Animal Production Systems

MSc thesis

Pig welfare in Croatia:

A critical reflection on the EU pig welfare directives

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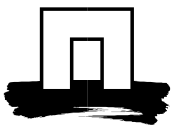

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Abstract

Of all Croatian pig farms, 75% are small, technologically outdated production units with less than ten sows and less than three hectares. Croatian pig production systems do not comply with European production standards and compliance with European production standards will require the modernisation of pig housing systems. It is expected that modernisation will involve the termination of small farms and enlargement and intensification of larger farms. The aim of this study was to investigate what consequence this modernisation process will have on the welfare of pigs (and humans) on Croatian farms. Seventeen Croatian pig farmers and six institutional stakeholders were interviewed to describe the different pig production systems and to investigate the implementation and enforcement process of the EU pig welfare directives. Documents on the implementation processes in Croatia and the EU were compared and the welfare of pigs was assessed on fifteen farms using resource-based and animal-based welfare indicators. Three production systems were distinguished: part-time family farms, full-time family farms and farm enterprises. The EU welfare directives were enforced through the veterinary service, agricultural administrative body and the agricultural extension service. Part-time family farms were least informed about the EU welfare directives. All farms showed different welfare problems. From the perspective of resources, pig welfare was better ensured on farm enterprises but from the perspective of animal-based welfare indicators no difference was found between the different pig production systems. The research findings did not show that modernisation of production systems will improve pig welfare. From a welfare point of view, neither the enlargement nor the termination of pig farms can be supported. Future studies are necessary to investigate other ways to address pig welfare problems at all types of production systems in Croatia.

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1. Introduction

1.1 Research problem

Croatia is preparing for accession into the European Union (EU). This process involves an alignment of the Croatian legislation with the common European rules and regulations. In this course, also the European pig welfare directives need to be implemented (EU, 2007). These were designed to ensure the welfare of pigs on farms, during transport and at slaughterhouses.

So far, Croatian pig production systems do not comply with European production standards (Progress Report, 2007). For example, the European Commission criticises that 75% of all Croatian pig farms are technologically outdated production systems with less than ten sows and less than three hectares (SAPARD, 2006). Croatian pig production systems are thus comparatively smaller than in old European member states. To illustrate, in old European member states 67% of all family farms own between 100 and 200 breeding sows (Antunovic *et al*. 2004). Croatian pig production systems are thus argued to be economically and ecologically unsustainable (Juric *et al*. 2003, Misir, 2003; Commission Decision, 2007). Also with regard to the EU pig welfare directives, the European Commission criticises that only limited progress has been made to ensure the welfare of pigs on farms in Croatia (Screening Report, 2007).

Consequently, the European Commission recommends modernising existing pig production systems (Commission Decision, 2007). This way, competitiveness, adequate waste management, food safety, hygiene and pig welfare standards shall be improved (SAPARD; 2006; Commission Decision, 2007).

It is expected that the recommended modernisation process will involve, on the one side, demolishing, rebuilding and intensifying large farms according to EU regulations (SAPARD, 2006; Antunovic *et al*. 2004a). On the other side, small farmers will be encouraged to terminate their farming practises and to sell their land in turn for receiving a pension (SAPARD, 2006; Antunovic *et al*. 2004a).

In old European member states the intensification of pig production has led to ethical concerns regarding the welfare of production animals (Veissier *et al*. 2008; Brambell, 1967). Reflecting on the current developments in Croatia, it is therefore interesting to ask: how will the described modernisation process affect the welfare of pigs (and humans) on Croatian farms?

The present study will look into pig welfare on farms in Croatia and reflect critically on the effect of the EU pig welfare directives on ensuring the welfare of pigs in confined spaces.

1.2. Literature review

The EU pig welfare directives recommend resources that are aimed at ensuring adequate living environments for pigs in confined spaces (EC Directive 1991; 2001). With regard to pig health, the EU has published different directives as for example Directive 2003/99 to control zoonoses (EC directive, 2003). The EU pig welfare directives follow Brambell's (1967) report which stipulates five freedoms to ensure the welfare of farmed animals (Veissier *et al*. 2008). These freedoms were summarised by the Farm Animal Welfare Council (2007) as follows:

Animals in confinement should be *free from hunger and thirst* which can be ensured through the provision of fresh water and species-specific diets. Care should also be taken that confined animals are *free from discomfort* by providing shelter, adequate environments and resting areas. Furthermore, animals should be *free from pain, injury or disease* and preventive measures, rapid diagnoses and treatments should be ensured. Animals should also be given opportunities to *express normal behaviour*. It is thus argued that they need enough space, company of their own kind and appropriate facilities. Finally, all confined animals should be *free from fear and distress* which can be achieved by good housing conditions, good treatment and avoidance of mental suffering.

Following this line of thought, the EU Scientific Committee on Animal Health and Animal Welfare (SCAHAW) gathers scientific recommendations to suggest resources required to provide minimum welfare standards for farmed animal species such as pigs (Blandfort *et al*. 2002; Moynagh, 2000).

Although all EU member states have to apply the same EU pig welfare directives, there are still differences in legislations amongst the different countries (Bock & van Leeuwen, 2005). For example, in South-Eastern European countries where associations between animal welfare and animal health often prevail, farm animal welfare is usually ensured according to the minimum standard recommended by the EU welfare directives (e.g. Bock & van Leeuwen, 2005; Nijland, 2005; Roe *et al*. 2003).

In North-West Europe, associations with animal welfare have gone beyond health concerns and focus primarily on associations between animal welfare and natural environments or animal welfare and the ability to express natural behaviours (Bock & van Huik, 2007). North-Western countries have thus established additional welfare schemes that go beyond the EU

welfare directives to ensure the animal's ability to express natural behaviour (Bock & van Huik, 2007; Veissier *et al*. 2008).

In Croatia, little is known about the perception and concepts of animal welfare. It is therefore interesting to address how perceptions of pig welfare are influencing the implementation process of the EU pig welfare directives and efforts to educate farmers about pig welfare. Additionally, few studies have been conducted to assess the welfare of pigs on farms in Croatia. Those studies relating to pig welfare mainly concern disease prevention- particularly relating to respiratory diseases- and production yields (e.g. Akos & Bilkei, 2004; Jemeršić *et al*. 2004; Mauch & Bilkei, 2004).

There are, however, several assessment methods to measure other farm animal welfare aspects than animal health. These methods are mostly focused on housing criteria that are supposed to influence the animals' welfare (Smulders *et al*. 2006). These criteria are, for instance, related to space allowance, feed availability and companionship (e.g. Verlade & Geers, 2007). Two well-known resource-based assessment tools are the Tiergerechtigkeitsindex (Sundrum, 1994) and the slightly amended Animal Needs Index (Bartussek, 1999).

Recently, scientific debates have occurred regarding the effectiveness of resource-based welfare assessments. In fact, it has been argued that assessing resources does not provide any information about the effect of these resources on confined animals and that welfare should be inferred through direct observations of animals (e.g. Dawkins, 2006; Kirkden & Pajor, 2006; Yeates & Main, 2008). Suggested animal-based welfare indicators refer to behaviour, physiology and production parameters (e.g. Dawkins, 1998).

Nevertheless, there seems to be a relationship between provided resources and the welfare state as measured directly on animals. Smulders *et al* (2006) thus argue that animal welfare needs to be addressed by both, resource-based and animal-based parameters.

To address pig welfare in Croatia, resource-based welfare indicators can be used to analyse the current compliance of pig production systems with the EU pig welfare directives. Animal-based welfare indicators can be used to discuss how modernisation will affect the welfare of pigs at pig production systems in Croatia.

Considering the modernisation of Croatian pig farms, it is also interesting to address how the modernisation process will affect the welfare of Croatian pig farmers. According to Brambell

(1967), the well-being of a farmer has great influence on his attitude towards the animals on the farm. In the light of implementing the EU pig welfare directives, the effect of modernisation on the welfare of Croatian pig farmers must therefore also be addressed.

1.3 Research aim

Based on the background information provided, the aim of this study was to investigate what consequences -in the light of modernising Croatian pig production systems- the implementation and enforcement of the EU welfare directives will have on the welfare of pigs (and humans) on farms in Croatia.

1.4 Research questions

The overall research question "how will the described modernisation process affect the welfare of pigs (and humans) on Croatian farms?" was addressed by six sub-questions. These questions were used to describe the different pig production systems in Croatia and to analyse the implementation process of the EU pig welfare directives into the legislation of Croatia. Furthermore, the questions addressed the attitude of stakeholders towards pig welfare and future perspectives of pig farmers. Also, the welfare of pigs was assessed at the pig production systems:

1. How are Croatian pig production systems characterised?
2. How are the EU pig welfare directives implemented and which stakeholders are involved in the implementation and enforcement process in Croatia?
3. How are the EU pig welfare directives communicated to the farmers at the different pig production systems?
4. How do institutional stakeholders perceive pig welfare and the future of the different production systems?
5. How do pig farmers perceive pig welfare, the EU pig welfare directives and the future of their farms?
6. Is there a difference between pig welfare at the different pig production systems when assessed on the basis of resources such as required by the EU and when assessed with animal-based welfare indicators?

1.5 Structure of thesis

In the following chapter, the research methodology will be outlined. In Chapter 3, the different pig production systems visited in Croatia will be described. In Chapter 4, the implementation process of the EU welfare directives into Croatian legislation will be outlined and compared with the implementation process of the pig welfare directives in old European member states. In Chapter 5, institutional stakeholders involved with regulating pig welfare will be outlined. Also, perceptions of pig welfare and future perspectives of pig farms held by institutional stakeholders will be outlined in order to understand efforts- or a lack of such- to educate farmers about pig welfare issues. On the same lines, also pig welfare perceptions of farmers and their future perspectives will be presented in order to understand motivations to ensure pig welfare and perceptions of the EU pig welfare directives. In Chapter 6, resource-based and animal-based welfare assessment results will be presented to outline differences in pig welfare problems between the different pig production systems. Finally, in Chapter 7 the research findings will be discussed in order to address consequences of the modernisation process for the welfare of pigs (and humans) on farms in Croatia.

2. Methods & Material

In the spring of 2008, a six-week field trip was taken to Croatia in order to describe the different pig production systems, to understand efforts to implement and enforce the EU pig welfare directives and to outline the state of pig welfare at the different production systems *in situ*.

2.1 Study area and participants

Seventeen pig farmers and six institutional stakeholders were visited in the counties of Koprivničko-križevačka županija, Međimurska županija, Osječko-baranjska županija, Varaždinska županija, Zagrebačka županija.

As indicated in Figure 1, all counties are located in the peri-Pannonian and Pannonian region. These regions have the highest agricultural activity in Croatia. Slavonia in the eastern Pannonian area shows the best conditions for intensive pig production but it still has to deal with effects of war such as land mines, unresolved land ownership issues and abandoned lands (SAPARD, 2006; pers. obs.).

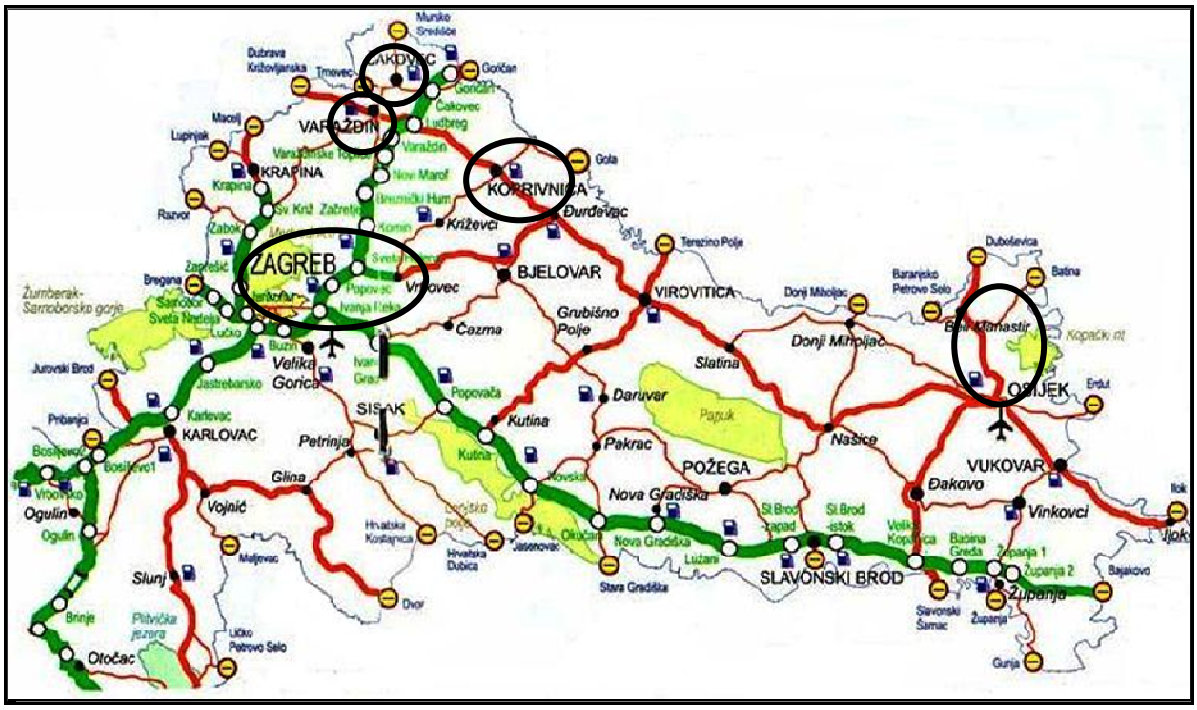

Figure 1 Map of North/East Croatia (Retrieved from www.find-croatia.com)

The visited pig farms were categorised into business entities and agricultural households, according to the definition by the Central Bureau of Statistics (CBS, 2003):

Agricultural household: "A household with agricultural production is any household that engages in agricultural production, which has a single management, uses jointly the means of production (machines, facilities and land) and the work of the household members" (CBS, 2003). It is further stated that this definition applies regardless of production for personal use or production for sale.

Business entities: "Business entities and parts of business entities which engage in agricultural production are legal and physical persons registered to perform agricultural activities, or which engage in agricultural production but are registered in another activity" (CBS, 2003).

Institutional stakeholders included employees in the Croatian ministry of agriculture, fisheries and rural development, agricultural administrative body, veterinary service, agricultural extension service, universities and non-governmental organisations. They were visited in the cities of Zagreb, Čakovec and Osijek.

Farmers were chosen using convenience sampling, i.e. researchers and institutional stakeholders were asked to arrange farm visits. Institutional stakeholders were approached using snowball sampling. During snowball sampling, key informants were questioned about other relevant stakeholders who were willing to participate in the study (Russell, 1995).

2.2 Research techniques and material

A triangulated research method was used: 1) documents were scanned for information regarding legal control of pig welfare on farms in Croatia and in the European Union, 2) semi-structured interviews were used to obtain an overview of the different pig production systems, perceptions of pig welfare and welfare legislations and 3) the welfare of pigs on the different production systems was assessed using resource-based and animal-based welfare indicators. In the following, the different research techniques will be explained in more detail.

2.2.1 Document analysis

Official documents on animal welfare legislation were retrieved from governmental websites, collected from representatives of the Croatian government, the Ministry of Agriculture, Fisheries and Rural Development and a non-governmental organisation. Information on implementation processes of pig welfare related regulations were summarised and compared in chronological order.

2.2.2 Semi-structured interviews

Farmers and institutional stakeholders were questioned using semi-structured interviews. Semi-structured interviews were chosen to produce comparable answers (Southwold, 2002). In addition to the questions in the interview guides for institutional stakeholders (see Appendix I) and farmers (see Appendix II), interviewees were further probed with questions such as "why?" and "what do you mean by this?" With this technique, it was possible to obtain a more thorough understanding of the unexplored topic "pig welfare in Croatia".

The interviews were conducted with the help of translators and recorded digitally with permission of the interviewed persons. For analysis, interviews were typed and quantitative information was entered into Excel, sorted by pig production system and presented in tables. Close-ended responses and welfare associations were coded and graphically presented (Poate & Daplyn, 1993). Open-ended questions were analysed using content analysis. During content analysis, answers with similar meanings are coded and placed into categories according to their logically inferred meaning (Silverman, 2001).

2.2.3 Pig welfare assessment

The welfare of pigs on farms was assessed using resource-based and animal-based indicators, whereby the two types of indicators were differentiated according to the following definitions:

Resource-based welfare indicators referred to the animals' pen, climate, conspecifics and stockpersons (Bracke, 2007a). The definition was applied in such manner that resource-based indicators were observed in the pigs' close environment or referred to interventions by a person and did not involve a direct observation of the pig.

Animal-based welfare indicators referred to behaviour, reproductive criteria, physiological and pathological measures (Bracke, 2007a). The definition was applied in such manner that animal-based indicators were directly observed on the pig and did not require a consideration of the pigs' environment.

Indicators were chosen from the book 'On-farm monitoring of pig welfare' (Verlade & Geers, 2007) in which the reliability, validity and repeatability of different resource-based and animal-based welfare indicators are discussed. Furthermore, the feasibility of the indicators was assessed using the following questions:

- Is the indicator quick to use?
- Is the indicator independent of the pig production system visited?
- Can the indicator be used to compare the different pig production systems?
- Is the indicator easy to observe?
- Is the indicator applicable to sows and fattening pigs alike?

Based on this evaluation, it was decided to omit health-related welfare indicators as assessment tools because the observation would require veterinary skills which were not available for this study. The chosen resource-based indicators are presented in Table 1 and the chosen animal-based indicators are presented in Table 2. The chosen resource-based indicators were logically categorised according to the five freedoms as discussed by Brambell (1965, see Chapter 1).

The welfare assessment was carried out using a welfare check sheet (Appendix III) and digital pictures were taken of each sampled pig pen. Before commencing the field work, the chosen indicators were discussed with a German farmer and a trial assessment was carried out in the first pig barn visited in Croatia.

At each visited pig farm in Croatia, at least one but a maximum of three pens were sampled. These pens were selected according to convenience, i.e. pens in front of the barn were prioritised because reaching the pens did not require a crossing of the barn which would have alerted the pigs and obstructed their behaviour.

Table 1: Resource-based welfare assessment indicators

Freedom	EU equivalent Indicator	Indicator definition	Measuring Technique	Unit of Measurement
Freedom from hunger and thirst	Water supply	The quantity and way of providing water to one or more pigs in a pen.*	The farmer was asked for the type of watering technique. It was distinguished between *ad libitum* or watering times.*	Counts
	Feed supply	The quantity and composition of feed delivered to any type of pen.*	The farmer was asked about feeding mode and feed composition.*	Counts
	Individual feeding space	A feeding space for an individual animal separated from feeding spaces of another animal.*	The pen was scanned for the presence or absence of individual feeding spaces.*	Counts
Freedom from discomfort	Floor type	Refers to the type of floor construction (Hörning, 2007c).	The type of floor was noted as concrete, slatted or both present.*	Counts
Freedom from pain an injury	Castration	Surgical removal of the piglets' testicles.*	The farmer was asked if and when castration was performed.*	Closed-ended question
	Tail docking	Tail docking refers to the surgical amputation of the whole or parts of the tail (EC Directive 2001)	The farmer was asked if and when tail docking was performed.*	Closed-ended question
	Teeth clipping	Teeth clipping refers to a reduction of the pigs' corner teeth using grinding or clipping (EC Directive 2001)	The farmer was asked if and when teeth clipping was performed.*	Closed-ended question
Freedom to express natural behaviour	Manipulative material	Organic substrate that animals can manipulate (Hörning, 2007b)	Presence and type of bedding was denoted.*	Counts
	Individual Space	Space allowance per pig (Hörning, 2007a)	Size of pen and number of pigs counted.*	Square metres
	Pen Type	Pen is an enclosure in which one or more animals are kept.*	Pens were matched to initially defined types: Group pen, single stall or farrowing unit.*	Counts
	Toys	A manipulative device that provides recreation for the pig and does not consist of bedding material (Bracke, 2007b).	Presence and type of recreational device was noted.*	Counts
Freedom from fear and distress	Weaning age	The time at which a piglet is taken away from its mother. *	The farmer was asked when piglets were weaned.*	Closed-ended question

* defined by author

Table 2 Animal-based welfare assessment indicators

Indicator	Indicator definition	Observation Technique	Unit of Measurement
Cleanliness	The proportion of animal that is covered in urine, faeces or dirt (Courboulay, 2007a).	A group scan in each pen was performed to note the number of pig which showed any signs of soiling. For illustration, pictures were taken.*	Counts
Skin Lesions	Lesions are wounds on the rump, shoulder, back, head, legs or ears (Velarde, 2007).	A group scan in each pen was performed and the number of animals with lesions was counted. Additional pictures were taken.*	Counts
Tail bites	Tail wounds caused by biting the tails of pen mates (Bracke, 2007b).	A group scan in each pen was performed to count the number of pigs with bitten tails. In addition, pictures of bitten tails were taken in each sampled pen. *	Counts
Ear bites	Ear wounds caused by the biting of pen mates (Bracke, 2007b)	A group scan in each pen was performed to count the number of pigs with bitten ears. In addition, pictures of bitten ears were taken in each sampled pen.*	Counts
Fear of humans	Fear of humans can be expressed as an active avoiding of the human hand or passivity, i.e. not approaching (Spoolder, 2007).	*Hands in stall*: The farmer was asked to place his hand in the stall and time was counted until one pig approached (on the basis of Spoolder, 2007). If the farmer was not available, the researcher put his hand in the stall.*	Time (Seconds)
Lying behaviour	The pig is lying on the side of his rump or belly.*	It was noted whether animals were laying cigar like (normal), huddled (cold), apart (too warm) (Geers, 2007).	Counts

* defined by author

The obtained data were coded and entered into Excel. Separate spread sheets were created for animal- and resource-based indicators to produce graphical presentations. Subsequently, the data was entered into SPSS 14.0 to perform descriptive and inferential test statistics (see section 2.3).

The animal-based and resource-based welfare assessment results were analysed to determine differences in pig welfare between the different pig production systems. To deal with on-farm variations, results from separate pens at a farm were averaged for each indicator.

Resource-based welfare assessment results were analysed along Brambell's (1967) five freedoms. Resources provided at the different production systems were checked for compliance and divergence from the EU recommended resources. Each indicator at each pig production systems that, on average, conformed to the EU recommended resources received a (+) to determine an overall resource-based welfare score. Additionally, animal-based welfare assessment results were compared between the different production systems. Finally, the resource-based and animal-based welfare assessment scores were contrasted to find a possible relationship between resource-based and animal-based welfare assessment results.

2.3 Statistical analysis

Resource- and animal-based welfare indicators were statistically analysed using SPSS 14.0. To analyse differences in counts between different production systems, non-parametric tests of associations were chosen (denoted as χ^2) (Hawkins, 2006). Differences in space allowance for different pig types at different production systems were analysed using non-parametric Kruskall-Wallis tests of differences (denoted as H) (Hawkins, 2006). Differences in space allowance between two types of production systems were analysed using the non-parametric Mann-Whitney U test (denoted as U) (Hawkins, 2006).

To test possible relationships between resource-based and animal-based welfare assessment results, linear regression analyses (denoted as F) were used for parametric results. The following formula was used for analysis:

$$AWI = \mu + \beta \cdot RWI;$$

Whereby AWI= animal based welfare indicator score; β= the slope of the line; RWI= resource-based welfare indicator score. For non-parametric results Spearman's rank correlation was used (denoted as r^2). Averages are presented with standard deviations (s.d.).

3. Pig production systems in Croatia

As outlined in Chapter 2.1, Croatian pig production systems were officially distinguished into agricultural households and business entities. Some of the visited agricultural households were enlarging and engaging in pig production for commercial purposes (e.g. Antunovic *et al*. 2004a). Arguably, these agricultural households were also business entities, leading to confusion between the two terms. To circumvent confusion, the visited pig production systems were renamed as follows: traditional agricultural households were referred to as part-time family farms; business-orientated agricultural households were referred to as full-time family farms and business entities were referred to as farm enterprises. In the following, the organisation and the sampled pig pens for the welfare assessment at the three different production systems will be described. Subsequently, production performances of the different pig production systems will be compared.

3.1 Part-time family farms

A traditional agricultural household that engaged in pig production primarily for own consumption was referred to as a part-time family farm according to the following definition:

The proprietor was a family which could not earn their livelihood exclusively through farming but depended on off-farm income sources. The main aim for keeping pigs was own consumption while pigs were occasionally sold on local and national markets. Next to pigs, these farms had diversified production activities and farmed other animals as well. They farmed independently and were not part of a cooperative (defined by author). Figure 2[1] represents a typical part-time family farm.

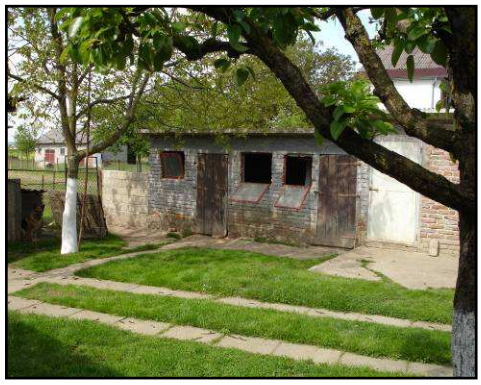

Figure 2 Part-time family farm

3.1.1 Organisation of part-time family farms

In total, seven part-time family farms were visited. Five of the seven part-time family farmers considered pig keeping a “family tradition”. Pigs were usually taken care of by wives or grandparents while the men engaged in off-farm work. Main off-farm income sources included factory work and military pensions.

[1] All photographs are courtesy of the author

Six out of seven part-time family farmers owned small areas of land, ranging from one to three hectares. Pig feed was produced on farm but supplemented with purchased feed stuff. One part-time family farmer stated to own 16 hectares of land. In this case, the family owned a business-orientated crop farm but family members also engaged in off-farm work. It was stated that the family was not able to maintain their livelihood through farming practises and pigs were kept for own consumption, therefore conforming to the definition of part-time family farmers.

At part-time family farms, pigs were obtained from neighbours or relatives and primarily kept for own consumption. Interestingly, however, as Table 3 shows, 71 % of all part-time family farmers also traded their pigs. In these cases, farmers often stated to sell their piglets to middlemen and regarded piglet trade an important asset to their off-farm income. All trading farmers agreed to depend on this extra income to sustain their livelihoods.

Table 3 Characteristics of part-time family farms

	Part-time family farms N =7
Farm size (ha)	4.3 (s.d. 5.22)
History of pig farming (years)	8-30
Labour units (FTE)	3.0 (s.d 2.23)
Off-farm income (%)	100
Home consumption (%)	100
Sources for pigs (%):	
Own farm:	57
Neighbour:	29
Family:	14
Farms trading pigs (%)	71
Feed origin (%)	
On-farm:	14
On-farm and purchased:	71
Unknown:	15

Furthermore, none of the visited part-time family farms was specialised in pig production and six part-time farmers owned poultry, rabbits or cows as well. As Table 4 shows, most farms housed between one and four pigs, whereby the number of sows was higher than the number of fattening pigs. An exception was again found at the business-oriented crop farm. Here, the farmer fattened seven pigs in order to supply his helpers during the harvest season. Three farms owned both, fattening pigs and breeding sows but two visited farms only housed fattening pigs and two farms only housed breeding sows.

Table 4 Pig production at part-time family farms

	Part-time family farms (N=7)
Number of pigs on farm (Range) (excluding piglets)	1-8
Number of fattening pigs on farm	1.6 (s.d. 1.52)
Number of breeding sows on farm	2.0 (s.d 1.73)

On the visited part-time family farms, 17 pens were sampled for the welfare assessment. Eight sampled pens housed fattening pigs, five pens housed non-suckling sows, one pen housed a farrowing sow and three pens housed weaned piglets.

3.2 Full-time family farms

An agricultural household that engaged in business-orientated pig production was referred to as a full-time family farm, according to the following definition:

The proprietor was a family and could earn their livelihood exclusively through farming. The main production aim was to sell the pigs on local, national and international markets while keeping a small amount of pigs for own consumption. Pig production was often but not exclusively specialised. All farmers were independent and not part of a cooperative (defined by author).

Figure 3 New and old full-time family farm

As the picture on the left hand side in Figure 3 shows, at one occasion the visited family farm had already undergone the modernisation process and constructed a new farm site for fattening pigs according to EU regulations.

3.2.1 Organisation of full-time family farms

In total, six full-time family farms were visited. In contrast to part-time family farms, only two farmers argued to keep pigs out of tradition. All other farmers argued to have started pig keeping out of economical interests and more men engaged in the care of pigs than on part-time family farms. Five out of six full-time family farmers owned between 10 and 117

hectares of land and, as Table 5 shows, five of six farmers partially produced their own pig feed.

Table 5 Characteristics of full-time family farms

	Full-time family farms N =6
Farm size (ha)	42.2 (s.d. 44.29)
Labour units (FTE)	3.0 (s.d. 0.84)
History of pig farming (years)	10 – 30
Off-farm income (%)	33
Home consumption (%)	83
Sources for pigs (%)	
Own production:	83
Piglet producer:	17
Farms trading pigs (%)	100
Feed origin (%)	
On-farm and purchased:	83
Unknown:	17

All farmers generated their main income through pig trading and only two farmers stated to have an additional off-farm income source. These farmers owned the smallest areas of farm land, i.e. six and ten hectares, respectively. Despite the economic focus, five out of six farmers produced pigs for own consumption as well.

At five out of six full-time family farms, pig supply was ensured through own production while one farmer purchased his pigs from a piglet supplier. In turn, pigs were sold to slaughterhouses, fattening farms and middlemen.

In contrast to part-time family farms, pig production at full-time family farms was more specialised. Three full-time family farms specialised in piglet production and one farm specialised in fattening pig production. Only two farms engaged in piglet production and fattening pig production. Furthermore, only three farmers kept other animal species- namely hens and water birds- besides pigs.

As Table 6 shows, the numbers of sows varied greatly, i.e. from 11 to 90 whereas both fattening pig producers owned between 400 and 500 fattening pigs.

Table 6 Pig production at full-time family farms

	Full-time family farms (N=6)
Number of pigs on farm (Range) (excluding piglets)	12-590
Number of fattening pigs on farm	450.0 (s.d. 70.71)
Number of breeding sows on farm	43.2 (s.d. 32.07)

On the visited full-time family farms, 25 pens were sampled for the welfare assessment. Ten sampled pens housed fattening pigs, five pens housed non-suckling sows, four pens housed farrowing sows, five pens housed weaners and one pen housed a boar. The boar was the only one sampled; he was excluded from the analyses as there were no other boars to compare the obtained welfare scores.

3.3 Farm enterprises

Since full-time family farms also acted as business entities, the institutional distinction between business entities and agricultural households (e.g. CBS, 2003) was confusing. To circumvent the confusion, business entities were referred to as farm enterprises according to the following definition:

One or a collection of different specialised production site(s) that produced pigs for one pork company. Pork was sold on national and international markets. All activities carried out on production sites were decided by the headquarters of the company. Individually contracted farmers formed cooperation with the enterprises (defined by author). Figure 4 represents a company-owned pig production site.

Figure 4 Farm enterprise

3.3.1 Organisation of farm enterprises

In total, four production sites of three different farm enterprises were visited. Two sites were company-owned production units as shown in Figure 4. Two further production sites were farms of contracted family farmers.

The visited farm enterprises were founded 10 to 15 years ago. Farm enterprises were managed by agronomists. On company-owned production sites, pigs were taken care of by trained workers and veterinary assistants and on contracted farms the farming family took care of the pigs. Workers employed to take care of the pigs at company-owned production sites had no additional income source but, as Table 7 shows, contracted family farmers stated additional income sources such as crop production and off-farm work.

Table 7 Characteristics of visited farm enterprises

	Farm enterprises (N=4)
Labour units (FTE)	7.0 (s.d. 5.48)
History of pig farming (Years)	10-15
Off-farm income (%)	50
Home consumption (%)	0
Source for pigs (%)	
Own production:	100
Farms trading pigs (%)	100
Feed origin (%)	
On farm and purchased:	50
Purchased:	25
Unknown:	25

Farm enterprises owned large areas of lands such as 20,000 hectares which were often partly rented and partly owned. Employees managing the arable lands were not engaged in the care for the pigs. All production sites were supplied with feed stuff by the farm enterprises. Feed was mostly produced at the farm enterprises and only additives were purchased. Pig supply was ensured through company-owned nucleus farms and fatteners were brought to company-owned slaughterhouses.

Farm enterprises owned separate production sites for breeding sows, piglets and fattening pigs. Two of the visited production sites were specialised in piglet production and two visited production sites were specialised in fattening pig production. As Table 8 shows, the number of pigs varied between contracted farmers and company-owned production sites. For example, the visited contracted farmer housed 350 fattening pigs while the company-owned production site housed 12,000 fattening pigs. Similarly, one contracted farmer owned 100 breeding sows while the company-owned production unit housed 1,350 breeding sows. In total, however, farm enterprises often produce up to 150,000 pigs per year (Caldier, 2007).

Table 8 Pig production at farm enterprises

	Farm enterprises (N=4)
Number of pigs on farm (Range) (excluding piglets)	100 - 12000
Number of fattening pigs on farm (#)	350 and 12,000
Number of breeding sows on farm (#)	100 and 1,350

Out of the four described production sites only the pigs at one company-owned piglet production unit and one contracted family farm for fattening pig production could be visited.

At the company-owned piglet production unit four pens were sampled and at contracted family farm for fattening pig production unit three pens were sampled.

3.4 Comparison of production and economic parameters

Across all production systems, the same high performing pig breeds were farmed. Despite three part-time family farmers who lacked knowledge about the breed of their pigs, most farmers stated to own hybrids, involving the following breeds (in descending order of frequency): German Landrace, Swedish Landrace, Pietran, Duroc, Yorkshire, Large White and Edelschwein.

Accordingly, Table 9 shows that litter sizes were similar across all production systems. Interestingly to note is, however, the high standard deviation at family farms. This variation could have occurred because some farmers may have referred to surviving piglets whilst others referred to the number of born piglets when stating litter sizes.

Table 9 Comparison of piglet production parameters

	Part-time family farms (n=5)	**Full-time family farms (n=5)**	**Farm enterprises (n=2)**
Litter size	11.3 (s.d. 4.21)	12.1 (s.d. 7.51)	12.5 (s.d. 1.40)
Litter/year	2.4 (s.d. 0.48)	2.0(s.d. 0.00)	2.0 (s.d. 0.00)

At full-time family farms and at farm enterprises, sows produced two litters per year but part-time family farmers produced more, between two and three litters per sow and year.

As Table 10 shows, fattening periods were longest at part-time family farms. Slaughter weights at part-time family farms were correspondingly higher than on full-time family farms and farm enterprises. A possible explanation for this difference can be derived from the purpose of the pigs. At part-time family farms, pig meat was often processed into dry cured ham which required a high fat content and correspondingly higher slaughter weights.

Table 10 Length of fattening periods (weeks) and slaughter weights (Kg/Live weight)

	Part-time family farms	**Full-time family farms**	**Farm enterprises**
Length of fattening period	39.2 (s.d. 13.66) (n=5)	13.0 (s.d. 2.65) (n=3)	12.0 (s.d. 0.00) (n=2)
Slaughter weight (Range)	100.0-200.0 (n=5)	100.0-120.0 (n=4)	110.0 (n=2)

Prices for piglets appeared stable across the different production systems. As Table 11 shows, prices for fattening pigs were considerably lower at farm enterprises than on part-time and

full-time family farms. Variations may be explained due to inadequate organisation of the pork market which causes pork prices to fluctuate considerably (Franić & Grcić, 2001).

Table 11 Market prices (Kuna[(1)]/Kg/Live weight) for pigs

	Part-time family farms	Full-time family farms	Farm enterprises
Average price for piglet	14.00 (n=2)	12.75 (n=4)	14.00 (n=1)
Average price for fattener	10.50 (n=4)	13.75 (n=2)	7.50 (n=1)
Average price for sow	5.50 (n=2)	?	?

[(1)] 1 Kuna ~ 0.34 Euro

3.4 Summary

In sum, pig production systems in Croatia were distinguished into part-time family farms, full-time family farms and farm enterprises. Part-time family farms were described as agricultural households that engaged in non-specialised pig production primarily for own consumption, obtained an off-farm income and owned small numbers of pigs and areas of land. Full-time family farms were specialising, business-oriented agricultural households and farmers obtained their income through pig trade, owning larger numbers of pigs and land than part-time family farmers. Farm enterprises were described as business companies that either owned large, specialised production units or contracted specialised family farmers. Despite the different organisations of the pig production systems, all farms traded pigs on the pork market and generated some form of income through pig production.

4. Implementing EU pig welfare directives into legislation

To investigate the implementation process of the EU welfare directives into the national legislation of Croatia documents were analysed. Additionally, differences between the implementation process of the EU pig welfare directives into Croatia's national legislation and into the common European rules and regulations were compared.

The process of establishing pig welfare legislation in the European Union appeared to differ considerably from the implementation of animal welfare into the legislation of Croatia. In old EU member states, animal welfare directives developed as a "step-by-step process", out of consumer concern about the steady industrialisation of livestock production systems that started in the 1950s (Brambell, 1967). Upon Brambell's (1967) publication, the EU adopted the convention for protection of animals during transport (1968), slaughter (1976) and on farms (1976). As the time line in Figure 5 illustrates the latest directive 2001/93/EC to ensure pig welfare on intensive farms in the European Union developed as a result of a 31 year long process of integrating animal welfare into the set of common European rules and regulations.

Regarding the development of pig welfare legislation in Croatia, it appeared to be a "time-lapsed process". In fact, one may even argue that it developed faster than public concerns and support for farm animal welfare regulations. One interviewee explained: "*Many people cannot survive from month to month on the basis of their salaries. This is the main reason why consumers do not take animal welfare into their consideration.*" Another interviewee stated: *"(...). If people in Germany or in Sweden are not ready to pay, in Croatia they just don't care. I understand that we must care about animals, really, but actually it is not a big question."*

The difference in the development of legislation between the EU and Croatia might be explained by the country's recent history. During Croatia's membership in the Socialist Federal Republic of Yugoslavia, legislations concerning farmed animals did not exist (pers. com.), possibly because production was state-owned and posed therefore no need to control. After Croatia's independence 17 years ago, the country endured five years of war. Only in 1999, the first animal welfare act was implemented into law (AFC, 2008). Due to pressure from the EU the EU pig welfare directives will be wholly implemented into Croatian legislation by the end of 2008, nine years after the first welfare act was published (pers.com.).

Welfare regulation for pigs on farms in the EU	Year	Welfare regulations for pigs on farms in Croatia
- The EU publishes a convention for the protection of animals kept for farming purposes (Roe *et al*. 2003). In addition to this convention, also welfare at transport (1968) and slaughter (1976) are addressed with a convention. Throughout the next years, these conventions are gradually refined to elaborate species specific regulations (Veissier *et al*, 2008).	**1976**	- Croatia is part of the Socialist Federal Republic of Yugoslavia. The Yugoslavian legislation does not include regulations for the protection of farmed animals (pers. com.)
- The EU publishes directive 91/630 EEC to regulate the housing of pigs on farms. It lays down standards for housing, environment and management of the pigs at intensive production sites.	**1991**	- The Republic of Croatia declares independence from the Socialist Federal Republic of Yugoslavia, leading to a five year long war of independence, until 1995.
	1999	- The Croatian government publishes its first Animal Protection Act (pers. Comm. Animal Welfare Department). The legislation contains official gazettes for ecological animal keeping but no specific guidelines on how to keep intensively housed pigs (Rupić *et al*. 2002).
- Amendment of EC directive 91/630/EEC is published, laying down more detailed standards on how to keep pigs on intensively producing farms (EC directive 2001/93/EC)	**2001**	
	2004	- Animal Friends of Croatia (AFC) elaborate an animal welfare bill to present to the Croatian Government (AFC,2008)
	2005	- Croatia is given EU candidate status
	2006	- The Croatian parliament accepts the animal welfare bill of 2004 (AFC, 2008); the Croatian government starts to transpose EU regulations, also for agriculture and veterinary services (Croatian government, 2006); An Animal Welfare Department is founded in the veterinary directorate (pers. com.)
	2008	- Ongoing transposition of EU welfare directives into national legislation (pers. com.); Guidelines about good farming practises for each animal species are written (pers. com).

Figure 5 Process of implementing pig welfare regulations into legislation in the EU and Croatia

5. Education of farmers about EU pig welfare directives

Institutional stakeholders involved in educating farmers about the EU pig welfare directives were outlined. On this line, perceptions of institutional stakeholders of pig welfare as well as future perspectives of the different pig production systems were analysed to understand present education efforts. Subsequently, pig welfare perceptions and future perspectives of farmers regarding their farms were investigated in order to understand their motivation to ensure pig welfare on their farms. Finally, opinions of pig farmers regarding the EU pig welfare directives were addressed.

5.1 Institutions educating farmers about the EU pig welfare directives

The EU pig welfare directives need to be enforced on Croatian farms by 2013 (pers. com). A number of institutional stakeholders as outlined in Figure 6 are involved in educating farmers about the upcoming enforcement of the EU welfare directives.

The Croatian **ministry of agriculture, fisheries and rural development** is responsible for aligning the Croatian policies with the policies of the **European Union**. In this process, the EU welfare directives are transposed into national legislation by the **department of animal welfare** which has been established as part of the **veterinary directorate** in 2004 (pers. com.). The transposition and realisation of the regulations is monitored by the European Union (e.g. Screening Report 2007; Progress Report 2007).

The establishment of animal welfare legislation is also influenced by interest groups. For instance, a **non-governmental organisation for the protection of animals**, founded seven years ago (AFC, 2008), aims to promote vegetarianism and animal rights by raising consumer awareness. The organisation also collaborates with the ministry to design animal protection laws (AFC, 2008; pers. com.). Their work is supported by international animal protection organisations (pers. com.).

Furthermore, the ministry approaches **universities** to conduct research on animal welfare issues. For example, a department for animal husbandry published brochures with husbandry guidelines for specific animal species with the aim to increase cooperation between science and producers (pers. com.). Also at the veterinary faculty, research is conducted concerning ethology, welfare and hygiene (pers. com.).

To realise the directives on farm, the ministry deploys three communication channels: 1) the veterinary service, 2) the agricultural administration and 3) the agricultural extension service.

1. The **department for animal welfare** designs and disseminates uniform check lists for on-farm welfare monitoring to veterinary inspectors via regional veterinary offices (pers. com.; MPS, 2008). Veterinary officers are organised in 21 **county veterinary offices.** They coordinated the work of veterinary **practitioners** and **veterinary inspectors** which monitored business operators and controlled the realization of legislation on farms (pers. com.).

2. The **Croatian Livestock Centre** is an administrative institution. Employees monitor meat and carcass quality, provide subsidies to farmers, write books of good farming practises, advise farmers who want to modernise their farms, introduce ear marks and create herd books for all livestock species. In this process, the institute aims to establish a database with all Croatian pig farmers through **field officers** which register individual pig farms around Croatia (pers. com.).

3. Finally, the ministry communicates with farmers via the **agricultural extension service**. **Extension officers** organise, for example, agricultural fairs and seminars for farmers but also visit farms to give advice and monitor production (pers. com.).

Despite these potential communication channels, the different pig production systems as defined in Chapter 3 did not appear to be addressed equally. As illustrated in Figure 6, most communication channels from the ministry were directed towards **full-time family farms**. Education of full-time farmers was further supported by **international aid programmes** such as TAIEX, USID and EXTAM (pers. com.).

Farm enterprises only communicated with the veterinary service while collaboration with agricultural administration seemed sparse. However, one farm enterprise had advisors from **European pig production companies** which also provided guidelines to ensure animal welfare (pers. com.).

Part-time family farms were linked to the least communication channels. Similar to farm enterprises, only veterinarians communicated well with part-time family farmers while communication with agricultural administration was sketchy and communication with the extension service non-existent. Unlike full-time family farms and farm enterprises, part-time family farms did not receive international aid.

Communication between different production systems was also sparse. Besides some contracts between farm enterprises and full-time family farms, no interaction between the

different farms was recorded. Farmers were, however, not specifically questioned about this topic and future research should address horizontal communication at farm level.

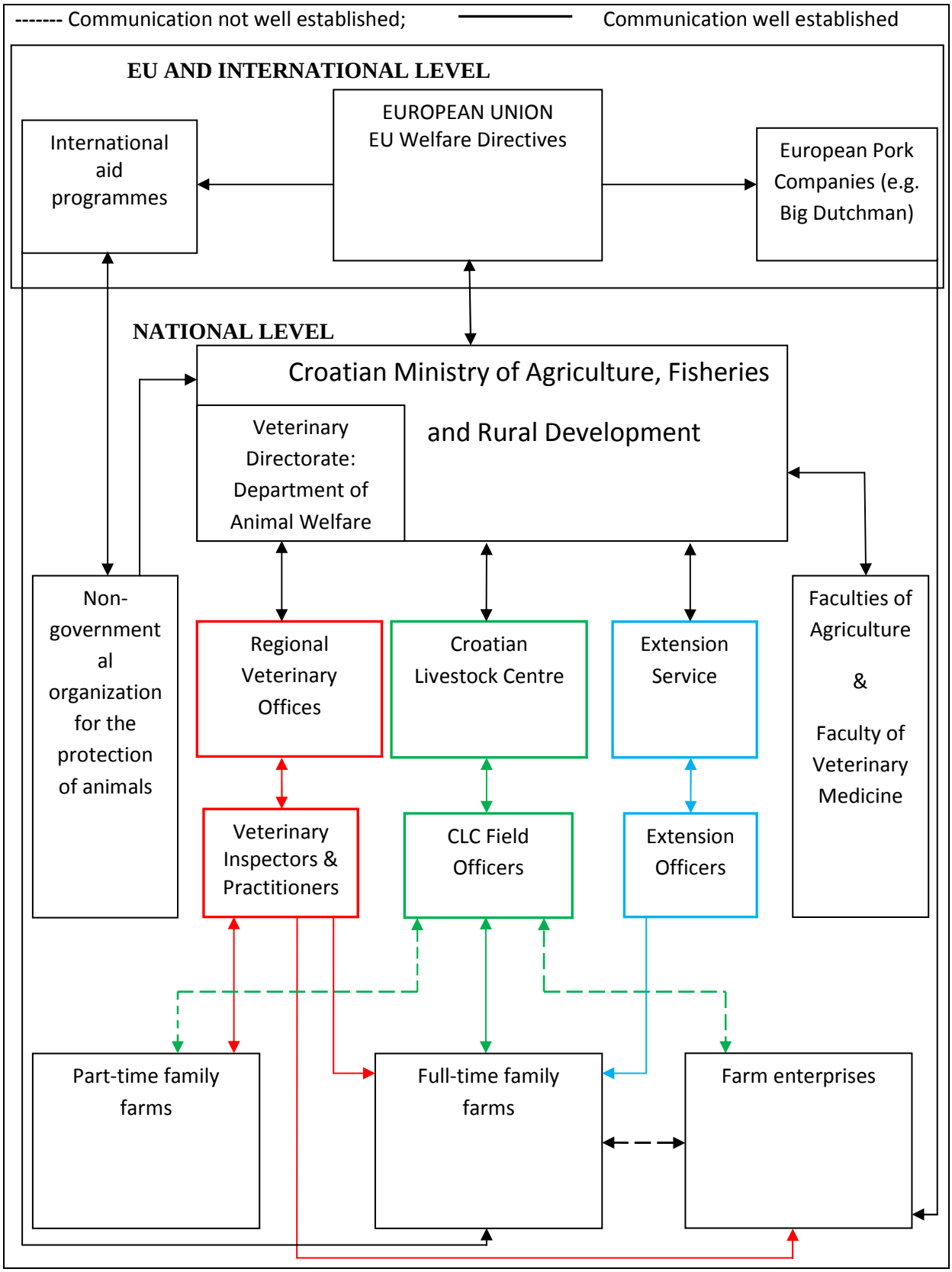

Figure 6 Institutions involved in implementing the EU pig welfare directives and educating pig farmers

5.2 Institutional stakeholders: perception of pig welfare and future perspective of farms

Efforts to educate farmers of the different production systems about the EU pig welfare directives differed. Differences in efforts to educate farmers may have been influenced by three intertwined factors, namely a) perception of pig welfare and b) different future perspectives of farms but also c) practical problems.

5.2.1 Perception of pig welfare

Three out of six institutional stakeholders associated pig welfare with *natural environments* and *natural behaviour*; two other considered that it refers to *company* for the pigs. They also argued that good farmers would ensure *natural* environment for the pigs, provide f.e. *mud, straw* and *space* and that good farmers should generally be *enthusiastic*, *motivated* and *educated.*

All six institutional stakeholders expected pig welfare to be better on small farms than on large farms, although two interviewees expressed scepticism at the same time. They responded "*better care does not mean better conditions*" and "*it is all psychologically that animals have it better on smaller farms*." When asked to describe why welfare was expected to be better on small farms than on large farms, the respondents referred to positive terms such as *good care* and *respect* when describing welfare on small farms and negative words such as *bad, stress* and *dirty* when describing welfare on large farms. Table 12 provides an overview of mentioned associations.

Table 12 Associations with pig welfare stated by institutional stakeholders

Associations with pig welfare on small farms	Associations with pig welfare on large farms
• Enough space • Good food • Good human- animal interaction • Small number of animals • More enrichment • Outdoor access • Tradition • Become friends • Care • Respect • Time • No economic focus	• Permanent stress • Bad food • Pig is a number • Large number of animals • Dirty • Bad ventilation • No sunlight, light • Old fashioned conditions

Interestingly then, although part-time farmers were least educated by institutional stakeholders about animal welfare issues, authorities regarded the welfare of pigs on small farms better than on large farms.

5.2.2 Future perspectives of different pig farms

Differences in communication efforts may also be related to different interests in the future of the three pig production systems.

Part-time family farms

All interviewees expected that part-time family farms would disappear or that their number would drastically decline in the coming years. Two interviewees remarked, however, that keeping pigs for own production was a tradition in Croatia and would therefore be likely to persist in the future. Additionally, it was stated that the EU pig welfare directives would not be suitable to address pig welfare on small farms, possibly providing a further argument for the lack of communication with part-time family farmers. Nevertheless, the animal welfare department considered to prepare special regulations to ensure pig welfare on small farms in the future (pers. com.).

Full-time family farms

Authorities differed in their arguments regarding the future of full-time family farms. Small full-time family farms were expected to quit farming in the future. They expected that small farms would quit farming because they were not eligible for subsidies as they had too few pigs (threshold set at 10 sows per farm, pers.com.) and owned too small pieces of land. During interviews, it was also stated that they could not expand their land because often adjacent pieces of land were owned by people who did not want to sell their land (pers. com.). Most argued that these farmers could switch to other farming activities such as ecological production or fruit production. In contrast, three interviewees expected good chances for larger full-time farmers. Especially good, young and motivated farmers could increase their production and continue to farm pigs for the conventional market.

Farm Enterprises

With regard to farm enterprises, no specific future perspectives were stated by institutional stakeholders. However, one interviewee argued that consumers and the Croatian government were interested in producing large quantities of pork to low prices thus promoting the expansion of large-scale production units.

5.2.3 Practical Problems

In addition to perceptions of pig welfare and future perspectives for the pig production systems, efforts to communicate with farmers were also influenced by practical problems because of 1) lack of resources, 2) lack of cooperation and 3) lack of interest in and information about farm animal welfare.

1. The ministry, the veterinary sector, the administrative body and the extension service commonly stated that communication problems arise because of a lack of financial and human capital. As a result, for instance, only 15.3% of all breeding sows in Croatia were registered with the Croatian Livestock Centre in 2007 (Mahnet, 2008). Also the veterinary sector stated that the number of veterinary inspectors was too small to monitor animal welfare efficiently.

2. Lack of cooperation seemed to be a further complication. For instance, uniform checklists to control animal welfare and health as suggested by the ministry were not yet implemented and each veterinary officer had different criteria for farm checks, possibly leading to miscommunication. Farmers, particularly smaller ones were also often reluctant to cooperate because of fear for administrative costs and financial damage (pers. com.). Cooperation between extension offices, veterinary services and administration should be investigated in future research.

3. Furthermore, it was argued that interest in and information about animal welfare was small, both amongst institutional stakeholders and amongst farmers because, as one interviewee stated: "*The welfare of farmers is more important than the welfare of animals*." Consequently, it was argued that the state did little to promote education in animal welfare issues and farmers showed little interest in learning about animal welfare issues. To change this behaviour, one interviewee stated that: *"It must be an order of the EU to educate farmers. This way, the government would do it. Otherwise it is a mission impossible."* Also, family farms did not always have internet access, complicating communication intentions (pers. com.).

5.3 Pig farmers: perception of pig welfare and future perspective of farms

The success of enforcing pig welfare legislation on the different pig production systems was also dependent on the perception of pig welfare and future perspectives held by the farmers.

5.3.1 Perception of pig welfare

All farmers participating in this study liked pigs and agreed on the importance for pigs to feel good on their farms. However, farmers did not consider "pig welfare" as the most important factor on their farm. For example, nine farmers were asked to rank the importance of pig welfare in relation to pig health, farm economics and food safety on their farms. Only one part-time family farmer stated animal welfare as the most important factor. All other farmers prioritised pig health, regardless of production system. Employees at farm enterprises ranked pig welfare second, followed by economy and food safety. Full-time family farmers ranked economy second, followed by pig welfare and food safety and all except one part-time family farmer ranked food safety second, pig welfare third and economy last. Additionally, one part-time and one full-time family farmer stated that all aspects are equally important.

When asked to explain the term "pig welfare" three farmers were confused by the term and could not think of any associations. Figure 7 illustrates, the other six farmers used 24 different terms to describe their welfare associations. Overall, the term *good food* was used most often to describe pig welfare (11 times), followed by *water* (9 times) *good microclimate*, *space* and g*ood care* of the animals (each six times).

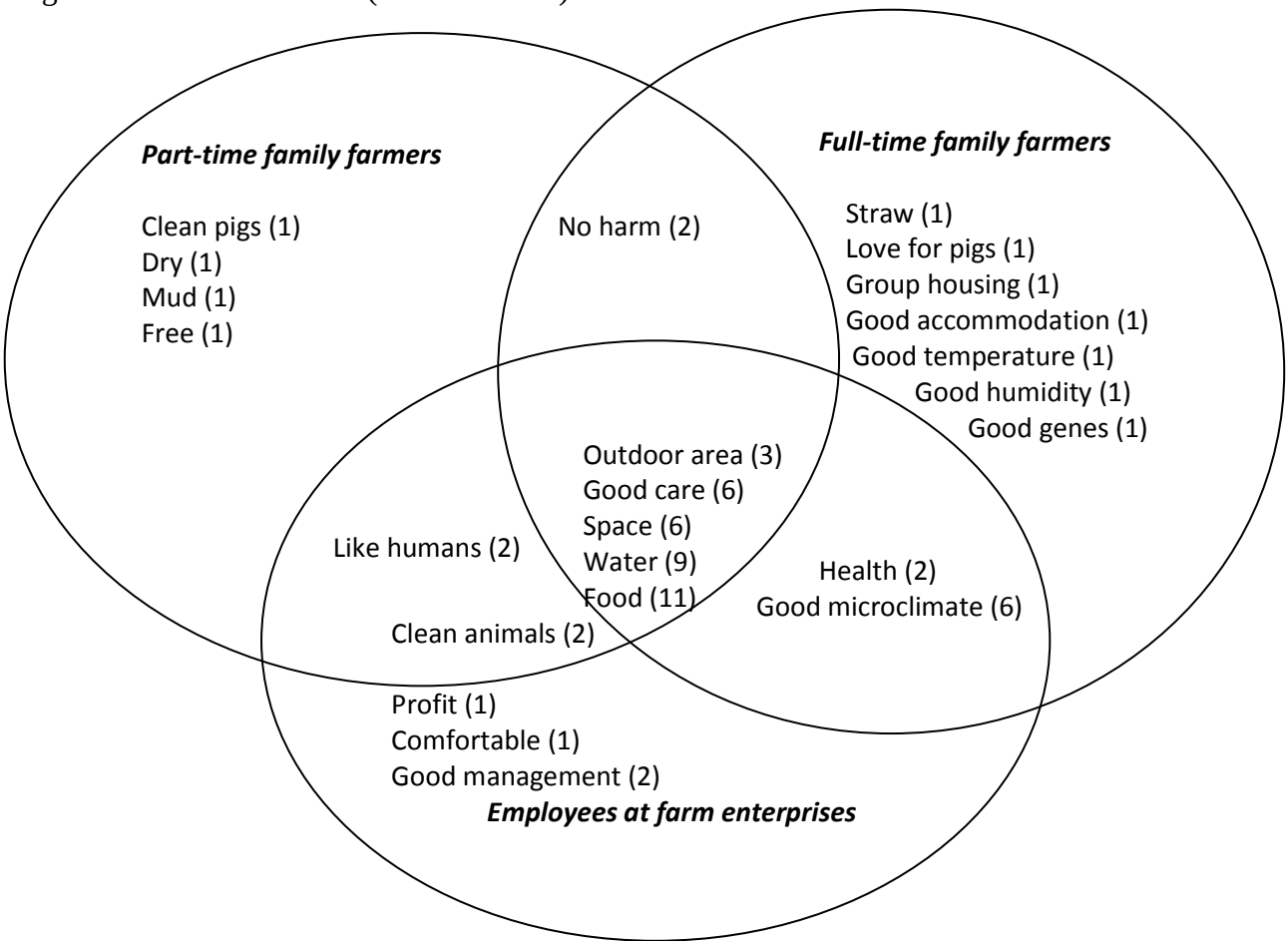

Figure 7 Associations with pig welfare stated by pig farmers (frequency in brackets)

5.3.2 Farmers perspective of their future

Farmers of different production systems had different future perspectives.

Part-time Family farmers:

In contrast to institutional stakeholders, four out of seven part-time family farmers expressed that the current developments in the pork production sector would not affect their farms and that they would continue farming as usual. Three part-time farmers were uncertain about their future. While one farmer stated that part-time farming was not attractive anymore, two farmers related their uncertainty to lacking regulations and governmental support. For instance, one farmer stated that the ban of home-slaughter practises would force them to quit farming while another farmer complained about the lack of governmental support for part-time family farmers and argued "*The government should help small farms (...) It would be a pity to lose this kind of production. This is a symbol of our region, our country. They produce a high quality; you cannot find this in the supermarket."*

Full –time family farmers:

When asking full-time family farmers about their future perspective, answers varied considerably. Two out of six farmers expected improvement of their situation in the future. In contrast, one farmer expected a worse situation than today. However, all farmers also expressed uncertainty concerning the fluctuations on the pork market. One farmer argued that everything would remain the same while another farmer considered diversifying his farming activities in order to continue with farming.

Employees at farm enterprises

The vision of employees at farm enterprises differed between employees at company-owned production sites and contracted family farmers. While one contracted family farmer expressed uncertainty about his future, employees at company-owned production sites had a positive view on their future.

5.3.3 Perception of EU pig welfare directives

Interestingly, all employees at farm enterprises and five out of six full-time family farmers were aware of the upcoming EU welfare directives but, as Figure 8 shows, out of the seven visited part-time farmers, only one interviewee expressed awareness. Two farmers had

retrieved information from the internet, two farmers mentioned seminar attendances and one farmer attended lectures at universities.

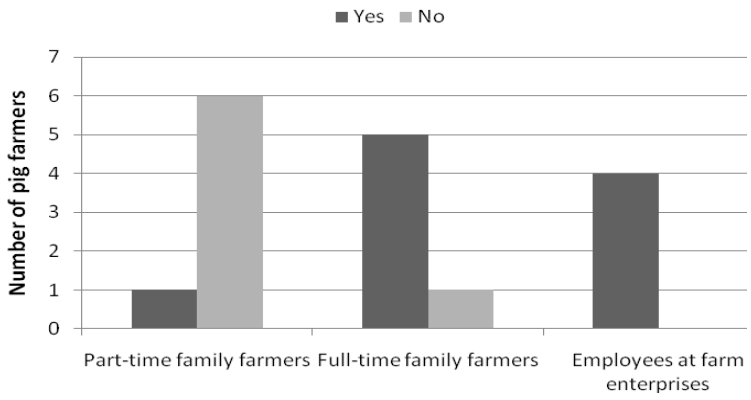

Figure 8 Awareness of EU pig welfare directives shown by pig farmers

Nevertheless, even amongst farmers that were aware of the directives, only employees at company-owned production sites and two of the informed full-time family farmers were acquainted with the actual content of the directives. When reflecting on the content of the directives and the welfare of pigs on their farms, employees at farm enterprises stated full compliance of their farms with the EU pig welfare directives. The full-time family farmers indicated a need to change either the slat width of the flooring, to facilitate group housing of sows or to increase space allowance.

When questioned about their opinion about the EU pig welfare directives, only three farmers related their opinion to the welfare of pigs. For example, two part-time family farmers argued that pig welfare regulations would control humane slaughtering, animal health and disease outbreaks. All other farmers related their reasoning to production and human benefits. One employee at an enterprise thus stated that "*if the animal feels good, you have good results*". Amongst full-time family farms and farm enterprises, it was twice stated that the EU pig welfare directives are important because "*you have to follow the rules of the European Union*" whereas part-time family farmers implied that the EU pig welfare directives would regulate prices, label quality and provide legal status and financial aid.

5.3.4 Plans to improve animal welfare

Corresponding to the different future perspectives and concepts of pig welfare, plans to improve pig welfare on farms also differed between the different production systems. It was thus frequently argued that by improving the pig welfare, they would show better production results and bring more money to the farm. One farmer stated: "*If the money is good, the pigs*

will feel good. If the money is bad, it is the pigs' fault." As Figure 9 shows, the larger the farm, the more farmers where interested in improving the welfare of pigs. Thus, while only half of the part-time farmers wanted to improve the welfare of their pigs, the majority of questioned full-time family farmers considered improvement. Amongst employees of farm enterprises, all interviewees had intentions for improvement.

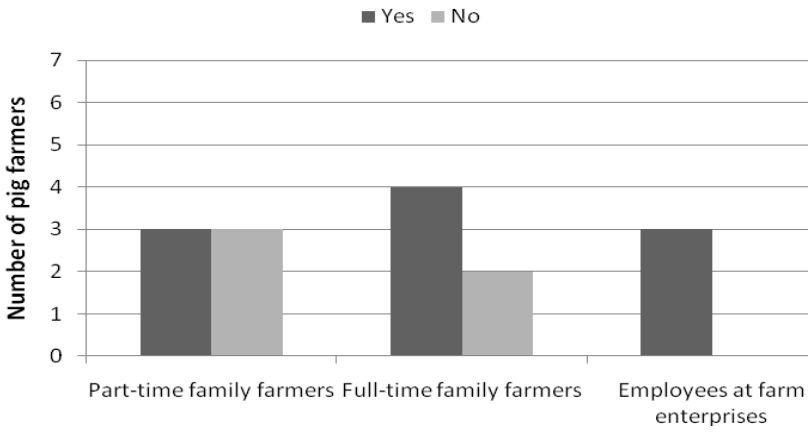

Figure 9 Intensions of pig farmers to improve pig welfare

Interestingly, the type of improvement farmers referred to varied between the different production systems and related to the perceived welfare or production problems on their farms. Employees at farm enterprises stated *artificial ventilation*, more *space* and *cleaner areas* as improvement factors. Full-time family farmers also stated *artificial ventilation* but added *outdoor access* as improvement ideas. Part-time family farmers wanted to improve through *increases in production* and *safer farrowing areas* to reduce piglet loss.

On the same lines, part-time family farmers, full-time family farmers and employees at farm enterprises had different ideas about what constitutes to a good farmer. Full-time family farmers expected a good farmer to have *good meat results*, *good animals* but also to *ensure good climate*. Furthermore, the farmer should *like animals* and *be calm*. Part-time family farmers argued that a good farmer needs to *feed his animals well*, *provide health care* and *be healthy* and *kind* himself and *sell his pigs at a good price*. Furthermore, one employee at a farm enterprise stated that a good farmer has to be *motivated*.

5.4 Summary

In Croatia, the EU pig welfare directives are implemented on demand of the EU as part of the accession process. The implementation process differs therefore from older European member

states where the pig welfare directives were enforced as a result of long process involving citizen concerns about intensive animal production.

The EU pig welfare directives are implemented by the Department of Animal Welfare. Farmers can be educated about the EU pig welfare directives in three ways, via the veterinary service, the agricultural administrative body and the agricultural extension service.

However, not all pig production systems were equally addressed by institutional stakeholders. These differences were the result of welfare perceptions, future perspectives and practical problems faced by involved stakeholders.

Part-time family farmers were hardly educated about the EU pig welfare directives. On the one hand, this was due to the fact that institutional stakeholders expected the welfare of pigs to be good on small farms and on the other hand, they expected part-time family farmers to discontinue with farming in the future. Consequently, part-time family farmers showed low interest in pig welfare improvements and were frustrated about the lack of support by the Croatian government.

Full-time family farmers were more educated about the EU pig welfare directives and showed motivation to improve welfare conditions in order to increase profit and productivity. Institutional stakeholders argued that large full-time family farms had a good future perspective and provided financial aid to them to realise the necessary modernisations.

At farm enterprises, employees were also aware of the EU welfare directives and motivated to improve pig welfare in order to ensure productivity and profit. On company-owned production sites the enforcement was, however, ensured by European advisors and not by the Croatian government.

6. Pig welfare at the different production systems

In order to investigate the status of pig welfare on the different pig production systems, the welfare of pigs was assessed on the visited farms using resource-based and animal-based welfare indicators. In the following, the resource-based welfare assessment results will be presented whereby differences in resources provided at the different production systems will be outlined and compliance with and divergence from the EU pig welfare directives will be highlighted. Secondly, animal-based welfare assessment results will be presented to demonstrate differences in effects of the different production systems on the welfare of the pigs. Finally, resource-based and animal-based welfare assessment results will be compared to investigate possible relationships between provided resources and welfare effects as measured directly on the pigs at the different production systems.

6.1 Resource-based welfare assessment results

The EU pig welfare directives (EC Directive 1991; 2001) stipulate resources that are aimed at ensuring the five freedoms as suggested by Brambell (1967), namely: 1. Freedom from hunger and thirst; 2. Freedom from discomfort; 3. Freedom from pain, injury and disease; 4. Freedom to express natural behaviour; 5. Freedom from fear and distress. In the following, the resource-based welfare assessment results will be presented along Brambell's (1967) five freedoms. Doing so, differences between the different production systems will be outlined and compliances as well as divergences from the EU recommended resources will be highlighted.

6.1.1 Freedom from hunger and thirst

Freedom from hunger and thirst should be ensured by providing fresh water and species-specific diets (FAWC, 2007). The EU pig welfare directives recommend *ad libitum* water supply and feed more than once a day, delivered in individual feeding spaces (EC Directive, 2001). Additionally, sows should be provided with sufficient quantities of high-fibre and high-energy food (EC Directive, 1991).

At the different pig production systems, all sampled pig pens received *ad libitum* water and where supplied with feed more than once a day. All group pens at farm enterprises and at full-time family farms that were not supplied with *ad libitum* feed were equipped with individual feeding spaces as, for example, illustrated in Figure 10. At part-time family farms, two out of six sampled group pens without provision of *ad libitum* feed did not provide individual feeding spaces.

Figure 10 Individual feeding spaces

Feed compositions also differed between the different pig production systems. As Figure 11 shows, all visited farm enterprises and five out of six full-time family farmers provided high-fibre and high energy diets. Part-time family farms provided the least amount of energy but high amounts of fibre. Although all farms provided maize, the percentage of farms supplying mineral/vitamin mixtures and wheat decreased with decreasing farm size. Part-time family farmers provided their pigs with kitchen leftovers, green grass and potatoes, bread and whey. Accordingly, part-time family farmers did not comply with the EU recommended feed compositions.

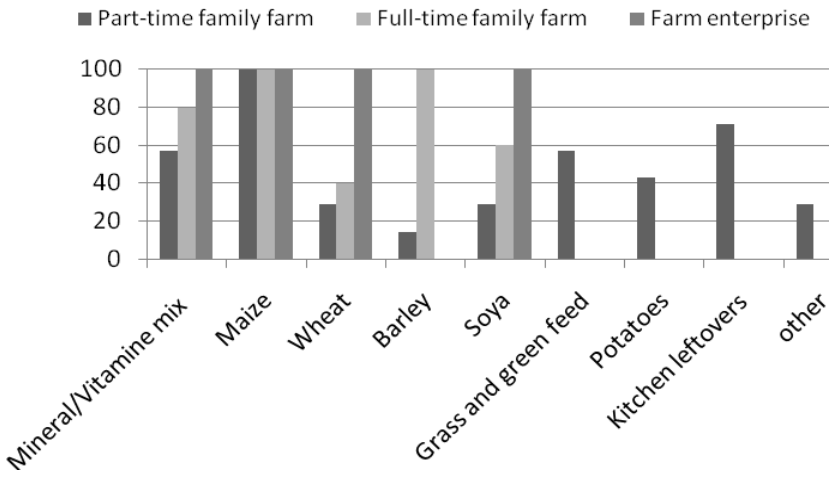

Figure 11: Feed composition at the different pig production systems

Based on the resources provided at the different pig production systems, Table 13 shows that freedom from hunger and thirst was better ensured on full-time family farms and farm enterprises than on part-time family farms.

Table 13 Compliance with (Y) and divergence from (N) EU recommendations to prevent hunger and thirst

EU recommendation	Part-time family farms	Full-time family farms	Farm enterprises
Fresh water	Y	Y	Y
High fibre diet	Y	Y	Y
High energy diet	N	Y	Y
Individual feeding spaces	N	Y	Y
Welfare score (Score/total)	**2/4**	**4/4**	**4/4**

6.1.2 Freedom from discomfort

Discomfort can be avoided by providing shelter, adequate environments and comfortable resting areas (FAWC, 2007). On this line, the EU pig welfare directives propose that all pigs should have access to dry, clean and thermally comfortable areas (EC Directive, 1991). Furthermore, the EU pig welfare directives indicate that dry comfort areas should be created by providing pigs with separate lying areas and defecating areas that are equipped with drainage openings (EC Directive, 1991). These openings should have specific opening widths.

Floor types found at the different pig production systems were categorised into concrete floors, fully slatted floors and floors alternating between concrete and slatted floor areas. Based on this distinction, floor types differed significantly between the different production systems (χ^2= 29.96, df = 2, p< 0.001, n=46). At the company-owned production site, floors alternated between concrete and slatted floors (n=4) while at the contracted pig production site floors were concrete (n=3). At full-time family farms, most pen floors were also concrete (n=13 out of 25) and on part-time family farms all floors were concrete (n=17). No difference was observed between floors provided for pigs with different functions (χ^2 test of association, in all cases p>0.05).

As illustrated in Figure 12, slats for fatteners must be 80mm wide and openings 20 mm small (EC directive, 1991). As Figure 13 shows slatted floors had larger openings (25 mm) and smaller slats (65 mm) than recommended by the EU welfare directives on old full-time family farms. When confronted with the differences in slat widths, one full-time farmer stated to object to the EU recommendation because it would increase cleaning labour.

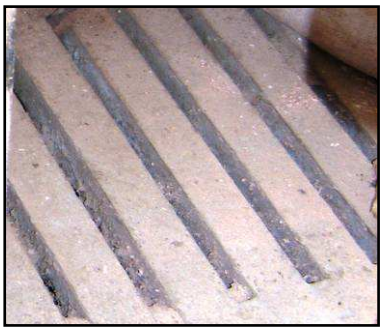

Figure 12: Non-EU slat width

Figure 13 EU slat width

Based on the resources provided at the different pig production systems, Table 14 shows that comfort was best ensured on farm enterprises while least ensured on full-time and part-time family farms.

Table 14 Compliance with (Y) and divergence from (N) EU recommendations to ensure comfort

EU recommendation	Part-time family farms	Full-time family farms	Farm enterprise
Separate resting and defecating area	N	N	Y
Slat width for fatteners (80/20 mm)	N/A[1)]	N	Y
Welfare score (Score/total)	**0/1**	**0/2**	**2/2**

[1)] This recommendation was not applicable to the production system

6.1.3 Freedom from pain, injury and disease

Freedom from pain, injury and disease should be ensured by using preventive measures, rapid diagnosis and immediate treatments (FAWC, 2007). The EU pig welfare directives (EC Directive 1991; 2001) provide several recommendations on this line that relate to a) resources and b) surgical interventions. Regarding resources, floors should not be slippery to prevent leg injury. Regarding surgical interventions, tail docking and teeth clipping may not be carried out routinely, castration may not involve tearing of tissue and all interventions should be carried out by trained persons.

a) Resources

In line with the EU pig welfare directives (EC 2001: 1991), previous research has shown that leg injuries appear to be influenced by floor conditions. For example, Edwards & Lightfoot (1986) showed that leg injuries were lowest in concrete but straw-bedded stalls and increased with the proportion of slatted floor areas. Furthermore, Anderson & Bøe (1999) showed that leg injuries were lower on straw-bedded, concrete floors than on barren, concrete floors or fully slatted floors. Based on these results, one can argue that leg injuries are more likely to occur on concrete, barren or fully-slatted floors than on straw-bedded, concrete floors.

As Table 15 shows, the percentage of pens with straw bedding differed significantly between the different production systems ($\chi^2 = 23.88$, df =2, p>0.001, n=47). While all sampled pens at part-time family farms were bedded with straw, none of the pens at farm enterprises were bedded with straw. Following Anderson & Bøe's (1999) research, leg injuries were thus most effectively prevented on part-time family farms.

Table 15 Percentage of pens with straw bedding at the different pig production systems

	Percentage of pens with straw	**Number of farms**
Part-time family farms	100	7
Full-time family farms	43	6
Farm enterprises	0	2

In contrast, injury-promoting concrete and barren floors were found at three pens of the visited contracted family farm and at four pens of full-time family farms. One can therefore argue that pigs in these pens were more at risk of leg injuries.

At the company-owned production site, floors were fully slatted with the exception of concrete lying boxes (n=4). Since Edwards & Lightfood (1986) showed that leg injuries are depending on the proportion of slatted floor area, one can argue that pigs in these pens were also at risk of obtaining leg injuries.

b) Surgical interventions

Regarding surgical interventions- tail docking, teeth clipping and castration- different production systems appeared to follow different practices. Regarding Table 16, part-time family farmers stated to routinely clip the teeth of piglets at 1-2 days of age. Looking at full-time family farms, both, teeth clipping and tail docking were carried out routinely. At farm enterprises, teeth were not clipped routinely but tails were docked at three days of age. Accordingly, all farms practised one or more routine interventions.

Table 16 Age (days) of piglets at surgical interventions

	Part-time family farm	**Full-time family farm**	**Farm enterprise**
Number of farms	3	4	1
Age teeth clipping	1-2	2	N/A[1)]
Age Castration	23	21	3
Age Tail docking	N/A[1)]	50 %: 1 50%: 21	3

[1)]This parameter was not applicable at the visited pig production system

Furthermore, production systems differed in the age of piglets at castration. On part-time and full-time family farms, castrations were performed at three weeks of age. At farm enterprises, castration was performed at three days, together with tail docking and vaccinations in order to reduce human interventions (pers. com.).

Looking at the EU pig welfare directives, no suggestions are made regarding the age of castration. It has been argued that pigs feel less pain when castrated before 20 days of age (McGlone & Hellman, 1988). However, Taylor *et al.* (2001) found no difference in pain experience when castrating piglets as early as three days and as late as 17 days of age. No statement can therefore be made as to whether pigs on family farms or farm enterprises experienced more pain.

Arguably, the collected data on resources was not comprehensive enough to fully investigate the freedom from pain, injury and disease. Future studies should, for instance, investigate a) whether castration is performed by trained persons and b) whether castration methods differ between the different pig production systems. Also, no indicators were chosen to assess freedom from disease. Differences in medical treatments provided at the different pig production systems should also be addressed in future studies.

Based on the presented research results, Table 17 shows that part-time family farms prevented pain and injury more effectively than full-time family farms and farm enterprises.

Table 17 Compliance with (Y) and divergence from (N) EU recommendations to prevent pain and injury

EU Recommendation	Part-time family farms	Full-time family farms	Farm enterprises
Floor condition	Y	N	N
Teeth clipping	Y	N	N
Tail docking	N	N	Y
Welfare score (Score/total)	**2/3**	**0/3**	**1/3**

6.1.4 Freedom to express natural behaviour

The freedom to express natural behaviour can be ensured by providing pigs with sufficient space, companionship and proper facilities (FAWC, 2007). Following this line, the EU pig welfare directives (EC, 1991; 2001) recommend a) to house all pigs- except lactating sows- in groups, b) to provide specific individual space allowances and c) to provide sufficient quantities of manipulative material.

a) Group housing facilities

As Figure 14 shows, the majority of sampled pens were group pens and there was no significant difference in pen types across the different production systems (χ^2 test of association, $p>0.05$; n= 47).

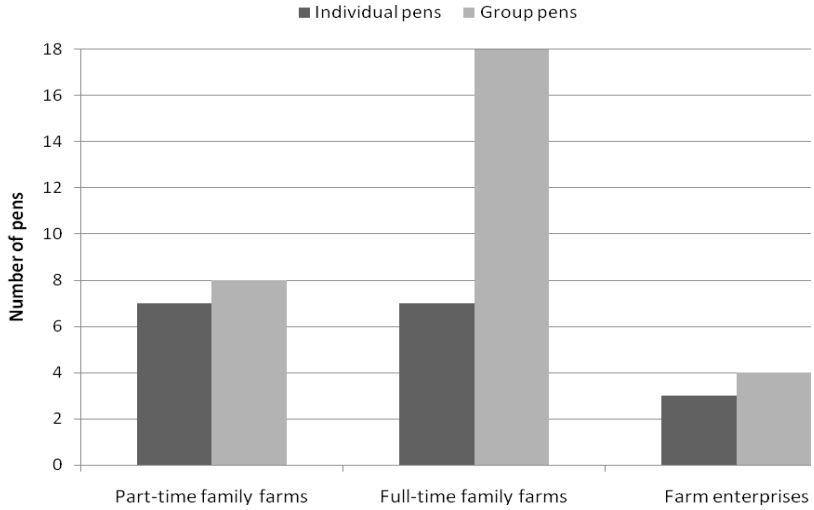

Figure 14 Number of group and individual pens at the different production systems

Looking at group housing facilities for pigs with different functions, farm enterprises and full-time family farms housed all fatteners and weaners in groups. Only at part-time family farms fatteners were housed individually in two out of eight cases.

At the company-owned production site 50 % (n=2) of the sampled pens for non-lactating sows were group houses and 50 % (n=2) individual pens in an insemination unit. It was, however, stated that these sows would be transferred to group housing facilities after successful insemination. At full-time family farms, only 25 % of the sampled pens with non-suckling sows (n=4) were kept in groups. All part-time family farms had less than ten sows and were not required to provide group housing (EC directive, 2001). And indeed, all part-time farmers housed their non-lactating sows in individual pens.

b) Individual space allowances

In order to analyse whether pigs were provided with sufficient space allowance, it is necessary to pay attention to the weight of the pigs from the different pig production systems. Reference values for space recommendations will therefore be defined on the stated slaughter or selling weights. For weaners, the EU recommended space allowance is 0.30 m² (25 kg), for fatteners at farm enterprises and full-time family farms the EU recommended space allowance is 0.65 m² (110 kg) and for fatteners at part-time family farms the EU recommended space allowance

is 1 m² (>110 kg). For group-housed sows an individual space allowance of 1.30 m² is recommended (EC Directive, 1991).

As Table 18 shows, except for sows, all pig production systems provided on average more individual space for their pigs than recommended by the EU welfare directive. At a part-time family farm, individual space for sows in a group pen was smaller (1.21 m²) than recommended by the EU (1.30 m²).

Table 18 Individual space allowances in group pens at the different production systems

Individual space allowance in group pens (m²)	**EU recommended space allowance**	**Part-time family farm**	**Full-time family farm**	**Farm enterprise**
Sows	1.30	1.2 (n=1)	2.3 (n=1)	3.1 (n=1)
Fatteners	0.65/1.00	2.0 (s.d.0.49)[a] (n=9)	0.9 (s.d.0.23)[b] (n=6)	1.1 (s.d. 0.00)[b] (n=3)
Weaners	0.30	1.0 (s.d.0.66) (n=3)	0.7 (s.d. 0.82) (n=5)	N/A[1)]

The different subscripts indicate significant differences at $p < 0.05$
[1)] The recommendation is not applicable for the pig production system

Furthermore, fattening pigs at part-time family farms were provided with significantly more individual space than on farm enterprises and full-time family farms ($H=11.75$, $df=2$, $p=0.003$; $n=18$). Space allowance for weaners did not differ between the different production systems ($p >0.05$; $n=8$, Mann-Whitney U test).

c) Manipulative material

To encourage investigation behaviour, the EU pig welfare directives recommend providing pigs with manipulative material such as straw, hay or sawdust (EC directive 1999). As outlined in Chapter 6.3, none of the visited farm enterprises and only 43% of the sampled pens at full-time family farms provided bedding material (see Figure 15). At part-time family farms, all pens provided bedding material, thus conforming to the recommendations of providing manipulative material for pigs (see Figure 16).

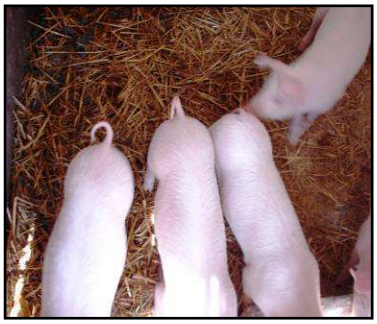

Figure 16 Pen with bedding

Figure 15 Pen without bedding

Also toys can be provided to stimulate natural behaviour (EC Directive, 2001). The visited company-owned production site provided group housed sows with iron chains and also a full-time family famer provided iron chains for his pigs. He argued, however, to only use the chains when he observed behavioural problems amongst the pigs.

As summarised in Table 19, it appeared that part-time family farms provide pigs more often with manipulative material than full-time family farms and farm enterprises.

Table 19 Compliance with (Y) and divergence from (N) EU recommendations to allow natural behaviour

EU recommendation	Part-time family farms	Full-time family farms	Farm enterprises
Space allowance for fattening pigs	Y	Y	Y
Space allowance for weaned piglets	Y	Y	N/A[1)]
Space allowance for group housed sows	N	Y	Y
Group housing for fattening pigs	N	Y	Y
Group housing for weaned piglets	Y	Y	N/A
Group housing for sows	Y	N	Y
Manipulative material	Y	N	N
Toys	N	N	N
Welfare score (Score/total)	**5/8**	**5/8**	**4/6**

[1)] This recommendation was not applicable at the visited production system

6.1.5 Freedom from fear and distress

In order to prevent fear and distress, any conditions which may cause mental suffering should be avoided. This can be achieved by good housing conditions, good treatment and avoidance of mental suffering (FAWC, 2007).

The freedom of fear and distress is the least respected in the EU pig welfare directives (EC Directive 1991; 2001), possibly because it cannot be addressed by resource recommendations. One can, however, argue that recommendations regarding weaning age are associated with fear and distress. According to the EU pig welfare directives (EC Directives 1991; 2001) piglets should not be weaned before 28 days or 21 days if the piglets will be kept in separate rooms than the sows.

As Table 20 shows, all visited pig production systems complied with the EU welfare recommendation. The company-owned production site weaned piglets at three and a half weeks. At full-time family farms, four visited farms produced piglets and the average weaning age was 4 weeks. Also one part-time family farm produced piglets and weaned them at four weeks of age.

Table 20 Compliance with (Y) and divergence from (N) EU recommendations to prevent fear and distress

	Part-time family farms	**Full-time family farms**	**Farm enterprises**
Weaning age	Y	Y	Y
Welfare score (Score/total)	**1/1**	**1/1**	**1/1**

6.1.6 Compliance with and divergence from EU recommended resources

The previously outlined resource-based welfare assessment results are summarised in Table 21. According to EU pig welfare recommendations, farm enterprises provided the best welfare for pigs while full-time and part-time family farms were less successful in ensuring the welfare of their pigs.

Looking at the different freedoms however, farm enterprises did not ensure all five freedoms equally well and some freedoms were better ensured on part-time family farms than on farm enterprises.

Table 21 Resource-based welfare score for the different pig production systems

	Part time family farms	**Full-time family farms**	**Farm enterprises**
Freedom from hunger and thirst (score/total)	2/4	4/4	4/4
Freedom from discomfort (score/total)	0/1	0/2	2/2
Freedom from pain, injury and disease (score/total)	2/3	0/3	1/3
Freedom to express natural behaviour (score/total)	5/8	5/8	4/6
Freedom from fear and distress (score/total)	1/1	1/1	1/1
Overall resource-based welfare score	**10/17**	**10/18**	**12/16**
Percentage of total compliance	**(59%)**	**(56%)**	**(75%)**

Farm enterprises were more successful than family farms in ensuring freedom from discomfort. Part-time family farms were, however, superior in ensuring freedom from pain and injury.

6.2 Animal-based welfare assessment results

As outlined in Chapter 1.3, focussing on resources to assess pig welfare does not provide any information about the effect of these resources on the pigs (e.g. Kirkden & Pajor, 2006, Yeates & Main, 2008). Consequently, scientists have proposed that welfare should be inferred from direct observations of the animals (e.g. Dawkins, 2006). In response to this debate, it was decided to investigate the welfare of pigs at the different production systems using animal-based welfare indicators.

In the following, first methodological problems encountered while using the chosen animal-based welfare indicators will be outlined, followed by a comparison of pig welfare at the different production systems using animal-based welfare assessment results.

6.2.1 Methodological difficulties and discarded indicators

The feasibility of the chosen animal-based indicators was reduced because of methodological problems. For instance, the use of instantaneous group scans was not appropriate to assess the

amount of animals with lesions or bites, amongst others due to overcrowding, dirty pigs, rapid movement of the pigs, distraction by other persons in the barn and a lack of time.

Alternatively, it was decided to take pictures of the pigs in each sampled pen with the intention to analyse tail bites, ear bites and skin lesions digitally. To investigate the pictures systematically and to avoid repeated assessment of the same pig, one picture of each pen was chosen. To analyse skin lesions on pictures, the number of pigs of which the back, rump and hind quarters were visible was denoted. Out of these, the number of pigs showing lesions was counted and the percentage of pigs with lesions denoted. For ear bites, the number of ears that were fully visible from the front or back were denoted, the number of ears with bites counted and the percentage denoted. An average result for each farm was used for comparison between the different production systems.

For tail bites, assessment from pictures was not possible, as it was impossible to distinguish dirty tails and tail bites. Also lying behaviour was not taken into consideration because in most barns pigs stood up upon entry of the researcher and remained standing for the duration of the visit.

Consequently, the following animal-based welfare analysis will be limited to the indicators cleanliness, skin lesions, ear bites and fear of humans.

6.2.2 Animal-based welfare scores

As indicated in Table 22, the percentage of pens with clean pigs differed significantly between the different pig production systems ($H = 7.70$ $df= 2$; $p=0.02$, $n=11$). As illustrated in Figure 18, the percentage of pens with clean pigs was highest on part-time family farms and lowest at farm enterprises as illustrated in Figure 17.

Figure 18 Clean pigs at a part-time family farm

Figure 17 Dirty pigs at a farm enterprise

In contrast, the percentage of skin lesions and ear bites observed at the different pig production systems was not significantly different (all Kruskall-Wallis test, df =3, p>0.05, n=11). Additionally, there was no significant difference between the fear responses of pigs towards humans shown at the different farm types (Kruskall-Wallis test, p>0.05; n=15).

Table 22 Animal-based welfare assessment results

	Part-time family farms	**Full-time family farms**	**Farm enterprises**
Percentage of pens with clean pigs	88.2 (s.d. 20.84)[b] (n= 7)	44.5 (s.d. 39.00)[b] (n=6)	0.0 (s.d. 0.00)[a] (n=2)
Percentage of skin lesions	8.0 (s.d. 17.87) (n= 5)	3.7 (s.d. 5.10) (n= 4)	33.3 (s.d. 47.14) (n=2)
Percentage of ear bites	6.0 (s.d. 13.42) (n= 5)	13.7 (s.d. 9.73) (n= 4)	22.5 (s.d. 31.82) (n= 2)
Fear of humans in seconds	2.4 (s.d. 3.06) (n=7)	2.0 (s.d. 3.09) (n=6)	2.2 (s.d. 3.73) (n=2)

*) The different subscripts indicate a significant difference at p>0.001

Furthermore, the percentages of skin lesions and ear bites recorded at farm enterprises show a high standard deviation. Possibly, the large variation occurred because some pigs were sampled in pens at a contracted family farm while other pigs were sampled in pens at a newly build, company-owned production site. Indeed, Figure 19 shows that skin lesions were recorded at the contracted family farm whereas no skin lesions were recorded at the company-owned production site.

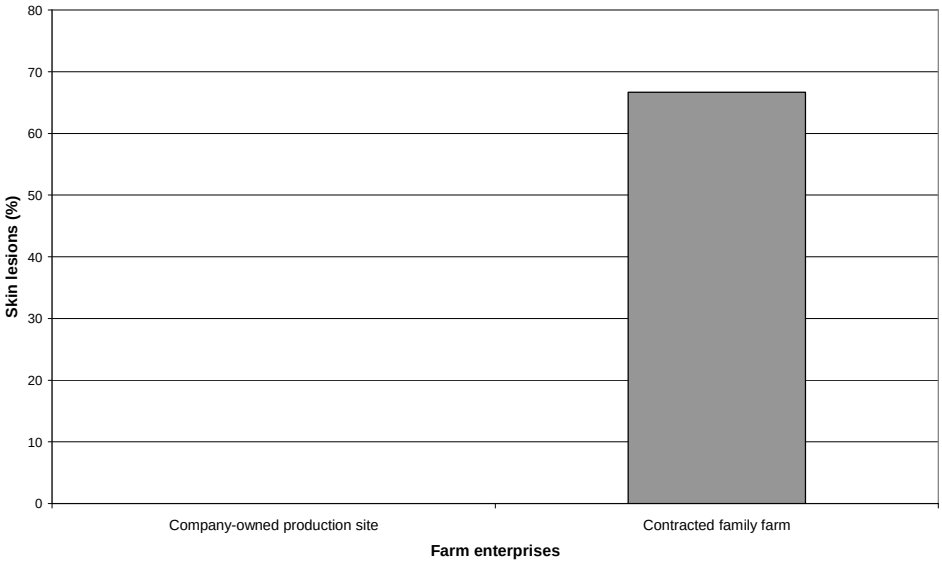

Figure 19 Percentage of skin lesions at the different pig production systems

As Figure 20 shows, also ear bites were only recorded at the contracted family farm but not at the company-owned production site.

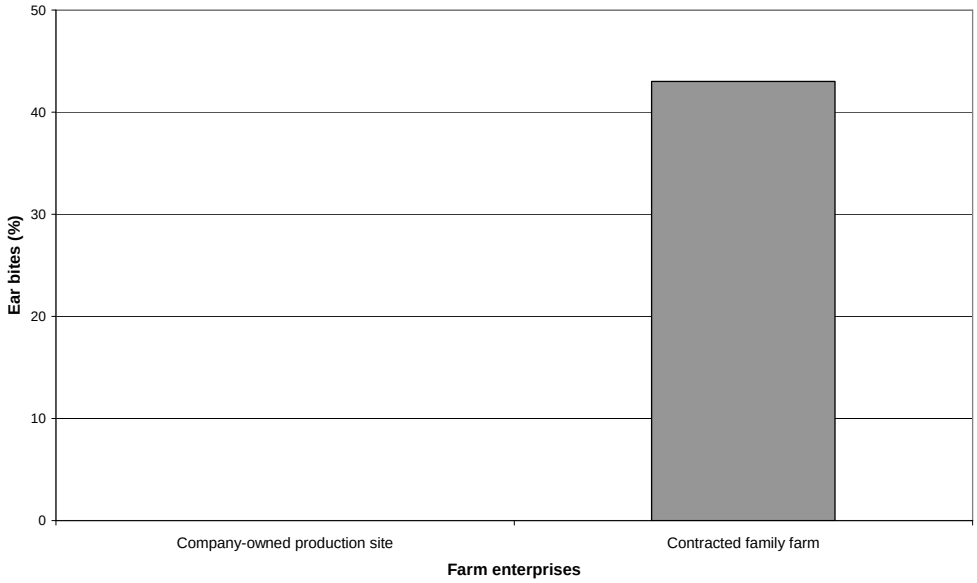

Figure 20 Percentage of ear bites at the different pig production systems

Nevertheless, even when including company-owned production sites and contracted family farms separately in the analyses, skin lesions and ear bites did not differ significantly between the different pig production systems (both Kruskall-Wallis test of differences, $p > 0.05$, $df = 3$, $n = 11$).

6.2.3 Suggested nutritional problem

Finally, body condition scoring can be used to assess the nutritional status of pigs. Signs of mal-nutrition include, for instance, haggard loins and long hairs (Courboulay, 2007b). Since health-related welfare indicators such as body condition scoring required expert or veterinary knowledge, it was initially decided to omit health related indicators. However, as Figure 21 shows, it may be suggested that sows at part-time family farms show signs of malnutrition.

Figure 21 Malnutrition in breeding sow

In order to investigate the proposed malnutrition of breeding sows adequately, future studies are necessary.

6.3 Relationship between resource-based and animal-based welfare assessment results

Information obtained from resource-based and animal-based welfare indicators do not seem to be complementary. Thus, according to resource-based welfare assessment results, farm enterprises ensured pig welfare most successfully whereas part-time family farms ensured pig welfare least successfully. From the perspective of animal-based welfare assessment results, however, the welfare of pigs did not differ between the different pig production systems.

Nevertheless, pigs were significantly cleaner at part-time family farms than on full-time family farms and farm enterprises. Arguably, this indicates different effects of provided resources on the welfare of pigs.

As Table 23 shows, pens at part-time family farms showed better floor conditions and pens contained more manipulative material than at full-time family farms and farm enterprises.

Table 23 Overview of divergences from EU recommendations at the different production systems

	Part-time family farms	**Full-time family farms**	**Farm enterprises**
Freedom from hunger and thirst (score/total)	-High energy feed -Individual feeding space	None	None
Freedom from discomfort (score/total)	-Separate resting and defecating areas	-Separate resting and defecating areas -Slat width	None
Freedom from pain, injury and disease (score/total)	-Tail docking	-Floor condition -Tail docking -Teeth clipping	-Floor condition -Teeth clipping
Freedom to express natural behaviour (score/total)	-Space allowance for group housed sows -Group houses for sows -Toys	-Group housing for sows -Manipulative material -Toys	-Manipulative material -Toys
Freedom from fear and distress (score/total)	None	None	None

To explain the significantly larger percentage of clean pigs at part-time family farms, it is therefore necessary to address the provision of straw as a factor to explain the difference between the different pig production systems.

In addition, it is interesting to note that group sizes varied significantly between the different pig production systems ($H= 17.32$; $df= 2$; $p < 0.001$, $n=49$; Kruskall-Wallis test). Group sizes were largest on farm enterprises ($\mu= 42.75$ pigs $\pm$ 7.25), followed by full-time family farms ($\mu= 18.00$ pigs ± 2.10) and part-time family farms ($\mu= 4.33$ pigs ± 1.07). Brambell (1967) states wild pigs usually live in small family group with up to eight pigs. At the European

Commission, ideal group sizes for pigs are still subject to research and not yet regulated (EC directive, 2001). In order to find a relationship between resource-based and animal-based welfare indicators, group size will also be taken into consideration.

6.3.1 Relationship between straw provision and animal-based welfare results

As Figure 22 shows, cleanliness appeared to be significantly correlated with straw provision (R^2= 0.82; F= 60.08, df 13, p< 0.001, n= 15). To exclude pathological causes for the cleanliness of the pigs, none of the pigs showed signs of diarrhoea.

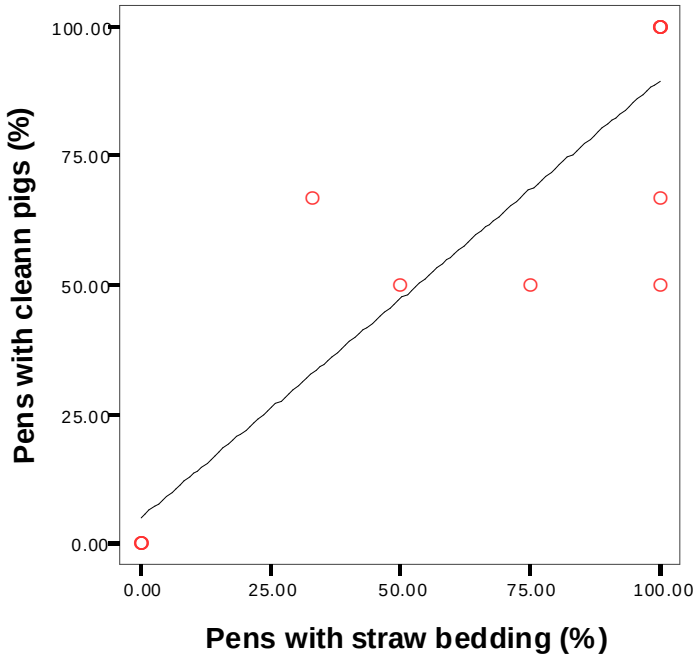

Figure 22 Relationship between pens providing straw (%) and pens with clean pig (%)

The percentage of skin lesions, in contrast, was not significantly correlated with the percentage of pens providing straw (R^2= 0.10). Also the percentage of ear bites was not significantly correlated with the percentage of pens providing straw (R^2= 0.23) (both Spearman's rho correlation, p>0.05, n=11).

6.3.2 Relationship between group size and animal-based welfare results

As Figure 26 shows, cleanliness also decreased significantly with increasing group size (R^2= 0.55; F= 10.81, df = 9, p = 0.009, n = 11).

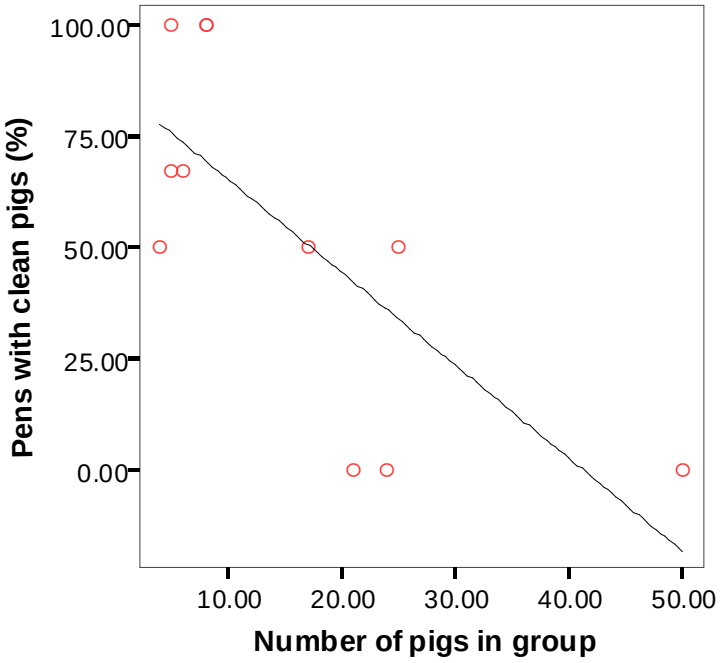

Figure 23 Relationship between group size in pens (n) and clean pigs (%)

In contrast, there was no significant relationship between the percentage of recorded skin lesions and group size (R^2= 0.46). Also the percentage of ear bites was not significantly correlated with the group size (R^2= 0.34) (both Spearman's rho correlation, p>0.05, n=11).

Arguably, the cleanliness of the pigs could have influenced the assessment results for ear bits and skin lesions. If pigs are dirty, skin lesions and ear bites will be difficult to observe. Testing this assumption statistically, there was no significant correlation between the percentage of skin lesions and the percentage of pens with clean pigs (R^2= -0.17). Also the percentage of recorded ear bites was not significantly correlated with the percentage of pens housing clean pigs (R^2 = -0.18) (both Spearman's rho correlation, p>0.05, n=11).

Interestingly, however, as Figure 24 shows, the percentage of skin lesions and the percentage of ear bites were positively correlated (R^2= 0.76; p=0.007, n=11, Spearman's rho correlation).

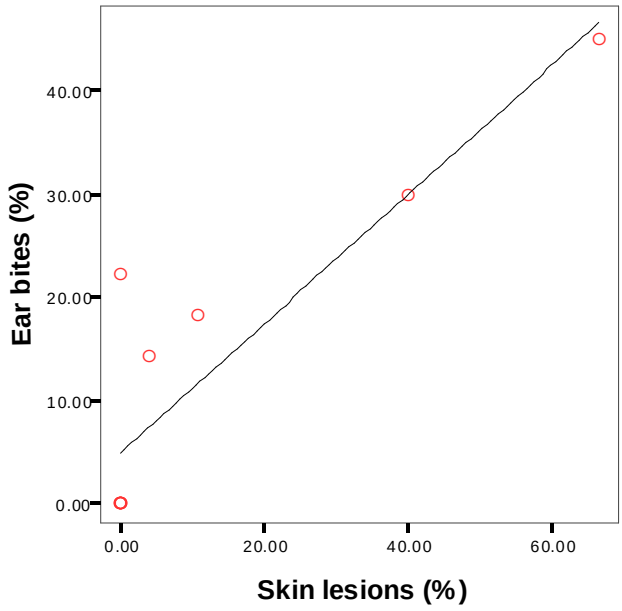

Figure 24 Relationship between skin lesions (%) and ear bites (%)

6.4 Summary

According to the resource-based welfare assessment results, pig welfare was best ensured on farm enterprises and least ensured on part-time family farms. Looking at the different freedoms as proposed by Brambell (1967), it appeared, however, that part-time family farms were superior to farm enterprises in ensuring freedom from pain and injury.

According to animal-based welfare assessment results, no difference in pig welfare could be found between the different production systems. Pigs at part-time family farms were cleaner than on full-time family farms and farm enterprises. Ear bites, skin lesions and fear of humans did not differ significantly between the different pig production systems. Additionally, it may be suggested that sows at part-time family farms showed problems of malnutrition.

The percentage of clean pigs was positively correlated with the percentage of pens bedded with straw and negatively correlated with the number of pigs in a group. Furthermore, skin lesions and ear bites were positively correlated. No significant relationships were found between ear bites, skin lesions and straw or group sizes. Also, ear bites and skin lesions were not significantly correlated with cleanliness.

7. Discussion

Croatia is aiming to join the EU in the near future and the country has to be aligned with the common European rules and regulations (EU, 2007). On this line, also the EU pig welfare directives need to be implemented and enforced (EU, 2007). So far, Croatian pig production systems neither comply with the EU rules and regulations (Progress Report, 2007) nor are they competitive enough to sustain on the European pork market (Misir, 2003). The European Commission therefore recommends that pig production systems in Croatia should be modernised in order to increase competitiveness, adequate waste management, food safety and hygiene as well as animal welfare standards (Commission Decision, 2007; SAPARD; 2006). The expectation is that this process leads to the reconstruction of larger farms according to European standards and termination of small farms (Antunovic *et al*. 2004; SAPARD, 2006).

The aim of this study was to investigate what consequences -in the light of modernising pig production systems- the implementation and enforcement of the EU pig welfare directives will have on the welfare of pigs (and humans) on farms in Croatia.

7.1. Pig welfare at the different pig production systems in Croatia

According to comparisons with EU recommended resources, the results showed that full-time family farms and farm enterprises ensured *freedom from hunger and thirst* according to EU standards. *Freedom from discomfort* was best ensured at farm enterprises because pigs were provided with separate lying and defecating areas and slat widths according to EU norms. *Freedom from pain and injuries* was, however, best ensured on part-time family farms because floors were bedded and helped to prevent leg injury. All farms had difficulties ensuring the *freedom to express natural behaviour*. Full-time family farms and part-time family farms lacked group pens while farm enterprises and large full-time family farms did not provide pigs with manipulative material. *Freedom from fear and distress* was equally well ensured at all pig production systems.

On the basis of provided resources, it was argued that pig welfare was best ensured at farm enterprises. Looking at animal-based welfare indicators, however, the resource-based welfare assessment results was not supported. There was, for instance, no difference in the number of skin lesions and ear bites observed at the different pig production systems. There was also no difference in the fearfulness of pigs towards humans. Moreover, pigs at part-time family

farms were significantly cleaner than pigs at full-time family farms and farm enterprises but sows at part-time family farms were suffering from malnutrition.

Based on the welfare assessment results of this study, no statement can therefore be made as to whether the modernisation and hence the implementation and enforcement of the EU recommended resources will improve or impair the welfare of pigs at the different pig production systems in Croatia.

Furthermore, one can argue that some of the outlined welfare problems cannot be addressed by reconstructing pig production systems. These problems are related to lacking knowledge and education.

For instance, part-time family farms showed problems providing sows adequate quantities of high energy feed. At least two studies have indicated that feeding problems can occur as a result of feed competition (Levis, 2004; Brouns & Edwards, 1994). At part-time family farms, all sows were kept in single stalls, excluding competition as a cause for the observed malnutrition. The apparent malnutrition must therefore be related to inadequate feeding practises. In fact, More *et al*. (2005) also reported nutritional problems amongst pigs of smallholders in the Philippines and argued that it relates to a lack of education and information about adequate feeding practises.

Furthermore, all farmers and particularly full-time family farmers practised routine surgical interventions such as castration, tail docking and teeth clipping. Routine surgical interventions are all still common throughout the European Union (Gallois *et al*. 2005). However, the EU recommends refraining from these practices (EC Directives, 2001). To reduce surgical interventions, changes in management practises seem necessary but not changes in the buildings at farming premises.

Furthermore, only few sampled pens were equipped with toys for recreation as recommended by the EU (EC Directive, 2001). It can be suggested that also the provision of toys does not require a reconstruction of farming premises. Rather, provision of toys may be achieved through educating farmers about ways of providing pigs with safe toys and by advocating beneficial results from doing so.

7.2 Pig welfare problems related to education

Brambell (1967) and the FAWC (2007) argue that well-trained and affectionate staff is the most important factor in providing animal welfare. Accordingly, the EU pig welfare directives

recommend that all stockperson should be trained sufficiently for their task of caring for the pigs (EC Directive, 1991). Education of pig farmers was, however, not equally well ensured across all pig production systems in Croatia.

The results have shown that the veterinary service, the agricultural administration body and the agricultural extension service were all communicating with full-time family farms. Institutional stakeholder described that educational efforts were often complicated by a lack of cooperation by the farmers as well as a lack of human and financial resources. Consequently, in 2007 only 15.3% of all full-time family farms were registered with the agricultural administration body (Mahnet, 2008). In order to address the outlined welfare problems at full-time family farms, efforts to register and educate full-time farmers should be encouraged by directing financial and human capital at the involved institutions.

Education of employees at farm enterprises appeared to be the primary responsibility for European advisors. Communication with governmental education channels seemed less well established.

The education of part-time family farmers appeared least ensured. In fact, only the veterinary service seemed to have contact with part-time family farmers while the agricultural administrative body and the extension service were not involving part-time family farms in their education efforts. The neglect of communication with part-time family farmers can, of course, be explained by the stated lack of cooperation, financial and human capital. On this line, it appears logically that the government focuses first on aligning business-oriented full-time family farmers with European rules and regulations before considering farms that produce primarily for own consumption.

One can, however, also argue that besides practical challenges faced by institutional stakeholders; the neglect of part-time family farms is intentional. Part-time family farms were argued to terminate their farming practises in the future therefore posing no need to be educated.

Part-time family farming is a wide-spread tradition in new European and candidate countries but it is often neglected in the European alignment process (Abele & Frohberg, 2003; Kostov & Lindgard, 2004; Thurston, 2008). Despite the interest of institutional stakeholders to terminate part-time family farms, part-time family farmers showed intentions to continue with their lifestyle in the future. Accordingly, the visited part-time family farmers in Croatia were

frustrated by the lack of governmental support and were not motivated to improve the welfare of their pigs.

One can argue that the lack of involvement with part-time family farms causes welfare impairments for both, part-time family farmers and their pigs. Semi-subsistent farming serves a social safety net function for many rural inhabitants in new European and EU candidate countries with socialist and communist histories (Vira & Narnicka, 2003). For example, unemployment rates in these countries are higher than in old European member states and often, rural inhabitants depend on semi-subsistent farming to supplement their off-farm income and 50-75% of their products are usually sold on the market (Vira & Narnicka, 2003). Indeed, also part-time family farmers stressed that pig production was an important asset to their off-farm income work. Additionally, semi-subsistent farming is often regarded as a sign of independence from the government and has symbolic value for inhabitants of former socialist and communist countries (Petrick & Tyran, 2003).

According to the strong social significance, it is questionable whether neglecting part-time family farms will drive part-time family farmers to terminate their farming practises in the near future. Accordingly, the neglect of part-time family farms as players on the national pork market may have serious implications for the welfare of pigs and humans. On the one hand, preventing part-time family farmers from receiving formal status could increase trading activities on the informal market. It has been argued that informal markets are well established within Croatian society (Screening Report, 2007). Also part-time family farmers stated to sell piglets to middlemen which are part of the informal market (pers.com.). Neglecting part-time family farmers would thus reduce governmental control and encourage informal market activities. On the other hand, lacking regulations and education also poses risk for the spread of zoonoses. Murrell & Piozo (2005) thus argue that trichinellosis is still common in Croatia as a result of lacking control during the war which took place from 1991-1995.

To circumvent welfare impairments for pigs and humans on part-time family farms in Croatia and other new European member and candidate countries, it appears necessary for the EU to recognise part-time family farming in legislation. This way, one can argue, part-time family farms are more likely to be addressed with financial aid and education measures in the future. Consequently, pig welfare problems caused by a lack of knowledge- such as malnutrition- could be addressed and the welfare of pigs could be improved.

7.3 Compliance with EU pig welfare resources is no guarantee for better pig welfare

Other welfare problems were caused by a lack of compliance with EU recommended resources (EC directive 1991, 2001). On this line, it is necessary to point out that the number of resource-related welfare problems was highest at full-time family farms. These farms often lacked group housing facilities for sows, provided bigger slat widths than recommended by the EU (EC directive 1991, 2001 and provided no manipulative material and bedding for their pigs.

In compliance with the recommendations of the European Commission (Commission Decision, 2007), the presented results support that full-time family farms need reconstruction in order to comply with EU standards. One can, however, doubt that reconstruction along the lines of missing EU resources will guarantee pig welfare. For example, although farm enterprises complied best with the recommended resources, pig welfare did not appear to be better than on full-time family farms or part-time family farms when measured with animal-based welfare indicators.

Arguably, the provision of straw at part-time family farms and at small full-time family farms had a positive effect on the welfare of pigs. With regard to manipulate material these farms were therefore superior to large full-time family farms and farm enterprises.

For example, pigs at part-time family farms were significantly cleaner because their pens were bedded with straw. Also Spoolder *et al* (2000) found that the cleanliness of pigs increases with straw provision and concluded that straw increases pig comfort. On the same lines, Tuytten (2005) argues that provision of bedding enhances physical and thermal comfort for pigs. Of course, in natural environments, pigs are not clean as they bathe in mud to protect their skin. Pigs at the visited production systems had, however, no access to earth-like substrates. Consequently, the observed dirt had to stem from faeces and hence reduced pig welfare at farm enterprises and large full-time family farms.

Furthermore, straw bedding does not only provide comfort but also decreases leg injuries (Edwards & Lightfoot, 1986; Andersen & Bøe, 1999). Slatted or concrete floors as provided on full-time family farms and farm enterprises are, however, likely to increase the risk for leg injury occurrences (Edwards & Lightfoot, 1986; Andersen & Bøe, 1999).

On the same lines, at least three studies have shown that straw provision reduces aggressive interactions amongst pigs (Day *et al*. 2002; Bracke, 2007; Zonderland *et al*. 2008). Injuries such as skin lesions and bite marks on tails and ears are often the results of aggressive

interactions in group pens (Schmolke *et al*. 2004). Accordingly, one can assume that pigs at part-time family farms and small full-time family farms should show lower amounts of skin lesions and bites than at large full-time family farms and farm enterprises. Interestingly, however, in the present study no differences were found between skin lesions and ear bites recorded at the different pig production systems.

One explanation for this contradiction is that some of the sample pens at farm enterprises and large full-time family farms were equipped with toys. Blackshaw *et al* (1997) thus indicate that aggressive behaviours were significantly lower in group pens with toys than without toys. In contrast though, Scott *et al* (*In Press*) report that hanging or lying chains did not reduce pig-directed behaviours in group houses when compared to straw enrichment. Other factors must have also influenced the presented results.

For instance, the reliability of the results was reduced due to methodological problems. Pictures were biased because they were not taken at random but chosen according to the visibility of the pigs on the pictures. Furthermore, when comparing lesions no distinction was made between lesions on shoulders, rump and hind quarters. As Whay *et al* (2007) report, skin lesions were more frequently observed on the flank than on head or neck regions. The comparison of different body parts may thus have also biased the results. Future studies are therefore necessary to improve animal-based welfare assessment methods and to repeat the animal-based welfare assessment between the different pig production systems using the improved animal-based welfare assessment methods.

Nevertheless, van de Weerd & Day (*In Press*) argue that straw can have multiple positive effects with regard to the welfare of pigs in intensive housing systems. Also the results of this study suggest that straw bedding has no negative effect on pigs and potentially positive effects since it increases cleanliness. Accordingly, it may be suggested that compliance with other EU recommended resources cannot compensate for the beneficial effect of manipulative material.

In order to facilitate the implementation of manipulative materials in intensive pig production systems, research has already been carried out regarding the ecological feasibility of different bedding substrates in modern, intensive production systems (e.g. Amon *et al*. 2007; Blanes-Vidal *et al*. 2008). Also, Tuytten (2005) has argued that pigs may prefer earth-like substrates to straw which could also be more feasible with the modern slurry systems.

In addition, the EU pig welfare directives do not recommend maximum group sizes (EC Directive 1991, 2001). Group sizes were largest at farm enterprises and smallest at part-time family farms. Brambell (1967) argues that pigs naturally live in groups of up to eight pigs. The results suggest that small group sizes increase pig comfort, indicating a positive effect of small group sizes on pig welfare. Importantly though, Andersen *et al.* (2004) demonstrated that aggressive incidences increased with decreasing group sizes because the possibilities to win fights increased as well. These assumptions were supported by other studies such as Turner *et al.* (2001) and Nielsen *et al* (1995). The results of this study do not support this assumption. Future studies should therefore continue to address optimal group sizes for pigs in confined spaces.

In order to compete on the capitalistic European market, full-time family farms need to enlarge and intensifying (Misir, 2003; Antunovic *et al*. 2004a). On the basis of the presented results, one can, however, doubt as to whether enlargement and intensification of Croatian pig production systems will improve the welfare of pigs. In addition, one can also argue that enlargement and intensification may impair the welfare of full-time family farmers. For example, the visited full-time family farms were considerably smaller than family farms in old European member states. For instance, while the visited full-time family farms housed only between 11 and 90 breeding sows, 67% of all family farms in old European member states own between 100 and 200 breeding sows (Antunovic *et al*. 2004a). Accordingly, full-time family farms need to expand in order to be competitive. Expansion is often complicated because farming premises are small, farm lands parcelled and expansion difficult because of high financial risks, unresolved landownership and people's lack of interest in selling their land (pers com., Antunovic *et al*. 2004 a; SAPARD, 2006). It may therefore be suggested that in order to ensure the welfare of pigs and farmers at full-time family farms, intensification of pig production is not a good option.

To ensure pig and human welfare, full-time family farmers could arguably engage in alternative production methods. For example, it has been argued that Croatia shows good condition for organic agriculture (SAPARD, 2006). On this line, Antunovic *et al* (2004b) argue that organic pig production is a good alternative towards conventional pig production because it can use more robust pig breeds with less housing demands.

The market for organic products in Croatia has not been well-established yet, but Radam (2005) reports that Croatian consumers have a positive perception of organic products because they regard them as healthy. At the same time, however, Radman (2005) indicates

that Croatian consumers are less familiar with ecological products and regard them as expensive.

Additionally, consumers in Croatia, as well as in others South and South-Eastern European countries generally appear to prefer meat from small-scale farms (e.g Bock & van Leeuwen, 2005; Nijland, 2005; Roe *et al.* 2003., Tolušić *et al*. 2004). These preferences could be used for marketing national organic products.

Organic pig production as an alternative for full-time family farmers to remain within the pork industry should be investigated in future studies.

7.4 Conclusion and Recommendations

The results do not show whether the modernisation of Croatian pig production systems- and hence the implementation and enforcement of the EU welfare directives- will improve or impair the welfare of pigs on farms in Croatia. From the perspective of pig welfare, enlargement and modernisation of full-time family farms and farm enterprises cannot be supported. Likewise, efforts to terminate or intensify family farms could lead to welfare impairment- both for pigs and for humans- instead of welfare improvement. For example, neglect of part-time family farms could increase informal market activities and reduces control of pig welfare on these farms. It may therefore be suggested that other measures than modernisation are necessary to ensure pig welfare on farms in Croatia, as for instance alternative production methods and diversified education activities. Suggestions for policy makers include:

1. Part-time family farmers are not educated about the pig welfare directives because they are argued to terminate their farming practises in the future. Part-time family farming is, however a cultural heritage and an important livelihood strategy in rural parts of Croatia. EU accession money should therefore be directed towards preserving part-time family farms as a cultural heritage.

2. Part-time family farms should be addressed by extension because both human and pig welfare problems could be best addressed this way.

3. Expansion is not a solution for all pig production systems in Croatia. Alternative production methods should be promoted such as organic pig farming.

4. Although farm enterprises complied best with the EU recommended resources, the welfare of pigs did not appear to differ from the welfare of pigs at full-time family

farms and part-time family farms. Future studies should aim to revise the EU welfare directives and identify recommendations, as for instance the provision of manipulative material, which need to be recommended with more stringency.

Furthermore, the pig welfare assessment was impaired by methodological complications. Future studies should therefore address the following issues:

1. The results presented in this study were gathered from a small sample of pig farms in Croatia. Future studies with larger samples of part-time family farms, full-time family farms and farm enterprises are necessary to assess the validity, reliability and repeatability of the research findings.

2. The use of pictures to compare animal-based welfare indicators was biased because they were not systematically taken from the same body parts. Future studies should repeat the welfare comparison between the different pig production systems using improved animal-based welfare assessment methods.

3. In the presented study, health related indicators were omitted because veterinary skills were not available for this study. To complete the welfare comparison of pigs at the different production systems, future studies must including health parameters.

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Appendix I Interview guide for institutional stakeholders

I will introduce myself, my study and ask the participants for agreement to use a digital voice recorder during the interview. I will debrief the participants that the data will be handled carefully and that I alone will listen to it. I will also explain that the data will be treated anonymously and if they like, I will provide them with a written (English) copy of the interview.

1. General Information:

- What are the tasks/ is the mission of your institution/organization/ office?
- What is your area of responsibility?
- What does your work involve?
- How does your work relate to farm animal welfare?

2. Animal Welfare:

- A lot of people are concerned about animal welfare- politicians, consumers, scientists, everybody is talking about it. It seems though that everybody has a different understanding of what animal welfare actually is. What would you say? What is animal welfare?
- Do you think the welfare of animals on farms is a great concern to people in Croatia?
- Do you think there is a difference between what people in general and what farmers think about animal welfare on farms?
- Do you think there is a difference between what people think about the welfare of animals on small farms and on large farms?

3. Pig welfare:

- Are you concerned about the welfare of pigs on Croatian farms?
- Do you see a difference between the welfare of pigs on small and large scale farms? (Please give examples)
- In your opinion, what does a pig need to have in order to feel good?
- Does it matter if a pig feels good? Why?
- In your opinion, what makes a good pig farmer?
- Are Croatian pig farmers good pig farmers?
- Would you differentiate between smallholders and large scale farmers?

4. EU Directives:

- Are you familiar with the EU welfare directives? (if not, show list)
- Would you say there is a big difference between the EU welfare directives and the existing Croatian law on pig welfare on farms?
- Can you give examples of differences?
- Since when is farm animal welfare part of Croatian legislation?
- What does Croatia need to do to align their legislation with the EU welfare directives?
- Can you give examples?
- How do farmers learn about the European pig welfare directives?
- How are changes concerning the welfare directives realized in practice on pig farms?

- Who controls whether the EU pig welfare directives are implemented?

5. EU Pig Welfare Directives & Different Farming systems

- In your opinion, are the EU pig welfare directives realizable on both, small and large scale pig farms?
- Would the realization of the pig welfare directives improve pig welfare on small farms?
- Can you give me an example how it would improve the welfare of pigs on small scale farms? (Why not?)
- Do you think it is difficult to implement pig welfare directives on small scale farms?
- Can you give an example why it is difficult?
- Do you think the welfare directives are suitable to address pigs on small scale farms?

- Would the realization of the EU pig welfare directives improve pig welfare on large farms?

- Can you give me an example how it would improve the welfare of pigs on large scale farms? (Why not?)
- Would it be difficult to implement pig welfare directives on large scale farms?
- Can you give an example why it is difficult?
- How do you envision the future of Croatia's pork sector with regard to its need to implement the EU directives?

6. Different farming systems:

- What role do smallholders play in pork production today?
- What was their role in the past?
- How do you envision the future for smallholders?
- How do you envision the future for large scale pig farmers?

7. Can you give me any suggestion about relevant persons who I should definitely interview about my research topic? (Can you help me establish the contact?)

Thank you very much for your participation. If you are interested, I will send you a summary of the results of my study after I completed it.

Appendix II Interview guide for pig farmers

1. General Information:

1.1 The farm & family

1.1.1.1 How big is your farm land?

1.1.1.2 How many people work on the farm?

1.1.1.3 Who works on the farm?

Do you employ seasonal workers?

Are you part of a cooperative? **T.**

1.1.1.4 How long have you been farming?

1.1.1.5 At what age did you start farming?

1.1.1.6 Did you do something else before you started farming?

1.1.1.7 I know that you have pigs, but do you also have other animals on your farm?

1.1.1.8 Do you produce for yourself or do you produce to sell your products?

1.1.1.9 Where do you sell your products?

1.1.1.10 Are you able to earn your living through farming?

1.1.1.11 Were you (also) able to do so in the past?

1.1.1.12 Do you also have an off-farm income source?

1.1.1.13 What kind of off-farm work do you (and others of the farm) do?

1.2 The pigs

(1) How many pigs do you have now?

(2) Since you started farming, do you always have about the same number of pigs at one time?

(3) Did you always have pigs?

(a) If no, why did you start pig farming?

What breed are they? Talked about the breeds in the barn

(4) Sows:

How many piglets do you have per sow and year?

1.2.1.1.1 What is the weaning age for piglets?

1.2.1.1.2 What do you do with the piglets after weaning?

b. Where do you get the pigs from?
c. At what age do you purchase them?
d. Do you also sell your pigs alive and to whom do you sell them to?
e. What is the normal price for a pig if you sell it?
f. What do you use the pigs for?
g. Who takes care of the pigs?
h. Do you slaughter the pigs yourself?
i. How do you slaughter the pigs?
j. If not, where do you bring them for slaughter?
k. What is the average slaughter weight of the pigs?
l. How long does it take until the pigs reach their slaughter weight?
m. What do you do with the meat?
n. Do you make your own pork products? What kind?
o. Do you sell the meat/ the products?
p. Where do you sell your products/ meat?
q. At what price can you sell the pork (per kg)?

2. Pig Welfare:

1) A lot of people are concerned about animal welfare- politicians, consumers, scientists, everybody is talking about it. It seems though that everybody has a different understanding of what animal welfare actually is. What would you say? What is animal welfare?

2) How would you judge the welfare of your pigs at the moment?
Why does he think that?

3) Does it matter if a pig feels good?
   a) Why?

If you have the terms animal health, animal welfare, economy and food safety, can you ask the farmer to rank these four terms according to their importance on his farm?

4) In your opinion, what makes a good pig farmer?
5) Are you a good pig farmer?
6) How is the welfare of pigs on the farms around you? Is it the same, better or worse?
   a) Why?
7) In your opinion, what does a pig need to have in order to feel good?
8) Would you like to do something that could improve the welfare of your pigs?
   a) What would you like to do?
   b) Do you have any plans?
9) Do you like pigs? (Wait what they say)
   a) If yes: Why? What makes them so likable?
   b) If no: Why? What makes them dislikable? What are the pigs to you?

3. EU Welfare Directives

1. Have you heard about the EU welfare directives? Yes No

   If *No*, I will give three specific examples including numbers(e.g. space allowance)

2. Do you know that Croatian farmers have to follow these directives when they join the EU?

3. If you compare your farm to these standards do you think you need to change something on your farm?

4. Do you think that the welfare directives are equally good realizable on both small and large scale pig farms?
   a. Why? Can you give me an example?

4. Future Perspectives:

1. Do you think it is important to look after animal welfare now that the agriculture in Croatia is facing major changes as it prepares to enter the EU?

2. Do you think that following the European welfare directives will actually improve animal welfare in Croatia?
3.
   a. *Yes*: How would you improve it?
   b. *No*: Why not?

4. In your opinion, how will these directives affect pig farming in Croatia in general?

5. How will the implementation of these directives affect your farm?

6. How do you think you farm will look like in the future?

7. Are there any questions you would like to ask me or anything you would like to add?

Thank you very much for your participation. If you are interested, I will send you a summary of the results of my study after I completed it.

Appendix III Check sheet for welfare assessment

Check Sheet Welfare Assessment

Farm Nr. ____ Size: Small __ Middle ___ Large___

Private ___ Cooperative ___ Other _____

Sows ___ Fattening Pigs ___

Vocalisation when entering the barn? Yes___ No ____

Describe vocalisation (Many pigs? Bellowing, grunting, squeaking etc).

Group Housing? Yes__ No___

Number of pens in barn: ___ (Take at least 3 for sampling)

Total number of pigs in barn ____

Number of pigs per pen: ___

Environmental parameters:

1. Temperature: (~ °C)

2. Size of pen/box: ___ x ___ meters

3. Floor type: Slatted ___ Concrete ____ Both ___ Other _____
    a. Slat width ___ mm
    b. Different floor areas? Yes ___ No___
        i. Description

4. Bedding: Yes ___ No ___
    a. Type of bedding:

5. Enrichment: Yes ___ No__-
    a. Type of enrichment:

6. Water: Ad libitum: Yes ___ No ___ Where is water supply?_____
    a. Supply:
        i. Automatic ___
        ii. Bucket ___
        iii. Trog
        iv. Other:_____

7. Feed: Ad libitum: Yes___ No___
    a. If no, how often? ____times per day_____
    b. Supply:
        i. Automatic
        ii. Bucket
        iii. Trog
        iv. Other:_____
    c. How much feed per day? _____
    d. Individual feeding spaces Yes _____ No _____
    e. What do you feed the animal?
    f. Where do you get the feed from?

8. Outdoor access available? Yes ___ No___

Description of outdoor area:

9. Nesting material for sows? Yes_____
10. Individual housing for farrowing sows? Yes _____

    When are they separated from the group?

Animal based parameters:

1. Lying behaviour.
    a. Huddled
    b. Apart
    c. Cigar-like
    d. Other:
2. Fear of humans:
    a. Approach after ___ seconds (max 10 sec)

Pig 1: Pig 3:

Pig 2: Pig 4:

3. Tail and Ear Bites:
    a. Total number of pigs with bites:_____
    b. Number of pigs with tail bites: _____
    c. Number of pigs with ear bites: _____

Additional comments:

4. Skin lesion:
    a. Number of pigs with skin lesion:
    b. Description of skin lesions:
5. Cleanliness:
    a. Number of pigs soiled _____
    b. Diarrhoea: _____
    c. Description:

For piglets:

Teeth clipping ? Yes___ No__ What age?
Castration? Yes___ No__ What age?
Tail dogging? Yes___ No__ What age?

Weaning age?

Additional Comments: