

Full Length Research Paper

## Dairy cow welfare assessment on Algerian farms

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**This study is the first to use the Welfare Quality Assessment Protocol (WQ<sup>®</sup> AP) in Algerian farms, with all dimensions of welfare considered together. It aims at estimating the welfare level of dairy cows by identifying their positive and negative aspects in order to improve them and prioritize corrective action for their better sustainability. The observations were conducted in 100 dairy farms; scores were calculated for each farm, expressing the degree of conformity with 11 well-being criteria (absence of hunger, thirst, injury, illness, housing conditions, normal behavior). The results showed a level of well-being degraded with 95 farms classified as unacceptable, 4 farms as acceptable and only one as enhanced. The most degraded scores were related to eight criteria: Absence of prolonged hunger (22.8) and thirst (5.6), ease of movement (23.2), comfort around resting (40.7), absence of injury (37.6), absence of disease (31.9), expression of other behavior (12.6) and good human-animal relationship (34.3). The 95 farms classified as unacceptable are related to a high percentage of very lean cows (33.1%), a high frequency of mastitis (33.6%), lameness (33.8%), respiratory diseases associated with cough (15.6%) and a pronounced state of poor cleanliness on: udder (62.6%), hindquarter (60.6%) and hind limbs (60.6%).**

**Key words:** Animal welfare, assessment protocol, dairy cow, sustainability, score.

### INTRODUCTION

Issues relating to the animal, its status and its protection have become increasingly important over the past three decades, while the fate of animals was traditionally held or moved to a secondary concern. The ethical reflection on animal status and welfare was developed (Rollin, 1990; Marie, 2006) and protective rules were introduced in legislation. Institutions such as the European Union (EU), which in the Amsterdam Treaty identified animals

as sensitive beings and provided to fully take into account welfare requirements, developed several guidelines covering various aspects of animal welfare (including Council Directive 98/58/EC of 20 July 1998 concerning the protection of farm animals).

The OIE, as the international reference organization for animal health, not only develops standards for the welfare of animals, but also accompanies several

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**Abbreviations:** WQ<sup>®</sup> AP, Welfare Quality Assessment Protocol; OIE, World Organization for Animal Health.

countries through its regional committees for the implementation of strategies for the welfare of animal. Other organizations, such as the United Nations Food and Agriculture Organization (FAO), the International Organization for Standardization (ISO), the International Organizations of Farmers, non-governmental organizations (NGOs), governments and multilateral organizations, accompany this movement. Finally, significant public funding is granted to research institutions that deal with the issue of animal welfare, not only from a fundamental point of view but also through assessment methods for agricultural holdings (Blokhuis et al., 2003).

However, these developments are far from being made by the countries of North Africa (Algeria), where reflection on animal welfare is far from being a priority given the socio-economic problems of a population of over 160 million inhabitants. The countries of this region are striving to meet the strategies of OIE in terms of animal welfare, specifically the improvement of livestock conditions, transportation and protection of animal health and preservation of public health. But it is clear that despite the undeniable efforts, there are still several factors that affect animal welfare. The majority of dairy farms are conducted in intensive mode, with the dominance of permanent tied system which is a constant source of mental (stress) and physical (illness, injury ...) suffering, altering productivity, health and welfare of livestock. These serious constraints influencing dairy farming greatly limit its development, specifically an unfavorable climate due to irregular rainfalls, lack of water resources, insufficient supply of feed resources and existence of very contrasting agro-ecological zones as well as the continued loss of agricultural real estate assets in favor of urbanization that may destroy the entire agricultural real estate heritage, thus jeopardizing wildlife heritage, animal assets and the country's food security. In this general context and in order to propose ways of improvement, it is necessary to identify strengths and weaknesses of these farming systems through a study analyzing in a comprehensive manner their level of animal welfare and to draw conclusions on actions to be taken.

In this respect, several evaluation methods on the farm were developed, some based on the animal environment, for example the Animal Needs Index (Bartussek et al., 2000) and others based on the animal, such as WQAP (2009a). The animal-based indicators are more important and better than those based on resources because they can measure the actual condition of animals regardless of how they are housed and managed (de Vries et al., 2011).

For this, the WQ<sup>®</sup> AP resulting from the WQ<sup>®</sup> project (2009), which has shown its feasibility and reproducibility in many countries (13 European countries and 3 Latin American countries) and on different species (dairy cows, beef, pork and poultry) formed the basis of this study. Its

multidimensional nature including both physical and mental health as well as various aspects such as physical comfort, absence of hunger, disease and possibility to express normal behavior (Veissier et al., 2010) can respond to many concerns about the welfare of farm animals.

In this general context and in order to propose ways of improvement, our aim is to apply and analyze the WQ<sup>®</sup> grid at 100 Algerian dairy farms to assess their actual level and identify their strengths and weaknesses for better sustainability.

## MATERIALS AND METHODS

### Sample study

The choice of the study sample was made from the list of cattle farmers in the province of Algiers (Northern Algeria) in 2011. This list contains 970 farmers with 12.746 cattle's with 6392 dairy cows (5632 modern and 735 between improved and local dairy cattle) (Agricultural Department of Algiers, 2011). This list contains only the ones selected according to production type (dairy cattle), farms, joining the national milk rehabilitation program (which requires the possession of health approval for enabling them to deliver their milk directly to a government processing unit or milk through a milk collector), the number of dairy cows ( $\geq 6$ ) (minimum to have a health approval), the availability and cooperation of farmers to collect information. The number of dairy cows owned is a relevant selection criterion affecting in a decisive manner the behavior of farmers with respect to the management and use of new techniques such as mechanical milking etc.

We decided to visit 100 farms due to the limited number of observers (single observer) and the limited study period following the appointment schedule agreed with farmers, who voluntarily accepted to participate in the survey. The farms surveyed were chosen to reflect the diversity of dairy systems in Algeria.

### Questionnaire

A survey guide was used as a questionnaire containing qualitative and quantitative variables informing about the status of animals (body condition score), farming practices (maintenance of drinking troughs and functioning, the degree of freedom of cows, access to pasture or exercise area), comfort (cleanliness, injuries, sleeping area,), their health status (diseases) and their behavior (positive and negative), depending on the WQ<sup>®</sup> AP (2009) for dairy cows.

### Survey

The survey was conducted during 2011 over a period of 6 months (15th March to 15th September 2011) on 100 dairy farms with an average of  $12.0 \pm 7.9$  cows / by farm, with a minimum of 6 cows by farm and a maximum of 53 having an average daily milk production of 16 L. These cows belonged to different breeds: Holstein (44.6%), Montbeliarde (34.3%), Fleckvieh (9.7%) and Brown Swiss (11.4%), with an average of 2 breeds per farm. The farms visited are conducted in permanent (53.0) or partial (47.0%) tied stall with access to outdoor loafing area (28.0%) or a pasture (19.0%) from spring to summer. The observations were conducted by the same observer and lasted one day per farm. Data collected on cows and on herd level (depending on type of measurement) started just after the morning milking, and ended in the afternoon.

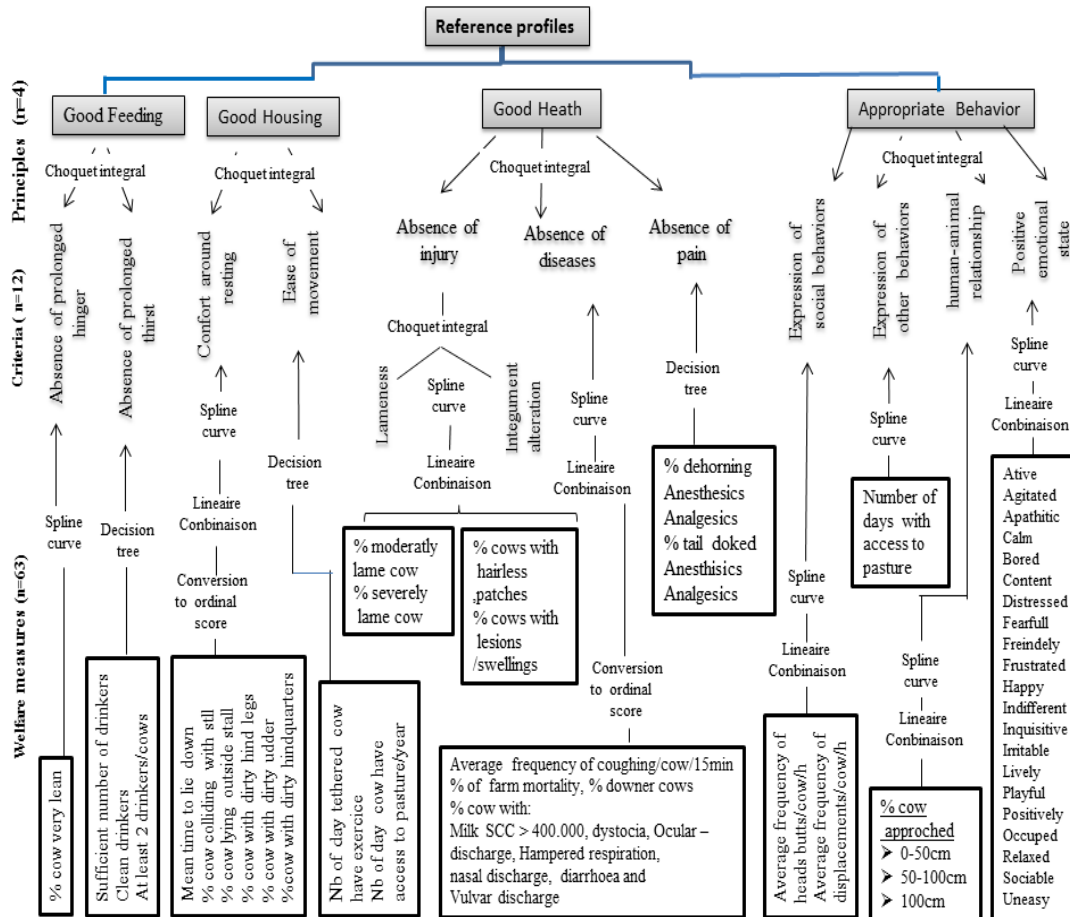


Figure 1. Welfare quality multicriteria evaluation model (Welfare Quality®, 2009).

**Measurements and scoring**

The data provided by the relevant measures were expressed on different scales and aggregated into 11 criteria. These 11 criteria were aggregated into 4 principles, and the 4 principles were aggregated into 1 classification. Different types of algorithmic operators were used in this aggregation process: Decision tree, weighted sum, linear combination, conversion to ordinal score, least squares spline curve fitting, and Choquet integral (Figure 1). In the first step of the aggregation process, decision trees were used to aggregate categorical measures into 3 criteria (e.g. absence of prolonged thirst, ease of movement and absence of pain due to management procedures). A decision tree leads to several possible outcomes, each of which was attributed a criterion score (based on expert opinion). For other criteria, welfare measures were first combined into a weighted sum or converted to an ordinal score, for example, no problem, moderate problem, or severe problem. The numbers of moderate and severe problems were then combined into a weighted sum on a scale from 0 (worst) to 100 (best). Finally, cubic functions were then used to transform the weighted sum into the criterion score. In the second step, Choquet integral was used to aggregate the 12 criteria into 4 principles. This integral uses weights to combine the different criterion scores into one principle score (expressed on the 0-100 scale). These weights, therefore, depend on the values of criterion scores; whereas the sum of these weights equals 1 (values for weights were based on expert opinion). Finally, herds were assigned to 1 of 4 welfare classes:

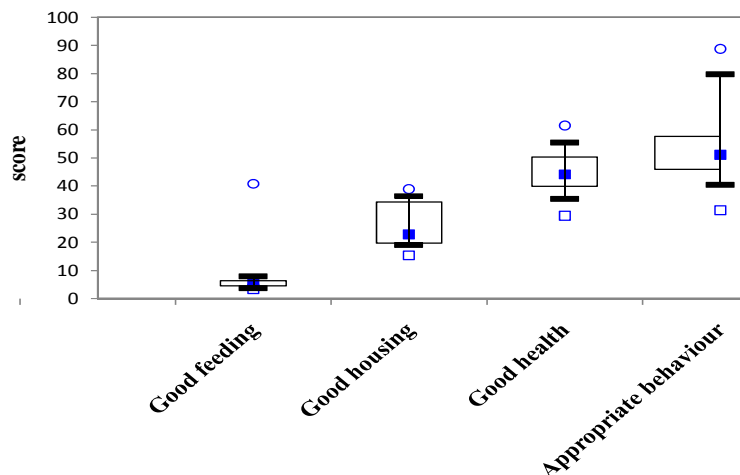
unacceptable, acceptable, enhanced, or excellent, based on reference profiles for the 4 principles (Botreau et al., 2009): to be classified as excellent, a herd must score >55 for each principle and >80 for 2 principles; to be classified as enhanced, each principle must be >20 and at least 2 principles must be >55; to be classified as acceptable, each principle must be >10 and at least 3 principles must be >20. Herds that did not comply with the minimum scores were classified as unacceptable (least 1 principle was ≤10 or at least 2 principles were ≤20). Detailed description of the use of algorithmic operators in the construction of criteria of WQ<sup>®</sup> AP can be found at: <http://www.welfarequalitynetwork.net/network/45848/7/0/40>.

**Statistical analysis**

Data processing was performed using Genstat Version 15.0 software (VSN International Ltd., UK), which was used to calculate descriptive statistics: The means and standard error of means for each score (quantitative variable) and the percentage or frequency of dairy cows (qualitative variable).

**RESULTS**

The implementation of WQ<sup>®</sup> AP on 100 Algerian dairy



**Figure 2.** Box-plot representation of the scores of the 4 welfare principles for the 100 farms surveyed. □, minimum; —, 1<sup>st</sup> decile; □□□□, 1<sup>st</sup> quartile; □, median; □□□□, 3<sup>rd</sup> quartile; —, 9<sup>th</sup> decile; □, maximum

farms revealed a deteriorated condition of well-being: Indeed, 95 farms were classified unacceptable, 4 as acceptable, one as improved and none as excellent (Figure 2). The 95 degraded farms classified as unacceptable were related to the weakness of eight criteria (Table 1). Absence of prolonged hunger assessed by the percentage of very lean cow estimated through the body condition score according to Edmonson et al. (1989) grid that uses scores of 0 to 5, showed that 81 farms contain very lean cows (BCS<2) with an average prevalence of 33.1% ranging from 5.8% to 51.9%. Absence of prolonged thirst measured by the number of drinkers by cow, their functioning and their cleanliness, showed that 5% of surveyed farms provided only one drinker per cow available at all times, or the drinkers were not clean, resulting in scores between 32 and 60. Conversely, 95.0% of farms did not provide enough drinkers and therefore scored 3. The criterion 'Comfort around resting', evaluated from 6 measurements: lying down time, lying down outside the lying down area, and cleanliness estimated at three body areas (legs, udder and hindquarter), according to alarm and alert thresholds obtained an average score of 40.8. This score showed that the majority of farms visited exceeded the alarm threshold for lying down time (6.3s) and cow cleanliness (which varies from 19.0 to 50.0% according to the part of the body).

### The time taken by the cow to lie down

This is the length of the lying sequence: The duration of lying down begins when the animal bends the lower legs and ends when it brings out these lower legs under its abdomen. 41% of visited farms exceeded the alarm threshold and 39% of the alert threshold for the measure 'time taken by the cow to lie down'. Only 20.0% of farms

recorded a time of normal sleep. In our study, the average time taken by cows to lie down is 5.9 s (min: 4.0 s and max 8.1 s).

### For both measures

Cows lying outside the lying area and equipment collision to equipment, a small proportion of livestock have exceeded the alert threshold which is respectively 2 and 1%. Also, a low average frequency of collision and cows lying outside the supposed lying area setting was observed, which is respectively 3.0 and 2.9%.

Regarding the cleanliness of dairy cows, we noted a high prevalence of cows with dirty udder (62.6%), hindquarter (60.6%) and lower part of the hind limbs (60.6%). Consequently, a large number of farms exceeded alert thresholds for these measures: 100.0% for udders cleanliness, 86.0% for the hindquarter and 63.0% for the hind limbs.

Ease of movement determined in the WQ<sup>®</sup> AP by the type of housing (tied up or loose). Indeed, the protocol penalized farms conducted in tied up houses (score = 0), unless there is access to outdoor loafing area or pasture. In this case, the number of hours per day or days per year is considered; contrary to the free stall where the score is 100. In farms visited, 53.0% were all the time in tied up stalls (scored 15) against 47.0% in semi-tied up stalls: 28.0% have access in outdoor loafing area with a minimum of 6 hours per day (scored 32) against 19% in pasture (scored 34).

### Absence of injuries

High percentages of moderately and severely lames

**Table 1.** Criterion scores on the 100 dairy farms studied.

Criterion	Farm score (Mean $\pm$ standard error)
Absence of prolonged hunger	22.8 $\pm$ 10.9
Absence of prolonged thirst	5.5 $\pm$ 11.5
Comfort around resting	40.7 $\pm$ 10.6
Ease of movement	23.2 $\pm$ 8.9
Absence of injuries	37.6 $\pm$ 9.8
Lameness*	37.3 $\pm$ 13.2
Integument alterations*	40.8 $\pm$ 13.7
Absence of diseases	31.9 $\pm$ 13.3
Absence of pain due to management procedures	100 $\pm$ 0
Expression of social behaviors	68.1 $\pm$ 8.5
Expression of other behaviors	12.6 $\pm$ 26.2
Good human-animal relationship	34.3 $\pm$ 9.2
Positive emotional state	85.5 $\pm$ 15.2

\*Means partial score of criterion 'Absence of injuries'.

cows were respectively 18.2 and 15.6%, resulting in a partial score for lameness (37). The percentages of cows with mild and severe integument alterations were 46.6 and 22.9%, resulting in a partial score for integument alterations (40.8).

### Absence of disease

Several symptoms highlighted an average percentage of cows with hampered respiration of 15.6% per farm and 0.0% of ocular discharge, nasal discharge and vulvar discharge. The average frequency of coughs was 1 per cow per hour. Farms archived an average prevalence of 33.6% cows with high somatic cell counts (>400 000 cell/ml at least once during the last 3 months), and 10.4% mortality, 2.3% dystocia, 3.6% diarrhea and 4.4% downer cow during previous years .

Expression of other behaviors assessed by accessibility of pasture (based on the number of days per year during which the cows had access to pasture for at least six hours), 19.0% of farms spent an average time of 170 days on pasture per year with an average time of 9 h per day.

Good human-animal relationship (evaluated through the avoidance test towards a foreign person, taking into account the distance at which cows could be approached), showed on average, 29.6% cows could be approached to 50 cm but not touched and 43.0% fleeing between 50 and 1 m, followed by 14.9% fleeing at 1 m. Only, 12.4% cows were touched.

Other welfare criteria used in the classification of farms as acceptable and improved in our study were: agonist interaction between cows (0.1/cow/h) associated to positive emotions (active, friendly, calm, relaxed, happy, and positively occupied,) and the total absence of use of painful methods (dehorning and tail docking) by farmers.

### DISCUSSION

The absence of works on the well-being of dairy cows conducted by the WQ<sup>®</sup> AP in Algeria context led us to compare our results with others conducted in Europe. knowing that welfare problems observed in our surveyed farms, linked to the housing system and husbandry practices (food, health, behavior, comfort,...), have been described previously.

The 95.0% downgraded farms were related to the type of housing system, of which the most dominant in our study was the impeded permanent system (zero grazing), that provided a permanent source of mental (stress) and physical (illness, injury ...) distress, altering productivity, health and well-being of livestock. This fact was observed in American (half on tied up mode), Austrian, Italian, German (Botreau et al., 2009) and Dutch farms (de Vries et al., 2013). This type of housing is dominant in the majority of Algerian farms and is growing more and more with the continuous loss of agricultural land resources for the benefit of urbanization that could destroy the entire agricultural support and endangering wildlife heritage and national food security.

This confirms behavioral problems encountered in surveyed farms and reflects the lowest scores recorded by the criteria 'Ease of movement' (23.2), expression of other behavior '(12.6) and 'Good animal-human relationship' (34.3). Also, the results of the calculation of welfare scores showed that only 19.0% of surveyed farms practicing free grazing on limited periods of the year with less than 6 h per day compared to other farms were mostly hampered (53.0%). These are similar to Tucker et al. (2009), which recorded more than 50.0% of the tie-stall barns in England.

An intense condition of fear in visited farms was also observed overlooked a foreign person. This condition had

a negative impact on livestock productivity and farmers safety. Indeed, fear, whether sudden, intense or prolonged, seriously damaged welfare, productivity and meat quality (Rushen et al., 2007).

The scores for 'Absence of prolonged thirst' (5.5) were the lowest in almost all surveyed farms due to water supply that seemed insufficient in 5 farms, with one water point per cow and absence of water point in 95 farms. This implies that specific attention should be given to this criterion in the study context because water supply was rationed, did not meet the water requirements of dairy cows and induced a reduction in metabolism, food consumption, cow weight and milk production (Cardot et al., 2008). Boudon et al. (2013) showed that a slight under-watering reduced immediately production performance and efficient use of feed resources. It was estimated that 50.0% restriction on the amount of water consumed *ad libitum* by cows caused a loss of 5 kg/day of milk.

The scores for 'Absence of prolonged hunger' (22.8) were low in farms with a high percentage of very lean cows (33%). This percentage of lean cows was specially related to Holstein breed. Therefore, the frequent leanness of Holstein cows should rather be ascribed to their higher milk production that puts them at higher risk of nutritional deficit at least at the beginning of lactation, and difficulty to recover these reserves during critical periods (late of lactation or during the dry period). This percentage was much higher than that found by de Boyer des Roches (2012) in France (16.3%).

Regarding 'Comfort around resting', low scores were mostly related to the high percentage of cows with lying down time exceeding 6.3 s and to high frequency of dirt at different body area of surveyed cows: Udder (62.6%), hindquarter (60.6%) and hind limbs (60.6%). Consequently, a large number of farms exceeded alert thresholds for these measures: 100.0% for udders cleanliness, 86.0% for the hindquarter and 63.0% for hind limbs. These frequencies were much higher than those obtained respectively by Whay et al. (2003) and de Boyer des Roches (2012), related to the frequency of dirt found at udder (20.0, 22.2 and 26.5%) and hindquarters (17.7, 10.7 and 51.5%), while they were lower than those observed in hind limbs (80.4, 100.0 and 100.0%). This high percentage of dirty cows referred to a degraded environment of the animal, a slippery wet lying area, without litter or thick litter indicating poor health conditions.

The majority of visited farms exceeded the alarm threshold for lying down time (6,3s). This was due, on the one hand, to the mismatch between the sleeping area and the movement of sleeping cows and on the other hand to a high percentage of lame cows observed in surveyed farms. It was also noted an average time taken by cows to lie down: 5.9 s (min: 4.0 s and max 8.1 s). This is similar to that reported by de Boyer des Roches (2012) in France: 5.9 (min: 3.1 s, max: 10.7 s) and Brorkens et al (2009): 4.1s (min: 2.3s, max: 8.9 s) in mulched area.

By cons, the lowest percentage for both measures: cows lying outside the lying area (3.0%) and 'collision to equipment'(2.9%), were related to the fact that surveyed farms bump less with infrastructure (feeders, drinkers) in the absence of a separation between cows. These frequencies are similar to those of Brorkens et al. (2009) (1.8%).

The lower score 'absence of injury' was to the weakness of: Absence of lameness (37.3) and alteration of the integument (40.8). The scores 'Absence of lameness', ranged from 0 to 50% with an average frequency of severe lameness (15.8%) against (18.2%) moderate lameness. These were linked to a concrete floor, sliding without bedding and permanent containment of cows in 53 visited farms. These factors represented a constant source of pain and discomfort and thus constituted major damage to their well-being (Whay et al., 2003; Coignard et al., 2013).

The frequency of severe lameness in our study was similar to that of de Boyer des Roches (2012) in France (14.6%). Consequently, the variability of lame cows in our study (0.0 to 50.0%) was lower than that reported by Barker et al. (2010) (0.0 to 79.0%). This divergence was raised in the studies cited above, and reinforced by the work of WQ<sup>®</sup> (2009) researchers.

The scores of 'Alteration of integument' (40.8) were associated to the average frequency of severe (22.9) and moderate (46.6), ranged between (0-66.6%) for severe alterations and (0-100.0%) for moderate alterations. This percentage was mainly linked to repeated contact of cows with betone floor and prolonged lying of lame cows. Also, their permanent presence in livestock buildings increased the risk of injury. Our result was similar to that found by de Boyer des Roches (2012) in France (38.6) and confirmed the several works that showed that detection of injuries is a necessary practice for health monitoring of the herd.

The lowest scores 'Absence of diseases' (31.9), were more linked to reported cases of mortality (10.4%), to the frequency of respiratory diseases associated with cough (15.6%) and especially to mastitis (33.6%) with high somatic cell counts (>400 000 cell/ml at least once during the last 3 months). This high percentage of mastitis was explained in part, by the almost complete use of mechanical processes and second, by the lack of maintenance and hygiene of milking equipment and the lack of use of cloths for each individual cow. Our percentage was similar to that found by Saidi et al. (2013) in Algeria (29.6%) but was higher than those found by de Boyer des Roches (2012) in France for mastitis cases (20.4%).

The percentage of respiratory diseases was related to the high number of farms that did not meet the standards (dark, current of air and moisture). While, the reported cases of mortality (10.4%), were motivated by: pelvic fractures, dystocia calving and septicemia. This percentage was higher than that found by de Boyer des



Roches (2012) in France (3.2%).

Other pathologies were identified such as diarrhea problems (3.6%), dystocia (2.3%) and cow lying syndrome (4.4%). These high prevalences showed the poor health condition of visited farms, the dominance of certain diseases that referred to the disparity in breeding lines.

The criteria that have contributed to the classification of farms in acceptable and moderate category were related to the average frequency (0.5) of others agonistics interactions displacement, chasing, fighting ...). Our results were in accord with the opinion of Bouissou and Boissy (2005), which showed that when the group of animals is together for a long time, the proportion of interactions represented by agonistic interactions decreases and threats, leaks and spontaneous avoidance will express more.

Also, a large number of farms have expressed more positive emotions (active, friendly, calm, relaxed, happy) and fewer negative emotions (restless, anxious, apathetic, scared, frustrated, irritable and indifferent). These results refer to the degree of familiarity and sociability between cows of farms surveyed. By cons, no tail amputation practice was adopted in farms visited. Our results confirm those of de Boyer des Roches in France (2012).

In conclusion, The implementation of the WQ<sup>®</sup> AP for the first time in Algerian farms showed that cows were exposed to various welfare problems, the most crucial ones (in terms of severity and prevalence) being: Health disorders including diseases, injuries, poor resting comfort and power management. Housing of dairy cows needs improvement to enhance resting comfort and reduce cow injury and disease.

Another study should be conducted at different seasons of the year in order, firstly, to assess risk factors that are associated with the degradation of wellbeing of surveyed farms, and secondly, to bring changes to certain criterions measures such as 'Absence of prolonged thirst'. The latter requires improvements that reflect the real condition of the animals as physiological and blood parameters (hematocrit), in addition to the existing arrangements.

The results of this study support the feasibility and potential of this tool not only for assessment, but also consulting and decision making purposes.

### Conflict of Interest

The author(s) have not declared any conflict of interest.

### ACKNOWLEDGMENT

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