

1 **Application of HACCP-principles to control visitor health threats on dairy farms**
2 **open to the general public**

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16

17 **Abstract**

18

19 An increasing number of Dutch dairy farmers have started a subsidiary branch. As a
20 result of these changed business strategies, civilian visitors are often allowed on
21 farm premises, for instance to get in contact with animals, buy regionally
22 produced products or to camp.

23 Prevention of accidents and disease incidents for the people visiting these farms is of
24 utmost importance because accidents and incidents can result in, morbidity and
25 mortality cases, or at least in financial claims and, hence, could harm the
26 reputation of the agricultural sector. This article describes how the hazard
27 analysis critical control points concept and principles (HACCP) can be applied to
28 the on-farm service. The application of this concept can be integrated with on-
29 farm operational herd health and production management programmes.

30

31 **Keywords:** dairy farms open to the public, entry of public, public health, quality risk
32 management, HACCP application

33Introduction

34In many European countries the number of dairy farms has diminished strongly and
35will probably decrease further in the coming years for reasons described below. The
36Centre for Statistics in the Netherlands calculated that the number of holdings with
37cows in milk and cows in calf diminished from 46.977 in 1990 to 23.527 in
382005¹. Urbanisation and decreased economic margins between farm income and
39production costs lie often at the bottom of the decision to stop farming. Furthermore,
40many young people are no longer motivated to take over the farm. Remaining farmers
41often increase herd size and implement new technologies to increase herd productivity
42per man and per hectare. Sometimes threats are turned into opportunities by applying
43services or products aimed to citizens as a strategy to make a (better) living in the
44future. Not including farms with an extra branch in relation to conservation plans of
45landscape and nature, 81.830 Dutch agricultural farms added an extra branch in
46extended agriculture in 2005.¹

47Besides economic benefits, the development of opening farms to citizens is often
48beneficial for a positive public image of the agricultural sector. The general public
49nowadays has little knowledge about agro-production. Strict hygiene rules and up-
50scaling of farms contributed to the fact that only a minority of people has an origin,
51connections or an affinity with farming, farmers or the origin of the food products
52they buy. Consequently, the perception of the public is largely determined by animal
53health and food safety calamities that occur and the image built by the media².

54In the wide variety of products and services that have been developed, e.g. bed and
55breakfast, traditional or biological production of food, games and sports, the direct
56contact with animals comprises a service offered on many farms open to the public.
57Besides advantages of opening farms to the general public, potential threats have to be
58taken into account. Outbreaks of zoonoses³, for example due to contacts between
59humans and sick or latent carrier animals, or due to consumption of non pasteurised
60milk can render people ill, which could result in insurance claims. People can also get
61injured due to contact with animals⁴ or by dangerous machinery on the farm^{5,6,7,8}.

62Besides direct financial consequences, negative publicity can cause indirect financial
63losses. This can harm an individual farm but also the whole branch. Laws aimed to
64protect human health like the Dutch Occupational health and Safety act can render
65farmers liable when no adequate measures were taken to prevent people from getting
66injured or ill.

67To control these risks a Hazard Analysis Critical Control Points (HACCP) based
68system could be used. HACCP was initially developed as a systematic approach to
69identify, evaluate and control steps in food manufacturing that are critical to product
70safety⁹. All food-manufacturing facilities within the EU are forced to work in
71accordance to the HACCP methodology since the 1st of January 1996 according to the
72Directive on Hygiene of Foodstuffs (93/43/EEC). In the near future, farmers will most
73probably be forced to work with the HACCP concept, because this was already
74suggested in the EU Hygiene directive (EC 853/2004) and the General Food
75Law (EC regulation 178-2002).

76The HACCP concept appears to be the best choice for identifying and managing
77quality hazards and associated risks on dairy farms because it is highly farm-specific,
78easy to link up with operational management, relatively low in cost, both product and
79process oriented, not requiring much labor or documentation, and is fit for
80certification and linking up with Food Chain Quality Assurance programmes⁹. The
81application of HACCP can further help in providing clients with more certainty about
82the quality of products and services¹⁰. The Codex Alimentarius describes a 12-steps

83 procedure¹¹ (Table 1.). This procedure is taken as starting point for designing a
84 HACCP like approach to dairy farms, which are open to the public.
85 In this article the principles of HACCP are used to control public health issues on
86 dairy farms open to the public using contact with animals carrying zoonotic pathogens
87 as an example. The ultimate objective of such application is to safeguard visitors from
88 the various hazards.

89

90 Hazard analysis

91 The hazards on a dairy farm open to the public can be divided into those influencing
92 the quality and quantity standard of the targeted product of animal origin and those
93 influencing the safety of activities offered to the public (zoonoses and injuries).

94 Besides an influence on the quality and quantity of raw milk for example, animal
95 health and production system related hazards as animal welfare, can influence the
96 acceptance of products by consumers and services by the general public. Dependant
97 on the product or service, different hazards and risks are relevant to be considered.
98 Commonly three categories of hazards are distinguished: microbiological, chemical
99 and physical hazards and risks.

100 Focusing on the service “animal cuddling”, microbial hazards, like zoonotic bacteria,
101 viruses and parasites, can be present on animal skin and in an environment
102 contaminated with animal waste (e.g. manure). The exact outcome of the (microbial)
103 hazard analysis will be different on each farm, dependant on the animals selected for
104 cuddling, the health state of these animals and the regional / national differences in
105 prevalence of zoonotic pathogens. For the Dutch situation, pathogenic
106 *Enterobacteriaceae*, like *Salmonella* spp, *Campylobacter jejuni*, *E. coli O157* and
107 *Yersinia enterocolitica*, are zoonotic bacteria that can be prevalent without signs.
108 Furthermore, dermatophytosis, zoonotic scabies, contagious ecthyma, giardiasis and
109 cryptosporidiosis are zoonoses to be taken into account.

110 On farms open the public, people can also get into contact with chemical hazards, like
111 cleaning products, pesticides, herbicides, and veterinary medicines, when these
112 products are e.g. left straying around on a farm. Furthermore chemicals be found on
113 the hair-coat of animals when they are treated with pour-on applications of veterinary
114 medicines.

115 The category of physical hazards is strongly related to animal and human behavior.
116 People can get injured, for example, due to biting, kicking or scratching of animals,
117 but also as a consequence of poor maintenance of houses, fences or equipment.

118 Risk Assessment

119 During risk assessment, the HACCP team will discuss the hazards and conclude
120 which risk conditions are prevailing on the farm. In the process the team has to make
121 a decision about the relevance and priority of each hazard to be addressed. Risk
122 weighing can be conducted on the basis of locally existing veterinary epidemiological
123 evidence^{13,14} or through the approach of adaptive conjoint analysis^{15,16}, by which
124 expert opinions on a given subject are collected, validated and ranked. The third
125 option to give risks a certain weight is by qualitatively assessing the probability of
126 occurrence of that risk and the impact it may have once it is occurring. Examples can
127 be found in Lievaert et al. (2005)¹⁷. The HACCP team members conduct this
128 weighting to the best of their knowledge and experience.

129 Focusing on the hazards of “animal cuddling” listed in Table 2., different risk factors
130 can be defined. Important risk factors in relation to the hazard “animals carrying
131 zoonotic pathogens” are visitors having direct contact with animals and presence in an
132 environment contaminated with animal waste (e.g. manure)³. Furthermore, many
133 visitors who come to farms open to the public, like young children and pregnant
134 women generally have a more fragile state of health which put them, like also people
135 with skin lesions, more at risk than others (Table 3).

136 Besides infections with zoonotic pathogens, injuries due to biting, scratching or
137 kicking animals are important hazards. Unpredictable behavior of animals is a risk
138 factor related to these hazards, as can be the behavior of target groups of visitors
139 (Table 4.). Moreover, limited knowledge about natural and abnormal animal behavior
140 and little experience in animal handling will put people more at risk than well trained
141 animal keepers for example.

142

143 Critical Control Points, CCP, and Points of Particular Attention, POPA

144 A critical control point (CCP) is defined as a step, series of steps, or a procedure in the
145 production process, which can be inspected or measured, which is associated with the
146 hazard of concern, at which process control can be applied, and where control is
147 essential to prevent or eliminate a safety hazard/risk; and where related corrective
148 measures must guarantee the full restoration of control once it was lost. When an
149 envisaged control point, hence, does not meet one or more criteria named for a CCP,
150 but still is considered highly relevant, that control point is named a Point of Particular
151 Attention, POPA. A POPA may contribute to a reduction of the risks to an acceptable
152 level. POPA’s are usually provided with a target level, just as is done in veterinary
153 herd health and production management programmes^{18,19,20}.

154

155 CCP’s and POPA’s in relation to the hazard: “animals carrying zoonotic 156 pathogens”

157 An adequate measure to prevent people from getting ill due to an infection with
158 zoonotic pathogens or getting injured by animals is to prohibit people to have direct
159 contact with animals and to prohibit access to cowsheds or pastures (CCP). The
160 implementation of this control point will not be desirable, when direct contact with
161 animals is defined as the main goal of the service “animal cuddling”. Nevertheless, an
162 implementation of such a control point for selected groups of people, like very young
163 children or immune-deficient people, can be advisable in situations where infections
164 are known to be prevalent. Furthermore, this control point has to be implemented
165 when animals are defined as carriers of zoonotic pathogens. Adequate fences and
166 supervision can provide control of this CCP. When people are allowed to have direct
167 contact with animals, additional control points (POPA) are necessary²⁰.

168 Animals exposed to visitors are *a priori* tested negative of selected zoonotic
169 pathogens, ideally. Critical control points can only be defined for zoonotic pathogens
170 that can be tested easily and reliably, for example by visual inspection on clinical
171 signs or with on-site and laboratory tests. Unfortunately, for many zoonotic pathogens
172 quick, reliable and affordable test methods are not available. Besides this problem,
173 reintroduction of zoonotic pathogens can not be excluded on many farms where
174 animals and visitors are entering and leaving. Nevertheless optimizing the health state
175 of the herd is important in these open systems to reduce public health risks A strict
176 policy (good farming practice codes) on the purchase and introduction of new animals
177 in the herd will be of value. Furthermore, exposure of visitors to animal waste must be
178 reduced (as much as achievable) to diminish risks for people getting infected with
179 zoonotic pathogens. This point of particular attention can be targeted on different
180 levels of hygiene. For example: by removing animal droppings from the animal
181 cuddling area at least every two hours or by removing dirt and faeces from hair coats
182 before animals are exposed to visitors.

183

184 **Standards and Targets associated to CCP's and POPA's**

185 For each CCP and POPA, the standards and targets must be defined to make control
186 possible. Targets have to be defined dependent on the circumstances and goals of the
187 individual dairy farm. For most CCP's and POPA's named in Table 4, targets can be
188 set on a zero-tolerance, for example not allowing visitors in specific areas on the farm
189 premises. For the POPA "Exposure of visitors to animal waste is as low as
190 achievable" targets can be set in relation to bacterial plate agar counts as is used in the
191 food industry. For example, not allowing more than a certain number of colony
192 forming units per cm² for aerobic grow and a zero-tolerance for enterobacteriaceae on
193 the plate agar taken from a dining-table.

194

195 **Establishment of a monitoring system for Critical Control Points and Points of 196 Particular Attention**

197 For all Critical Control Points or Points of Particular Attention together a monitoring
198 system has to be developed. To optimize and maintain the health state of a herd for
199 example, it will be necessary to perform regular checks on e.g. the presence of
200 zoonotic pathogens. Dependent on the pathogen this can be done by visual inspection
201 on clinical signs or through laboratory examination after sampling faeces, urine or
202 blood to detect pathogen carriers or shedders.

203 Most hygiene measures to make the exposure of visitors to animal waste as low as
204 achievable (POPA) and the prevention of dangerous situations (POPA) can be
205 monitored by visual inspection²⁰. For example visitors should be supervised on
206 wearing suitable clothing and footwear, washing hands and behaving as prescribed.

207

208 **Establishment of Intervention methods & corrective action plans**

209 Monitoring data can be used to notice that a process step has deviated from the critical
210 limit or target. Corrective action must be taken to ensure that the CCP or POPA has
211 been brought under control again, or at least the impact has been reduced.

212 When monitoring data of the daily visual health inspection or regular sampling
213 reveals signs of zoonotic diseases, exposure of visitors to animals suspected of
214 carrying zoonotic diseases must be prohibited immediately. When visual inspection
215 reveals an insufficient level of hygiene, entrance must be denied temporarily.

216 Adaptations in cleaning method / frequency or a more hygienic design of cowsheds
217 and stables can help in up-scaling the level of hygiene.

218When visitors do not behave according to the farm prescription rules, correcting
219actions must be taken by drawing attention to these rules, warnings or ultimately
220refusal of entrance. Examples of prescription rules are not allowing visitors to eat or
221drink in the cuddling area and an obligation to wear suitable clothes during and wash
222hands after contact with animals. Dependant on the animal species present, extra
223behaviour prescription rules for visitors can be added.

224

225Establishment of verification procedures and record keeping

226To determine whether the HACCP programme is working correctly, verification
227procedures must be designed. Verification procedures are preferably not carried out,
228by the person who is responsible for performing the monitoring and corrective
229actions. This task can be performed by a local veterinarian skilled in this area or by
230qualified external parties.

231A verification procedure must include a review of the HACCP programme and plan
232and its records, deviations and products dispositions and a conformation that CCP's
233and POPA's are kept under control. When possible, validation activities should
234include actions to confirm the efficacy of all elements of the HACCP programme. In
235addition to these internal validity screenings, it can be expected that in the near future
236external verification through auditing needs to be implemented. The latter could
237eventually lead to certification of these kinds of dairy farms²⁰.

238Results of the hazard identification and risk analyses, and determination of CCP's,
239POPA's and their critical limits or targets have to be documented when a HACCP-
240like system is applied. Furthermore, procedures and recordkeeping of the CCP and
241POPA monitoring activities (frequency; methods; results; responsible person) as well
242as the associated corrective measures for improvement (CCP or POPA; date; area;
243type of measures taken; effects) are indispensable to assist the farmer to verify that the
244HACCP-like programme is working according to the objectives. The stored
245documents and records kept can, moreover, be used to perform short and long-term
246evaluations.

247

248Discussion and conclusion

249In addition to hazards related to the production of milk, dairy farms open to the public
250have to deal with hazards related to the activities undertaken by people entering the
251farm. Controlling safety risks for visitors entering the farm can be performed by the
252application of a risk management programme²⁰. The HACCP concept regards the
253identification of hazards, and the analysis and handling of risks. It can, therefore, be
254highly suitable for that purpose⁹. On (dairy) farms the number of CCP's will be
255limited because there are few physical processes; on the contrary, there will be much
256more POPA's²⁰. The latter, because live animals show biological variation (see a
257serotitre distribution in a herd) and because our diagnostics have a certain level of
258false-positive and false-negative test results; standards and tolerance limits are
259therefore not defined but rather target values (e.g. a yearly clinical mastitis rate <
26025%). Moreover, application of corrective measures will hardly ever guarantee a full
261restoration of process control; therefore, already two CCP criteria are not met, and,
262hence we speak of HACCP-like programmes. And because HACCP-like programmes
263to control food safety will undoubtedly become compulsory for dairy farms probably
264within a few years, according to the suggestion in EC directive 853-2004, it seems
265logical to control safety risks for visitors by using such a HACCP-like approach.
266This HACCP-like programme can be easily linked to the veterinary herd health and
267production management programmes^{18,20}. These programmes also deal with

268 monitoring of animals and their environment (i.e. risk factors), with animal health and
269 welfare and with public health issues, but rather in a qualitative manner. Their main
270 focus is operational farm management to increase income and reduce production
271 costs. HACCP-like programmes are, however, much more structured and formalised,
272 and have a more tactical orientation²⁰.

273 For optimal implementation it is desirable, when general guidelines like good dairy
274 farming codes of practice¹⁸ and technical work instructions for defined farming areas
275 (e.g. a protocol for good cleaning & disinfection, and a protocol on the purchase of
276 new animals) would already be in place. They enhance the proper attitude and
277 mentality in farmers to adopt a HACCP-like programme more easily.

278

279 In this article is demonstrated that it is feasible to develop and implement a HACCP-
280 like programme for dairy farms open to the public, in order to control
281 microbiological, chemical and physical hazards regarding public health. Besides
282 prevention of calamities, HACCP can be used in case of complaints to prove to third
283 parties that safety risks of both farm products and on-farm services are kept under
284 control. Furthermore, it can be used as a marketing tool (certification) as well.

285 The application of HACCP principles on dairy farms can provide veterinarians with
286 income if they assist and advise farmers in developing and introducing such HACCP-
287 like and associated programmes, Veterinarians can only perform these activities at an
288 adequate level if they are willing to invest in knowledge and skills in domains like
289 hygiene, zoonoses, farm economics, quality risk management and communication
290 skills.

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Table 1. The 12 steps procedure to develop and introduce a HACCP-like programme ⁹, adapted after Cullor, 1995¹² (VPH= veterinary public health; QRM= quality risk management)	
Step no.	Description of action
1	Assemble a multidisciplinary HACCP team (e.g. veterinarian, farmer, and VPH or QRM specialist)
2	Description of the product and its distribution
3	Identification of the intended use and consumers of the product
4	Development of process flow diagrams on the farm
5	On-site verification of the flow diagram on the farm
6	Conducting a hazard analysis and risk assessment
7	Determination of Critical Control Points, CCP, and Points of Particular Attention, POPA
8	Establishment of standards & critical limits for each CCP and targets for each POPA respectively
9	Establishment of a monitoring system including each CCP and POPA
10	Establishment of an action plan with corrective measures. Provision of general prevention measures. The definition of Good Dairy Farming codes of practice and Work Instructions
11	Establishment of internal and external verification procedures
12	Establishment of record keeping and documentation

368

Table 2. Different categories of public health & food safety hazards on dairy farms open to the public			
Service /product provided on the dairy farm	Microbial hazards	Chemical hazards	Physical hazards
Animal cuddling (possibly different animal species)	Animals carrying / shedding zoonotic pathogens	Pour on applications of veterinary medicines	Trauma as a result of being kicked, scratched or bitten by an animal.
Sport, games in the farmyard / on the farm premises	Zoonotic pathogens in the environment	Pesticides, Herbicides, Cleaning and Disinfection products	Dangerous machinery, Protrusions, Unequal grounds, Electric fence, Open waters (drowning)
Food production (raw milk /dairy products) Food consumption	Food borne zoonotic pathogens / decay	Residues of chemicals and medicinal products	Foreign objects

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Table 3. Risk factors associated with a hazard: The example of “animals carrying zoonotic pathogens”
Direct contact with animals
Stay in an environment contaminated with animal waste (manure, scabs)
Lesions of the human skin
Fragile state of health of visitors (young, old, pregnant and immune-deficient people)

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371

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Table 4. CCP's and POPA's associated with a hazard: The example of "animals carrying zoonotic pathogens"	
No contact between animals and visitors	CCP
Animals are free of selected zoonotic pathogens	CCP / POPA*
Exposure of visitors to animal waste is as low as achievable	POPA
Isolation of unhealthy animals	CCP**
* = depending on the test reliability (sensitivity and specificity)	
**= depending on the micro-organism involved	

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