used.

Primary production, compared in 1995 and 2019, is the basic supply factor as shown in Table 2.

The size of the offer is derived from the volume of hunting the most important species. Here, you can see a strong increase in the supply in the surrounding countries, which recorded a 77% increase in the total number of selected species of ungulates between 1995 and 2019. It is also clear that the dynamics of development of the primary production volume differs fundamentally in the individual countries from a relatively lower increase in the order of tens of percent 38–66% (Austria, Germany) through 102–130% (Czech Republic, Poland) to 316% (Slovakia). In both the absolute and relative increases, the influence of the increase in black game catches prevails.

Analysis of development of the number of hunters. The growing number of catches places pressure on the available hunting capacity. According to the obtained data, the number of hunting licence holders (hunters) is decreasing. Figure 3 shows the details.

When comparing the number of shot individuals of selected ungulates, the need for shot individuals per hunting licence holder increased by 47% during the observed period (2010–2021) (Table 3). Due to the long-term decreasing number of hunt-
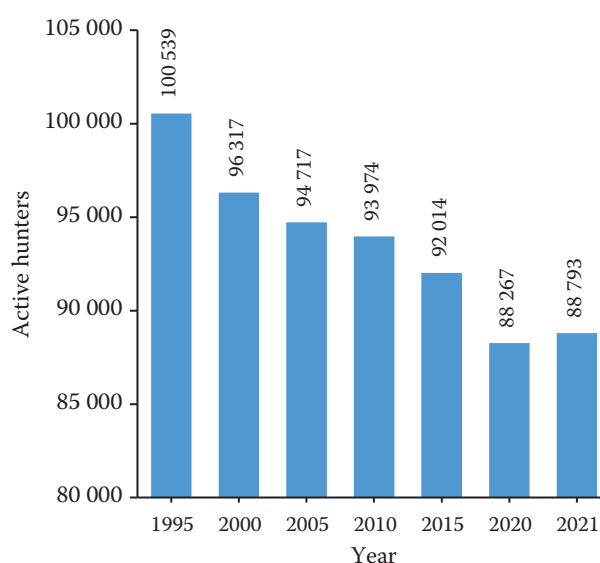

Figure 3. Number of hunters (UHUL 2021)

ing licence holders, the increasing burden in this part of the primary production is, thus, obvious.

The decrease in hunter's status is all the more serious as the rate of shooting requirements per hunter increases along with it.

Analysis of the dynamics of development of the trade balance and the dynamics of the domestic market. The increase in the number of shot animals is also reflected in the trade balance statistics (export minus import) between the Czech Repub-

Table 2. Selected ungulates harvested, dynamics in pcs. (LDKČR 2021)

Species	Year	Czech Republic	Germany	Poland*	Austria	Slovakia	Total
Red deer (*Cervus elaphus*)	1995	16 873	52 813	35 400	35 402	2 909	153 397
	2019	29 863	76 897	83 200	57 524	45 320	292 804
	change (%)	77	46	135	62	251	91
Fallow deer (*Dama dama*)	1995	6 643	35 314	4 700	–	974	47 631
	2019	31 057	65 427	6 600	1 034	16 597	120 715
	change (%)	368	85	40	–	1 604	153
Roe deer (*Capreolus capreolus*)	1995	101 353	1 016 200	129 800	230 895	14 792	1 493 040
	2019	105 665	1 226 169	200 000	278 312	25 689	1 835 835
	change (%)	4	21	54	21	74	23
Wild boar (*Sus scrofa*)	1995	37 775	253 788	61 300	11 451	10 376	374 690
	2019	161 699	882 231	242 200	47 251	74 947	1 408 328
	change (%)	328	248	295	313	622	276
Total	1995	162 644	1 358 115	231 200	277 748	39 051	2 068 758
	2019	328 284	2 250 724	532 000	384 121	162 553	3 657 682
	change (%)	102	66	130	38	316	77

*data from 2018

Table 3. Hunters' workload ratio, dynamics

Ratio parameters	2010	2015	2021	Change 2010–2021 (%)
Hunters	93 974	92 014	88 793	−5.51
Selected ungulates (pcs)	296 931	337 765	412 399	38.89
Ratio	3.16	3.67	4.64	46.99

lic and other countries. Table 4 shows a comparison of the years 2008 and 2021. Here, the relative dependence of the development of the expansion of the number of game caught on the trade balance with the above-mentioned neighbouring countries and vice versa is evident.

A relatively higher increase in the catches in the CR is recorded compared to the development in Germany, and, at the same time, a significant increase in the exports to Germany was recorded, similarly like in the case of Austria. On the contrary, in the case of Slovakia and Poland, where a relatively slower increase in primary production was recorded, a significant increase in the import of game from these countries was also recorded.

The size of the domestic market is determined by the difference between the production and the trade balance, i.e. the relationship market size = production – export + import.

Table 5 shows that between 2008 and 2021, the potential market increased by 5 352 tonnes of game, which is an increase of 43% while the net export increased by 90% (182 tonnes). The total volume of the game, and, thus, the potential market, is estimated at 17 794 tonnes of game in the Czech Republic in total. From the primary production, at the end of the period (2021), the selected ungulates pre-

sented in the previous points represent 92% of total venison harvest in the Czech Republic.

Comparison of the game purchase prices and consumer price index (*CPI*) of meat production. During the analysis of development of the purchase prices of cloven-hoofed game, it was found that the prices were stagnant for a long time. Table 6 shows the details.

For the purpose of comparing the dynamics of the consumer market with the market of primary production, the development of the game purchase prices was compared with the development of the meat *CPI* (consumer price index), when the available data of the period 2003 to 2021 were compared.

When adjusting the data in Table 6 and using the comparable available periods, it follows that although the meat consumer price index increased by 42.1%, no such a similar increase in the purchase prices, as shown in Table 7, was recorded. To compare the dynamics of the production prices of the assumed substitute, the development of the prices for common meat (pork, beef) was used. The increase in consumer prices of meat, which can be considered as a general substitute for game production, thus results in a fundamental gap between the development of the market consumer prices and purchase prices of game. Furthermore, the dynamics of the purchase prices of pork and beef for the given period were verified. From this verification, it is clear that producer prices of pork and beef do not have the same dynamics as consumer prices (their growth is lower), although the gap in the growth dynamics between the production prices of pork and beef and the dynamics of the consumer prices is significantly lower than for game.

Consumer market analysis. CAWI research revealed that the main source of game for the end

Table 4. Venison trade balance of the Czech Republic (CZSO 2021, 2022b)

Trade counterpart (tonnes)	2008			2021			2008–2021	
	export	import	balance	export	import	balance	balance change	(%)
Germany	1	98	−97	819	256	564	661	n/a
Poland	0	3	−3	0	295	−295	−292	11 378
Austria	41	28	13	125	–	125	112	863
Slovakia	37	2	35	46	45	2	−33	n/a
Subtotal	79	130	−51	991	595	396	448	n/a
Other	272	18	253	281	293	−12	−266	n/a
Grand total	351	149	202	1 272	888	384	182	90

n/a – not available

Table 5. Venison market estimate in the Czech Republic (in tonnes) (CZSO 2021, 2022b, c)

Trade balance market impact (tonnes)	2008	2021	Change 2008–2021
Germany	97	−564	−661
Poland	3	295	292
Austria	−13	−125	−112
Slovakia	−35	−2	33
Sub total	51	−396	−448
Other	−253	12	266
Grand total	−202	−384	−182
Primary production (tonnes)	2008	2021	Change 2008–2021
Selected ungulates	11 067	16 714	5 648
Other focus species*	1 577	1 463	−114
Total primary production	12 643	18 177	5 534
Total CZ venison market estimate	12 441	17 794	5 352

*hares (*Lepus europaeus*), ducks (*Anas* sp.), pheasants (*Phasianus colchicus*), sika deer (*Cervus nippon*)

Table 6. Primary purchase prices of the selected ungulates, dynamics (LDKČR 2021; GoodVenison 2022; MSVK 2022; OMSČB 2022); 1 EUR = 24.055 CZK

Species	Purchase prices (kg) in EUR		
	2003	2021	2022
Deer	1.66–2.91	1.04–1.87	1.25–2.08
Fallow Deer	1.66–2.08	0.83–1.25	1.04–2.00
Roe deer	3.33–4.16	1.45–3.33	1.45–3.74
Wild boar	1.25–1.66	0.62–1.25	0.62–1.45

Table 7. Meat *CPI* vs. venison purchase prices (in EUR per kg; 1 EUR = 24.055 CZK)

Item	2003	2021	Change 2003–2021 (%)	Gap to meat *CPI* (%)
CPI Czech Republic	100.0	150.2	50.2	–
Meat (*CPI*)	100.0	142.1	42.1	–
Beef without bones (price) PP*	6.13	6.54	6.6	35.5
Pork with bones (price) PP*	3.39	3.14	−7.4	49.5
Red deer (mid)	2.29	1.45	−36.4	78.5
Fallow deer (mid)	1.87	1.04	−44.4	86.5
Roe deer (mid)	3.74	2.39	−36.1	78.2
Wild boar (mid)	1.45	1.87	28.6	13.5

*Producer prices (kg) year average; *CPI* – consumer price index

customer is the local hunter. This represents 38.8% of the deliveries to the consumers (N = 472); see Table 8.

Regarding the consumer demand, the research further identified that the game most often prepared in households is wild boar (52%) and roe deer (20%). Only 9.9% of the respondents (N = 523) perceive the fact that the regulation of the game status and income from game are connected with forestry and its support. 41.9% of the respondents rather or completely disagree with the concept of game consumption as an activity that supports forest management (Figure 4).

In this case, a significant mismatch between the needs to support the main production function of the forest, which consists in the regulation of game, and at the same time, in the development of non-timber forest products (game) as an additional source of income, is evident. Furthermore, only 24% of the respondents (N = 523) fully agree with the statement that venison is a healthy product of organic quality. 16.1% of the respondents rather or completely disagree with this statement. In this case, the shift in public opinion is less significant from the state that allows game production to be presented as a premium product on the consumer market, forming either a substitute for the highest quality meat production, or a premium product *sui generis*.

Perception of venison and forestry. The research performed by STEMMARK Agency in 2018 showed that the public (73% of the respondents, N = 1 519) perceives the role of a shelter for animals as a very important role of the forest environment. This perception is contrary to the needs of effective forest production management.

As can be seen from Table 9, a significant and strong expectation of the public from the function of the forest is to provide a refuge for wildlife. We further

Table 8. Venison point of purchase for the final consumer (LDKČR 2021)

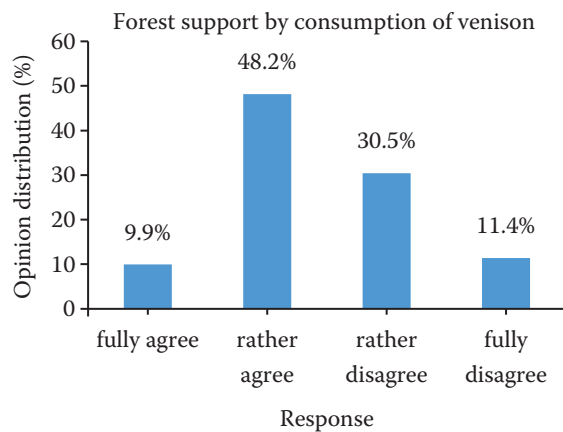| Venison source	N	Relative share (%)
Local hunter	183	38.8
Supermarket	110	23.3
Local store/butchery	103	21.8
Specialised e-shop	22	4.7
General e-shop	12	2.5
Other	42	8.9
Total	472	100

Figure 4. Public opinion on venison consumption as a part of forest support (LDKČR 2021)

put this fact into context with the needs of the forest management in the summary of the results.

Synthesis of the results. By comparing the development of the production of the selected species of ungulates, which represents 92%, by weight, of the primary production of game in the Czech Republic (2021), it is clear that there is a long-term permanent increase in the production, which records fluctuations in connection with high hunting of wild boar and a subsequent decrease in the subsequent year.

An increase in the production of the selected species of ungulates is also recorded in the surrounding countries, although the dynamics is not the same.

There is an obvious increase in the trade exchange of game production between the Czech Republic and other countries, where an increase in net exports by 90% was recorded in the period 2008–2021.

As stated in the results (also see Table 2), in some selected neighbouring countries (Slovakia, Poland), the dynamics of the game production is stronger than in the Czech Republic, which is reflected in the game trade balance with the given countries. On the contrary, countries with a slower growth rate of game production are net importers of game from the Czech Republic (Germany, Austria). The targeted development of venison production and maintenance of a comparable growth rate by the leaders of the neighbouring countries (especially Poland according to our research) can, thus, ensure a significant competitive position in the Central European venison market. This starting point will be further developed by a detailed comparative analysis taking into account the specifics of the individual neighbouring countries.

The size of the potential venison market in the Czech Republic can be estimated at 17 794 tonnes. The dynamics of the market shows growth, with an increase of 43% between 2008 and 2021. While

Table 9. Perception of the forest and forest management role by the public – adjusted; $N = 1\ 519$

Domain	Very important	Partially important	Indifferent	Mostly unimportant	Unimportant
			(%)		
Shelter for wild animals	73	21	6	0	0
Water resources protection	73	20	6	1	0
Rare plants protection	64	27	7	2	0
Forest fire protection	66	25	8	1	0
Protection from pests and diseases	63	27	8	1	0
Rainwater retention	69	21	8	1	0
Climate stabilisation	66	24	9	1	0
Increasing the area of the forest by new planting	60	29	9	1	1
Flood protection	62	27	9	1	0
Capture of dust and disposal of some pollutants in the air	62	26	10	1	0
Maintaining the diversity and traditional character of Czech forests	55	33	12	1	0
Prevents soil and landscape erosion	64	23	11	1	1

the primary production is increasing, the hunting capacity is decreasing, where the burden on the hunters calculated for the shooting of the selected ungulates increased by 47% between 2010 and 2021. The consumer market research showed that hunters are a significant part of the distribution chain, representing 39% of the game supplies to the final consumer. As expected from the statistical data, the consumer market survey showed that the most frequently prepared game in the household is wild boar (52%), followed by roe deer. The comparison of the growth of game purchase prices (primary production) is stagnant, while the CPI (consumer price index) of the meat increased by 42% in the monitored period 2003−2021. The perception of the role of the forest environment in relation to game by the public who perceives it as a shelter for game (73% of the respondents marked this point as very important) does not correspond to the need to develop this non-wood production function. At the same time, this perception does not correspond to the needs of regulating the game density to limit damage to forest stands.

DISCUSSION

As is clear from the research, the overall supply side is growing in the Czech Republic and in the surrounding countries, and regardless of the development or possible stagnation of the production in the Czech Republic, venison appears to be a product whose importance is growing in the EU-28 and especially in the surrounding countries. Further research would be appropriate to determine the critical factors of the demand side and the possibilities of its stimulation to increase the value of venison for consumers as a product.

A comparison of the development of the purchase prices of meat from farm animals (pork, beef) with the development of the purchase prices of venison deserves deeper attention. Comparison of these commodities, an estimation of the degree of correlation and then an analysis of the increased added value within the value chain from the primary production to the final consumer is necessary. The tasks of further research would be appropriate to concentrate on determining the optimal density of game with regard to sustainable forest management and the related increase in shooting.

At the same time, an evaluation of the possibilities of an increase in active hunters' capacity is neces-

sary. Support on the side of communication, promotion and incentives for hunters may be the solution.

Such measures are even more important with the increasing average age of the hunters, which was around 60 years old in 2013 and currently (2022) has risen to 65 years a further reduction can be assumed in the hunting capacity in the foreseeable future.

With regard to the consumer, the factors of specific taste, smell, preparation, concerns about possible risks associated with the consumption of game, as well as the ethical issues related to hunting as such must be taken into account. This follows from previous studies; a study of Proskina et al. (2013) in Latvia shows that consumers regard the quality and taste aspects of venison as the most important criteria for purchasing venison. Nevertheless, most of the consumers highlighted that price incentives to purchase quality venison at a lower price are important factors for them (such as avoiding retailers). This was confirmed by a previous study (Radder, Le Roux 2005), from which it follows that the choice of venison for consumption tends to be influenced by the specific taste and associated concerns that it will not correspond to any other types of red meat in a sensory way. Currently, according to the study by Leroy and Degreef (2015) on the relevant markets of Western Europe, the eating of meat does not always go unquestioned, leading to a moral crisis in specific consumer segments. The need for consumer education for venison consumption was raised, for example, in the study by Mesinger and Ocieczek (2021), which concludes that game meat in Poland is beginning to very slowly enter the next product life cycle and through the gradual promotion of meat products. Should the promotion continue at a sufficient level, consumer acceptance of this type of meat could increase.

With regard to the above, it is possible to recommend a marketing approach to consumers on two levels. In one line, build brand differentiation (e.g. CzechVenison) for exclusive quality with a certificate of origin with the subsequent processing. In this part of addressing consumers, it is advisable to use opinion makers, television/internet cookery programmes, etc. In the second line (game as a substitute for affordable meat), it is advisable to standardise the processing process, the labelling of different quality levels and offer folk recipes for preparation. Here, due to some specific preparation procedures, the offer should be extended to pre-processed semi-finished products.

Based on the results of the analysis, the possible potential in the final prices for the customer was quantified, which could not be realised annually at the level of primary production through the purchase prices of the game. It should be noted that common meat (pork, beef) also suffers from an insufficient rate of increase in the purchase price of producers, however, the primary production of game is significantly disadvantaged in this respect. Here, the increase in the consumer prices of meat was either reflected in other links of the game production value chain, or it was not realised on the market at all. It is, therefore, clear that the final consumer is ready and able to pay a significantly higher price for meat in the period under review than what results from the stagnation or decline in the prices of the primary production. Part of the solution is to expand and move the offer of the primary production to the processing phase, or to offer semi-finished products and, thus, move closer to the consumer in the distribution chain.

Subsequently, an existing gap (Table 10) in the estimated annual production was identified. For the volume of the estimated annual production, we used the latest published data from 2021, which we consider sufficient for the volume extrapolation, where the volume of the production is further reduced by 35% (qualified estimate) of the estimated difference in the volume of the primary production of unprocessed venison versus the product for the end customer. For the difference in the purchase price, the value assumed from the theoretical growth dynamics of the purchase prices was used, so that it follows the growth dynamics of the meat prices for the final consumer. The production volume of the last statistically known period was used to estimate the volume. This was recalculated based on the selected species of ungulates, which have a dominant mass representation in the total game production in the Czech Republic.

We thus estimate the unrealised income from the inability to reflect the development of the consumer price market for the main selected types of production in the order of hundreds of millions of CZK. Using our assumptions, it comes to 11.5 million EUR per year for the four selected species of ungulates which represent the core of the game production in the Czech Republic.

On the basis of the conducted research, it is so obvious that an important factor limiting the development of the venison market is the inability to realise an adequate income corresponding to the growth of the consumer prices for the primary production. This can be achieved if an additional value is added to the basic offer in the form of processing or the production of semi-finished products. The impact of the inability to realise an adequate income is also related to the low motivation of hunters, when the growing demand derived from the import of game indicates the market potential. However, this is partly lost due to the more dynamic development of the industry in the selected neighbouring countries (especially Poland), as it is evident from the increase in imports in the monitored period 2008–2021 by 356.6%.

In the context mentioned above, there is a public perception that one of the main tasks of forest management is to provide shelter in forests for forest animals, which is a challenge that should be solved by an adequate communication strategy from the forestry sector (Dembner, Anderson 1996; Riedl et al. 2019a). It is likely that the public does not associate game production, forest timber production and forest management with an adequate level of wildlife management and the extraction of sustainable maximum benefits from this NWFP (non-wood forest products) resource. The recommendation resulting from our research is to communicate to the public the need for the adequate regulation of game as a possible

Table 10. Meat *CPI* to venison purchase price gap

CPI	Unit	2003	2021	Change (%)	Gap to *CPI* (%)	Implied prices to *M-CPI*	Reality 2022	Price gap (EUR·kg⁻¹)
Meat (*CPI*)	–	100.0	142.1	42.1	–	–	–	–
Red deer		2.3	1.5	–36.4	78.5	2.6	1.7	–0.9
Fallow deer	midprice per kg	1.9	1.0	–44.4	86.5	1.9	1.5	–0.4
Roe deer		3.7	2.4	–36.1	78.2	4.3	2.6	–1.7
Wild boar		1.5	1.9	28.6	13.5	2.1	1.0	–1.1

CPI – Consumer price index; *M-CPI* – meat (*CPI*)

factor of damage to the forest as an ecosystem and as a source of the main wood production.

CONCLUSION

Based on the results and the above discussion, it is possible to answer the research questions.

What are the main (economic) limits limiting the development of the game market? The most significant economic limits to the development of the game market are the low game purchase prices, the inability to translate the rising costs (of the *CPI*) of hunters into primary production prices, and an underdeveloped processing and distribution chain, with hunters playing a significant role in the sale of unprocessed game with a low added value directly to the end consumer.

Although low purchase prices (primary production) can support the game market growth in general theory, the current situation is critical for the primary producers. At current primary production price levels, there is no economic incentive for the expansion of game meat production. For the primary producers, this situation represents the burden of necessary game regulation (to minimize forest and agricultural damage) with minimum or negative fiscal impact. Game meat is a close substitute for existing industrial meat products at higher levels of the value chain. This study focuses on the possibilities of bringing fair value down through the value chain to the primary producers.

Are there any ways to increase the forestry income from game production? A significant opportunity is the expansion of the range of primary production into products significantly closer to the consumer market (i.e. advanced processing of game at the level of primary producers, e.g. cutting plants, preparation of semi-finished products, etc.).

Another important factor is the creation of the consumer demand for venison as a *sui generis* product through active campaigns and through opinion makers, including TV coverage in cookery programmes. Due to the high costs of communication on the consumer market, it should be the collective advertising of all the interested entities in the forestry sector with possible state support.

It is therefore possible to increase the forestry industry income from venison through further development and an increase in the value for the customer, who, with an appropriate marketing strategy, can perceive this product as a premium organic food, through which it contributes to sustainable forest management. For a more detailed segmentation of the consumer market, which is a prerequisite for the effective use of marketing tools and targeting of communication, it will be necessary to analyse the demographic and geographic characteristics of the end consumers in more detail.

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