

MEKELLE UNIVERSITY



**ASSESSMENT OF DAIRY COWS WELFARE IN SELECTED
URBAN AND PERI-URBAN AREAS OF TIGRAY REGION, NORTHERN
ETHIOPIA**

BY

Alemu Gebrekurstos

**Advisor: Netsanet Berhe (DVM, MSc, MPH, Associated Professor of
Epidemiology and Biostatistics)**

**A Thesis Submitted to the College of Veterinary Sciences, Mekelle University, in
Partial Fulfillment of the Requirement for Degree of Master in Tropical
Veterinary Medicine**

**November, 2023
Mekelle, Ethiopia**

STATEMENT OF THE AUTHOR

I, the undersigned, hereby declare that this thesis entitled “Assessment of dairy cow welfare in the selected urban and peri-urban areas of Tigray region, Northern Ethiopia” is prepared by me with the guidance of my advisor. The thesis is my original work and has not been presented in any other university or institution for consideration of any publication. It has also been complemented by referencing source that is duly acknowledged.

Author : Alemu Gebrekristos

Signature

Date: 03/11/2023

ACKNOWLEDGEMENTS

First of all, I would like to express my sincere gratitude to Mr. Hailay Kidanu for his permission to work under his project and help in writing this thesis and my advisor Dr. Netsanet Berhe for his guidance, professional advice, constructive comments and encouragement of my work from the beginning up to the completion of this thesis. I am grateful to all of you who have contributed during my thesis work.

I am also grateful to the Office of Agriculture and Rural Development of Hintalo Woreda for giving me the opportunity to pursue my MSc study. I extend my heartfelt thanks to all animal health staff members in Hintalo Woreda who helped me throughout my study.

Last, but not least, I am grateful to express my thanks to my family for their financial support, encouragement, which induced and helped me a lot in all way to complete this research work successfully.

ABSTRACT

This study was carried out to assess the knowledge, attitude, and practices of the community on dairy cattle welfare in 47 purposively selected dairy farms of urban and peri-urban areas of Tigray region from March-to May, 2021. In this study, a door-to-door survey was conducted using semi-structured interview to collect primary data on various dairy cow welfare practices like feeding, housing and milking welfare keeping in mind the “Five Freedoms”. As a result, a total of 47 study participants from the different socio-demographic backgrounds were purposively selected and voluntarily filled out the semi structured questionnaire which was distributed to gather the required information from the respondents. In this tradition of the dairy cattle care, good welfare is seen largely as the absence of illness or injury and malnutrition.

More recent concerns about dairy cattle welfare have focused on the pain and distress that the cattle might experience as a result of widely accepted management practices, and the possibility that the animals suffer as a result of being kept under apparently inadequate conditions. The findings show that 57.45 % (n=27) of the respondents had knowledge about animal welfare, acquired through the vet. Profession whereas 61.7% (n=29) of the respondents prefer to have free movement of animals within their premises. None of the farmers had heard of the term dairy cow welfare. However, farmers of 76.5% (n=36) of the dairy farm agreed that cows should have free access to feed and water. 4.26% (n=2) of respondents in this study did not receive formal training on animal welfare issues. It is believed that more can and should be done to ensure that a dairy cow has a life worth living. An attitude of critical dairy cattle welfare issues relates to the supply of trained, skilled dairy farmers and stockmen. In conclusion, in the urban and pre-urban areas of Tigray region the farms are imperative immediate remedial measures in order to improve the degree of cow’s welfare.

Keywords: dairy, cattle, welfare, indicators, standards

LIST OF CONTENTS

	Pages
ACKNOWLEDGEMENTS	iii
ABSTRACT.....	iv
LIST OF CONTENTS	v
LIST OF TABLES	vii
LIST OF FIGURE.....	viii
ABBREVIATIONS	ix
1. INTRODUCTION	1
1.1. Background and Justification	1
1.2. Statement of the Problem	3
1.3. Objectives.....	4
1.3.1 Main Objective	4
1.3.1. Specific Objectives	4
1.4. Significance of the Study	4
2. LITERATURE REVIEW	5
2.1 Welfare Concepts and Assessment	5
2.1.1. Animal welfare freedom	6
2.2. Dairy Cow Welfare Assessment	8
2. 2.1. Assessment Based on Resources and Management	8
2.3. Housing Conditions in Relation to Dairy Cow Welfare	9
2.3.1. Building Design.....	9
2.3.2. Space Allowance	10
2.4. Management of Dairy Cow	11
2.4.1. Management of Feeding	12
2.5. Hygiene Management in Dairy Farms	12
2.5.1. Water Supplies.....	12
2.6. The Needs of Dairy Cows.	13
2.6.1 To Rest and Sleep:.....	13
2.6.2 To Feed and Drink	14
2.6.3 To Avoid Fear and Other Negative Experiences.....	14
2.6.4 To Have an Appropriate Thermal Environment.....	15
2.7. Welfare problem of dairy cow	15
2.8 Welfare Indicator of Dairy cow	16
2.8.1 Health.....	16
2.8.2 Diseases and disorders.....	17
2.9. Challenges to Dairy Cow Welfare	18
2.9.1. Painful Procedures	18
2.10. Improvement of Dairy Cattle Welfare	18
3. MATERIAL AND METHODS	19
3.1. Study Area.....	20
3.2. Methods of Data Collection	21
3.4. Data Analysis	23
3.5. Ethical Considerations.....	23
4. RESULTS	24
4.1. Questionnaires Survey Result	24
4.1.1. Sociodemographic characteristics of respondents	24
4.1.2 Dairy cow feeding and watering experience	25

4.2. Knowledge, Attitudes, and Practices of Dairy Cows Welfare	27
4.2.1 Dairy Cow Welfare Knowledge.	28
4.2.2 Farmers and Stock people Attitudes on DCW.....	31
4.2.2.1 <i>Frequency percentages of stockpersons responses to DCW Attitude</i>	32
4.3. Observational Welfare Results.....	33
4.3.1 Dairy Cow Welfare Practice.....	33
4.3.2. Health Management and Welfare Practice	35
4.3.3. Frequency Percentages of Stockpersons Responses to DCW Practices.....	37
5. DISCUSSION	39
6. CONCLUSION AND RECOMMENDATIONS	41
7. REFERENCES	42

LIST OF TABLES

Table 1. Socio-demographic characteristics of Tigray region (n=47) in the study.....	24
Table 2. Respondent response on microclimatic – condition (n=47)	27
Table 3. Knowledge of respondents about dairy cow welfare (n=47).....	31
Table 4. Respondents attitude on dairy cow welfare (n=47).....	33
Table 5. Observational assessment of dairy cow welfare (n=47)	34
Table 6. Respondent response practicing on human-animal improvement (n=47)	35
Table 7. Respondents on using bedding of dairy cow welfare (n=47)	36
Table 8. Respondents practicing on dairy cow welfare (n=47)	38

LIST OF FIGURE

Figure 1. Cyclical process of a welfare assurance scheme for assessment and improvement of dairy cattle welfare.....19

ABBREVIATIONS

AWA	Animal welfare assessment
BCS	Body condition score
DCW	Dairy Cow Welfare
FD	Five Domain
FF	Five Freedom
HPA	Hypothalamic pituitary adrenocortical
KAP	Knowledge Attitude and Practice
QA	Quality assessment
Qol	Quality of life

1. INTRODUCTION

1.1. Background and Justification

An improved understanding of motivation, cognition and the complexity of animals' behavior has led in the last 30 years to the rapid development of animal welfare (Broom, 1986; Hristov et al., 2006; Blokhuis, 2008; Fraser, 2008; Broom, 2011, OIE, 2011). That also contributed to an increasing interest among scientists in the field of welfare of dairy cattle (Albright, 1987; Rushen and de Passille, 1998; EFSA, 2009; FAWC, 2009; EFSA, 2012; von Keyserlingk *et al.*, 2009). It should be noted that producers have always been concerned about the condition of dairy cattle and have tried to ensure that they are healthy and well nourished. In this tradition of the cattle care, good welfare is seen largely as the absence of illness or injury and malnutrition (von Keyserlingk *et al.*, 2009). More recent concerns about dairy cattle welfare have focused on the pain and distress that the animals might experience as a result of widely accepted management practices and the possibility that animals suffer (Fraser, 2008).

In Tigray, most of the dairy farm in the urban and peri-urban areas include mainly Bos Taurus dairy cows, those European breeds differs greatly in their adaptation and ability to cope with tropical climatic conditions and managements compared with the local breeds. Therefore, this study will be conducted in dairy cows of urban and peri-urban areas of Tigray region because as we all are aware that in these areas the production system is either intensive and /or semi-intensive, where there is high concern in their welfare status which in turn affects safe and quality milk from produced from healthy animal using management practice that is sustainable from an animal. At farm level, dairy cow welfare assessment may use a multidimensional approach which involves animal and resource-based measurements (Johnson *et al.*, 2001; Zucali, 2016).

Farming systems for dairy cows, including housing and management conditions, are important factors affecting their health and welfare, partly through housing and equipment and partly through management and handling practices. Direct measurement of animal welfare is difficult and all the indicators are inconveniences and not reliable, hence it is expected to get better results by measuring animal welfare

by using a system of indicators instead of individual parameters (Rousing *et al.*, 2007). These measurements of welfare indicators will apply to lactating cows, dry cows and pregnant heifer, keeping in mind the “Five Freedoms” concept for animal welfare. Prevalence of lameness and hock injuries, for example, have been reported to range from 0% up to 100% (Fourichon *et al.*, 2001; Von Keyserlingk *et al.*, 2012). At the same time, a considerable variation is found in housing and management factors that are thought to affect dairy cattle welfare (Von Keyserlingk *et al.*, 2012). Lameness and skin lesions, for example, are indicators relating to health, and both have been associated with surface of the lying area in free-stalls and pasturing (Haskell *et al.*, 2006; Chapinal *et al.*, 2013). Therefore, identification and comparison of factors associated with dairy cattle welfare is preferably done in the same population. Only few studies have investigated associations between housing and management factors and indicators relating to different aspects of dairy cattle welfare simultaneously (Dwivedi, 2013; Burrows *et al.*, 2012; Husfeldt and Ender’s, 2012).

The welfare of dairy cows encompasses nowadays a major concern of public interest extending in most of the countries, due to its impact on health and productions of animals and, implicit, upon public health. Because of the fact that dairy welfare became part and parcel of milk-quality, its monitoring is an additional guarantee for the consumers that the products they buy derive from healthy animals, bred and kept according to standards of good practice in farms (Broom, 2004). The farm animal welfare is provided especially by housing and breeding systems suitable for animal health and behavioral needs and by proper farming practices, as well (Broom, 2004). Welfare is a condition of the animal, not something transmissible to it, and it range between very poor and very good (Loberg and Lidfors, 2001; Broom, 2004). Assessment of dairy cow welfare can be done by several methods. All the indicators have inconveniences and, in this way, are not reliable, used as sole assessment techniques. For this reason, it was suggested that better results could be obtained in measuring animal welfare by using a system of indicators instead of individual parameters (Winkler *et al.*, 2003; Rousing *et al.*, 2007). Usually determination of these indicators requires expensive investigations or high experimental effort; therefore they are inadequate in field research. More effective are the numerical assessment systems (Bartussek, 1999; Bartussek *et al.*, 2000; Amon *et al.*, 2001).

1.2. Statement of the Problem

The role of livestock production in economic development is crucial. As the result of intensification of dairy farms and the issue of dairy cows' welfare has become increasingly of a serious concern in many countries. The concerns of dairy cow's welfare emanated from the conditions in which how dairy cows are kept and management practices, because in intensive dairy farms where animals are kept in confinement for most of their lives, feeding methods, health care, and expression of normal behaviours. Especially, in Ethiopia our intensive dairy cow farms contain foreign breeds mostly Holstein Frisian and Jersey breeds, these breeds are well known productive cows but at the same time with the change in agro-climatic conditions they are susceptible to various thermal and other management difficulties. Currently, in Ethiopia there are no animal welfare legislations or any regulations that protect dairy cows from cruel actions by humans.

In Tigray, most of dairy farm in the urban and peri urban areas includes mainly *Bos taurus* dairy cows, which differs greatly in their adaptations and ability to cope with tropical climatic conditions compared with the local breeds (Somero, 2010). Dairy cow welfare assessment is very important in these areas; which involves a multidimensional approach (Zucali, 2016). At farm level, dairy cow welfare assessment may involve animal and resource-based indicators (Johnsen *et al.*, 2001). Traditionally, the use of resource-based indicators was common on-farm welfare assessment of dairy cows; however, having good management and resource may not indicate high level of welfare standards.

Moreover, resource-based indicators are less valid as farms with similar production systems demonstrate a huge variation in animal welfare (Rushen *et al.*, 2011). Hence, to assess an actual dairy cow welfare status, the use of animal-based indicators is increased (Johnsen *et al.*, 2001). Among the animal-based indicators, behavioral and physiological assessments such as lameness and mastitis incidence are important welfare indicator (von Keyserlingk *et al.*, 2009). In this study, the assessment of dairy cows' welfare was performed on selected areas of urban and peri-urban areas of Tigray region. A resource-based method was used to identify risk factors to evaluate whether animals were feeling well and live in the accepted welfare standards.

1.3. Objectives

Objective of this research was to identify indicators of welfare problems in dairy cows and examine whether those indicators were related with the actual welfare status of dairy cows and productivities. The welfare status of dairy cows was assessed by using a combination of welfare indicators through resource-based welfare indicators including behavioral observations, managements and others factors observed for any indicative of poor 'cow comfort', and use of documented farm records, and performance efficiency of cows were evaluated based on their milk yield.

1.3.1 Main Objective

The main objective of this research was to assess the welfare of dairy cows using knowledge, attitude and practice of farmers in selected urban and peri-urban areas in Tigray region.

1.3.1. Specific Objectives

- To assess the major problems of dairy cows' welfare in the study area.
- To determine the perception of farmers towards dairy cows' welfare in the area.
- To assess the knowledge and practices followed by farmers of a dairy cows' in the area
- To study the overall management problems of dairy cows in the selected study areas

1.4. Significance of the Study

As there was no research work about dairy cow welfare and no access to the imprudent on dairy cow welfare in this study area. Farmers tend to use traditionally following of dairy cow welfare. Hence, the study helped to determine impact of dairy cow welfare by indicating the level of knowledge, attitude and practicing of the farmer in the urban and peri-urban study areas of Tigray region. Therefore, the present study focused on the use of resource-based indicator was a common on-farm welfare assessment of dairy cows, however for an animal to be in good welfare state, it must be emphasized on its ability to feel pain, fear, and various forms of pleasure, are very important part of its welfare. The resource-based measures include measures to evaluate the provision of resources at the farm environment in which the animals were kept.

2. LITERATURE REVIEW

2.1 Welfare Concepts and Assessment

Farmed animals are subject to human imposed constraints and for a very long time the choice of farming techniques was based primarily on the efficiency of production systems for the provision of food. However, when choosing methods for keeping and managing dairy cow in order to protect these dairy cows against mistreatment and poor welfare, it is necessary to know how their welfare is affected by the various methodologies. Fraser (1999, 2008) point out that there are at least three different concepts considered when dairy cow welfare is discussed. One set of concepts is focusing on the dairy cows health and biological functioning, a second set is focusing on the dairy cows` ability to live a natural life, and a third set is focusing on the degree to which the dairy cows experiences aversive or positive feelings, such as pain, fear or pleasure.

Knowledge of the types of environments in which animals have evolved can help identify some of the challenges to welfare that occur when dairy cow are kept in conditions of modern agriculture. For example, cattle have evolved to graze outdoors with grass as their primary food source. In contrast, in modern agriculture, dairy cattle are often housed indoors, on concrete floors, with refined grains as their prime source of energy. These differences can pinpoint what are the most likely challenges to the welfare of dairy cattle (Spinka, 2006).

The concept of welfare is relevant to any kind of animal, although not to plants or inanimate objects. Welfare is a characteristic of an individual animal and is concerned with the effects of all aspects of its genotype and environment on the individual (Duncan 1981). The common convention is to use the term welfare to refer to the state of the dairy cow itself, while dairy cow care 'is used to refer to the way that people treat animals. Thus, the welfare of a dairy cow can be poor or good regardless of whether it is living in the contact with people. The degree to which the welfare of on a dairy cow is good or bad is taken into account when considering what constitutes proper animal care.

Broom (1986) defines it as follows: the welfare of an animal is its state as regards its attempts to cope with its environment. Coping means maintaining control of mental and bodily stability in response to a challenge. Welfare therefore includes the extent of failure to cope, which may lead to disease and injury, but also the ease or difficulty

in coping. Both the long-term and short-term costs of coping are important for a dairy cows` welfare. For example, a dairy cow may cope with an acute stress in the short-term by taking action that results in a long-term reduction in its welfare. For example, dairy cattle may be able to cope with the stresses associated with high milk in lactation, but this coping may result in long-term health problems that are apparent in later lactations. A dairy cow is in a good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behavior, and if it is not suffering from unpleasant states such as pain, fear, and distress. Good dairy cow welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. Dairy cow welfare refers to the state of the dairy cow.

In order to promote good welfare and avoid suffering, a wide range of needs must be fulfilled as the needs have a key role in the interaction between a dairy cow and its environment. A need is a requirement, which is part of the basic biology of the animal, to obtain a resource, receive stimuli or express particular behaviors (Hughes and Duncan, 1988; Jensen and Toates, 1993; Vestergaard, 1996). Needs are requirements that are necessary to maintain the biological functioning of the dairy cow. For example, in order to stay healthy and alive, an animal needs an adequate supply of nutrients. Evidence for needs includes indications of poor welfare when an individual does not have the resource or opportunity for action, or the results of studies that show that the individual has strong positive or negative preferences.

When the welfare of cows or other animals is assessed, sets of measures often have to be integrated, for example, physiological measures, behavioral and pathological measures. Each assessment of welfare will pertain to a single individual and to a particular time range. Some problems for dairy cows, such as metabolic pressures associated with high milk production and various factors leading to lameness, result in poor welfare for a very long period, perhaps many months.

2.1.1. Animal welfare freedom

This opinion considers the relative validity and utility of three concepts: The Five Freedoms (FF), Five Domains (FD) and Quality of Life (QoL) as tools for the analysis of animal welfare. The aims of FF and FD are different but complementary. FD seeks to assess the impact of the physical and social environment on the mental (affective) state of a sentient animal, FF is out come based approach to identify and

evaluate the efficacy of specific action necessary to promote well-being. Both have utility. The concept of QoL is presented mainly as a motivational framework. The FD approach provides an effective foundation for research and evidence-based conclusions as to the impact of the things we do on the mental state of the animals in our care. Moreover, it is one that can evolve with time. The FF are much simpler. They do not attempt to achieve an overall picture of mental state and welfare status, but the principles upon which they are based are timeless. Their aim is to be no more than a memorable set of signposts to right action. Since, so far as the animals are concerned, it is not what we think but what we do that counts, suggest that they are likely to have a more general impact.

The Five Animal Freedoms

It should be obvious that these, like the later Five Freedoms, are aspirations. The phrase was commandeered by the Bram-bell Committee report on the welfare of farm animals in intensive systems to summarize their conclusion that farm animals in confinement should be allowed sufficient space to permit the following five minimal behaviors or activities, namely to stand up, lie down, turn around, stretch their limbs and groom all parts of the body. Animal welfare knows many definitions, e.g. ‘the state of an individual as regards its attempts to cope with its environment’ (Broom, 1986) or ‘fit and feeling good’ (Webster, 2005). These definitions illustrate that animal welfare is a multidimensional concept (Fraser, 1995). The definition ‘fit and feeling good’, for example, implies that animal welfare comprises physical aspects (i.e. health and vigor) as well as psychological aspects (i.e. sense and feeling). Assessing animal welfare, therefore, requires a combination of different indicators. The Five Freedoms (FAWC, 1992) provide a generally supported comprehensive framework for choosing indicators of animal welfare.

The five animal freedoms are

- Freedom from thirst, hunger and malnutrition (have ready access diet & health)
- Freedom from thermal and physical discomfort (by providing suitable environment)
- Freedom from pain, injury and disease (by prevention or rapid diagnosis and treatment)
- Freedom from fear and distress (by providing sufficient space)
- Freedom to express normal behavior (ensuring conditions which avoid mental suffering.)

2.2. Dairy Cow Welfare Assessment

To establish whether an animal's physical and emotional needs are being met requires a detailed assessment of its welfare. Welfare assessment is a major challenge as the utility of any assessment methodology depends on the specific situation under examination and the ethical views held by the stakeholder group seeking the assessment (Webster, 2005).

The purpose of this review is to explore the subject of welfare assessment further by examining the conceptual frameworks, complexities and methodologies applied to the task. This report has presented knowledge and understanding of the scientific principles that determine the welfare of dairy cows. However, knowledge alone is not enough. This knowledge and understanding must be communicated to, and implemented by those who have direct responsibility for care of the animals. In order to ensure compliance with welfare standards on individual farms, within farming systems, or within market-led quality assurance schemes, it is necessary to establish effective, robust procedures for assessment, monitoring, and implementation of these standards. Two of the main subprojects in this program are directly concerned with the development and implementation of animal-based procedures for monitoring and control of on-farm welfare, namely (Webster, 2005):

- To develop robust on-farm welfare monitoring and information systems for selected farm animal species;
- To implement welfare monitoring and information system and the welfare improvement strategies developed.

2. 2.1. Assessment Based on Resources and Management

Currently the protocols monitoring welfare within QA schemes are based almost entirely on measures of husbandry (resources and records). It recognizes that no farmer can achieve ideal welfare in all the animals all the time and concentrates on what the farmer does, or could do to promote welfare in his dairy cow. However, the effectiveness of these approaches can only be established on the basis of reliable methods to assess dairy cow welfare state. This fact Effects of farming systems on dairy cow welfare and disease can be interpreted in two ways. Either the welfare standards do not lead to an overall improvement of welfare or the outcome-based measures do not measure the full range of welfare problems that were addressed by the standards (Broom, 2004).

2.3. Housing Conditions in Relation to Dairy Cow Welfare

2.3.1. Building Design

Feeding area: Under natural conditions the cow will stand with its front legs slightly apart which lowers the front of the body and makes it easier for the cow to reach the grass. However, when fed in the barn, both in loose housing systems and in tie-stalls, the cow usually stands with both front legs together. Therefore, it is easier for the cow to reach the feed if the trough is elevated above the floor level, and the risk of a cow falling as well as the risk of getting injuries on the front knees and the shoulder is reduced (Rom, 1989; Munksgaard and Krohn, 1990; Waiblinger *et al.*, 2001b). The risk of getting injuries at the shoulder is also reduced due to reduced load on the shoulder and forelegs (Waiblinger *et al.*, 2001b). It has been recommended to raise the feed trough 15-20 cm above the bedding level in loose housing and 12-15 cm in tie-stalls (Waiblinger *et al.*, 2001b; Housing Design for Cattle – Danish Recommendation, 2001).

However, the optimal level depends on the size of the animals. Furthermore, there is some evidence that a narrower feed trough, which ensures that the cow can reach the feed, reduces the risk of traumatic injuries (Munksgaard and Krohn, 1990). However, when cows are kept in tie-stalls, the stall is also used for resting. Thus, the separation between the trough and the stall should not be too high in order to avoid thwarting of the forward movement of the body of the cow when changing position from lying to standing. Also the level of feed trough should not be lower than it is in loose housing so that the head lunge movement is not hindered. Furthermore, it is also necessary to have some separation between the trough and the stall to avoid feed coming into the stall. In tie-stalls compromises between giving the cow easy access to the feed without dragging feed into the stall and easy access to change position from lying to standing is necessary. In loose housing systems, where the feeding area is only used for feed intake, the area can be designed to optimise feeding behaviour.

Resting areas: Cattle can either rest in stalls (tie-stalls or cubicles) or in more open bedded areas. Both the design and dimensions of tie-stalls and cubicles can vary as well as the flooring and provision of bedding material. It is important there is sufficient amount of space for forward motion not to hamper cows' movement when changing position from standing to lying and vice versa. Restrictions in the space in front of the cow for instance rails in the area of the head lunge can lead to interrupted

attempts to lying down or getting up and abnormal behaviour. Cubicles that are too long may lead to more dung in the cubicles.

Furthermore, if the dimension of the cubicles is not adjusted to the size of the animal, it can be difficult for the cow to rest in natural positions and her movement may be restricted. Caremark (1987) suggested that the optimal size of cubicles is a function of the size of the cow. A cow weighing 600 kg needs a length of 2.18 m and a width of 1.20 m. Boxberger (1983) suggested that the head lunge that cattle use to get up takes up to 1.5 m, measured from the carpus to the tip of the muzzle. There is only a limited amount of research on the effects of dimensions of cubicles. Tucker *et al.* (2004) found in two cubicles increased from 1.12 m to 1.32 m and from 1.06 to 1.26 m respectively. However, the optimal size of cubicles is dependent on the size of the cow.

2.3.2. Space Allowance

2.3.2.1 *Effects of space allowance on welfare*

Once a dominance relationship is established, agonistic interactions with body contact are rare on pasture, where sufficient space and resources allow the subordinate animals to avoid intruding the individual distance of other animals. In contrast, in housing conditions agonistic interactions, especially with physical contact, increase considerably (Wierenga, 1984; Miller and Wood-Gush, 1991) due to the limitation of space and resources like lying or feeding places. Injuries due to horn butts are higher indoors compared with pasture (Baars and Brands, 2000). In loose housing, the amount of total space is negatively related to the frequency of agonistic interactions and injuries in dairy cows and heifers (Wierenga, 1984; Metz and Mekking, 1984; Andreae *et al.*, 1985; Metz and Wierenga, 1987; Menke *et al.*, 1999; Fregonesi and Leaver, 2002) as is the amount of feeding space alone (DeVries *et al.*, 2004; Huzzey *et al.*, 2006).

The type of interaction differs: in high-space vs. low-space the number of threats is higher, but number of displacements including physical contact (butts) is much lower (Wierenga, 1984). In practice different aspects contribute to the total space allowance and are often associated with each other: width and length of the different alleys, number of resources (especially cubicles, feeding places) per animal as well as possible additional space such as an additional running (idling) area inside or outside

the barn. In a given indoor situation additional space in an outside area reduces agonistic interactions: cow herds showed less agonistic interactions when having access to an outdoor yard during the night compared with a closed yard (Menke *et al.*, 2000). Reducing only feeding space (length or available feed bunk or number of feeding places) leads to increased aggression (DeVries *et al.*, 2004; Huzzey *et al.*, 2006). There are also effects of space allowance on other behavior's, health and production.

2.3.2.2 *Feeding space /feeding place to animal ratio / drinker space*

The highest amount of aggressive interaction among loose-housed cattle occurs in the areas around the feeding places (Miller and Wood-Gush, 1991) and they increase with restricted access to preferred feed or reduced feeding space for review (Boe and Faerevik, 2003). The amount of social agonistic interactions as well as feeding behavior is related to both housing (feeding space per cow, design of the feed barrier) and feeding management (frequency and amount of food; restricted/ad libitum feeding) (Olofsson, 2000; Huzzey *et al.*, 2006). A reduced ratio of feeding places to animals or feeding space per animal increases agonistic behavior in dairy cows, also when fed ad libitum (Stumpf *et al.*, 2000; Schrader *et al.*, 2002; Mülleder *et al.*, 2003; DeVries *et al.*, 2004; Huzzey *et al.*, 2006) and in feedlot steers (Corkum *et al.*, 1994). The increase of agonistic interactions during this enhanced competition is not equally distributed, but depends on the social strategy of the individual (Mülleder *et al.*, 2003). Further, reduction in feeding space /places per cow causes shorter feeding times and longer times standing as well as changes in daily rhythm with increased time feeding during nigh (Grant and Albright, 2001).

2.4. Management of Dairy Cow

There are thousands of dairy farms around the world with different farm plans and management strategies. Climate, market conditions, traditions, breeds etc. affect the running and planning of the business. There you find many smaller family farms with either loose housing or stanchion barns. Regardless of management strategy, farm size or local climate, the cow has to calf, produce milk, eat, be kept in good health status etc. To be able to do so, we need to know how to manage the cow and how different production aspects interact with each other (Pulina, *et al.*, 2020)

2.4.1. Management of Feeding

As the dairy cow's genetic potential is increasing, feeds and feeding strategies are becoming more and more important. It is well known that the amount of milk to be produced is highly influenced by the amount and quality of the feed given to the cow. It is also possible to influence the milk composition through the feeding. As the cow normally experiences a shortage of nutrients in early lactation, it is of importance to feed the cow a well-balanced diet in order to maximize the dry matter intake. Not only is nutrition one of the highest input costs (about 50% of the total costs), but it also controls the results of milk production, reproduction and health. When all the feedstuffs (including roughage) have been analyzed, we have to make sure that each cow gets what she need in terms of energy, protein, minerals, vitamins and water. To do so, there are a number of feeding strategies and systems to choose between. Their common trait is that the roughage intake is controlled through the distribution of concentrates. The more concentrates that are supplied, either separately or in a mix with the roughage, the less roughage the cow will eat (Ørskov, E.R, Reid, G.W. and Kay, M., 1988).

2.5. Hygiene Management in Dairy Farms

The milk secreted into an uninfected cow's udder is sterile. Invariably it becomes contaminated during milking, cooling and storage, and milk is an excellent medium for bacteria, yeasts and molds that are the common contaminants. Their rapid growth, particularly at high ambient temperatures can cause marked deterioration, spoiling the milk for liquid consumption or manufacture into dairy products. This can be avoided by adopting the simple, basic rules of clean milk production (Lu, M. and Wang, N.S., 2017.)

2.5.1. Water Supplies

Unless an approved piped supply is available it must be assumed that water is contaminated and therefore hypochlorite must be added at the rate of 50 ppm to the cleaning water. Hard water (i.e. high levels of dissolved calcium and other salts) will cause surface deposits on equipment and reduce cleaning effectiveness. In such cases, it is necessary to use descaling acids such as sulphamic or phosphoric, periodically.

2.6. The Needs of Dairy Cows.

All animals have needs that drive their activity programs with the function of maintaining internal homeostasis and regulating interaction with the environment. Maintenance of homeostasis involves assessment of state in relation to tolerable ranges and positive and negative feedback control. The overall need of a dairy cow is to maintain bodily and mental integrity while growing and during adult life. In order to do this, cows have a series of needs that are relevant to the housing and management conditions imposed upon them by humans (Murphy, M.R., 1992).

A general need of a cow is to have sufficient control of her environment and some ability to choose what to do and when. When needs are not fulfilled there are negative, often measureable, consequences for the dairy cow. In listing needs and in later consideration of how to provide for them, it is assumed that extreme human actions, such as deliberately creating a large wound or infecting a dairy cow with a dangerous pathogen, will not occur. Some needs require satisfying only at intervals of some hours or only when young or when adult. Some of the needs of cows will vary slightly according to genotype and phenotype, for example, an animal of a high milk-producing genetic line and an old cow that has a large stomach because of long-term high-level feeding will need more food per day than the average cow. Most needs, however, are little affected by domestication. The causes of some problems of cows are multifactorial and related to more than one need. Many of the needs of cows involve not only the avoidance of poor welfare but also the increase of likelihood of good welfare (Murphy, M.R., 1992).

2.6.1 To Rest and Sleep:

Cows need to rest and sleep in order to remain healthy and to recuperate from stress and illness and are more likely to do so at times when any possible danger of attack is low. Adult cattle usually sleep for about 4 hours a day and usually while lying down. Some slow wave sleep can occur when cows are standing but in order to have rapid eye movement sleep cattle must be able to lie down.

Usually sleep (especially rapid eye movement sleep) occurs when the neck muscles are relaxed and the head is resting on the ground or the animal's body. Housing conditions that prevent cattle from lying down in this way may interfere with sleep. Sleep disruption may occur if comfortable lying positions cannot be adopted, as shown in calves, or if there is disturbance to lying animals because they are trodden

on or otherwise disturbed by other cows. If dairy cows are diseased, or for other reasons in poor physical condition, their need for rest and sleep is increased and the amount of rest or sleep that they are able to achieve may be inadequate (Murphy, M.R., 1992).

2.6.2 To Feed and Drink

Drinking: Lactating cows have a very high demand for water. If the temperature is high, cows need to drink great amounts of water. Sick cows may also need more water. If water is not available, lactating, over-heated and sick cows will become dehydrated earlier than other cows. Moreover, free access to water is of importance for cows fed diets containing excess of potentially toxic substances that need to be excreted by the kidneys or when diets are fed to manipulate cation-anion balance. The quality of water required is to satisfy cows 'needs to drink water without toxins or pathogens present to the extent that it is difficult for the cow to cope with them (Murphy, M.R., 1992)

Feeding: Food provides for the needs of nutrient intake, oral satisfaction, normal digestive function and carrying out foraging behavior. If any are lacking in the feed, there will be adverse consequences if essential nutrients cannot be provided by other means. The diet of commercially reared cows seems to be generally good but the possibility that certain supplements, e.g. vitamins and trace elements at higher than historically recommended levels, may lead to better welfare indicates that the normal diet may now lack some nutrients, especially for cows from high performance genetic lines (Schoener, 1971)

2.6.3 To Avoid Fear and Other Negative Experiences

As a prey species, cattle have evolved a number of mechanisms associated with predator detection and avoidance. As a consequence, the biological functioning of cows is strongly adapted to promote security. However, researchers in animal welfare have often paid little attention to animal health problems (Rushen, 2003), perhaps because of difficulties obtaining data about the incidence of health problems in the different types of cattle production; for example, information on animal health is more available and more easily obtained for intensively housed cattle than for extensively managed ones (Lacetera, N., 2019).

In this we focus on the issues that arise and to maximize the chance of recognition of danger and escape from it. Cows respond to sudden events and approaches by humans

or other animals perceived to be potentially dangerous with substantial sympathetic nervous system and hypothalamic pituitary-adrenocortical (HPA) changes. These physiological changes are followed by rapid and often vigorous behavioral responses. Fear is a major factor in the life of cows and has a great effect on their welfare. In any circumstance in which the cow can predict that a negative experience is likely, welfare will be poor (Broom, D.M., 1991).

2.6.4 To Have an Appropriate Thermal Environment

Cows need to maintain their body temperature within a tolerable range. If the ambient temperature is too high or too low, or the humidity is too high, welfare can be poor. Shade seeking is the main behavior dairy cow use to avoid overheating. Over-heated, or potentially over-heated, cows adopt positions that maximize the surface area from which heat can be lost and will attempt to drink (Jones, P., 2015).

2.7. Welfare problem of dairy cow

Given a natural healthy life, cows can live for twenty years or more. However, high yielding dairy cows are usually culled after three lactations, because they are chronically lame or infertile (EFSA, 2009; von Keyserlingk *et al.*, 2009; EFSA, 2012). It is well known that there are a large number of bacteria, both contagious and environmental, that are capable of causing mastitis. In some countries, records of the incidence of clinical and subclinical mastitis for individual cows are collected regularly as part of disease surveillance. Examples of other endemic diseases that may lead to premature culling of dairy cattle are tuberculosis, bovine viral diarrhea, infectious bovine rhino-tracheitis, leptospirosis and Johne's disease, although some of these can be controlled by vaccination.

Metabolic diseases of dairy cows are important in terms of lost production and poor welfare and include ketosis, milk fever, left displaced abomasum and acidosis. Many other causes as overproduction of milk, restrictive housing systems, poor nutrition, and physical disorders impair the animals' welfare in industrial dairy operations. In their fragile end-of-production state, handling, transport, and slaughter raise additional welfare concerns (FAWC, 2009; EFSA, 2009; 2012). It is well known fact that cows kept indoors have less opportunity to act naturally and exercise. Very often poor ventilation and high humidity increase the risk and spread of infection. Hard concrete flooring can cause foot damage and is more painful for lame cows to stand and walk

on. Also, zero-grazing systems have been linked to increased lameness. Some herds are kept on concrete floors with inadequate bedding. These are uncomfortable for the cows to walk, stand or lie down on.

Management and nutritional factors can have a large effect, often obscuring the influence of housing. The behavior of the cow, particularly time spent lying or standing, can influence the likelihood of lameness. In commercial dairy farming, nearly all calves are taken away from their mother shortly after birth. This causes severe distress to both the cow and the calf and has long-term effects on the calf's physical and social development. The most significant welfare problems in dairy calves in intensive rearing conditions have been investigated in the paper by Hristov *et al.* (2011). These problems mainly result from inadequate intake of colostrum (separation from the mother), inadequate ventilation (resulting in inappropriate airflow, low or high temperatures, high humidity and poor air quality), poor floor conditions (wet floor, without bedding), inadequate monitoring of health, and exposure to pathogens causing respiratory and gastrointestinal disorders and occurrence of iron deficiency. In addition, on cattle farms in our country welfare problems in calves originate from continuous restocking (no "all in - all out") and mixing calves from different sources, as well as insufficiently balanced solid food, insufficient access to water and generally poor response of farmer to health problems, especially necessary dietary changes. A special welfare problem is insufficient floor space allowance which results in calf's discomfort. In the EFSA reports (2009; 2012) and opinion of FAWC (2009) was suggested that nearly all diseases affect the welfare of dairy cows to some degree

2.8 Welfare Indicator of Dairy cow

2.8.1 Health

Poor health can be a major cause of poor welfare in farm animals and that the occurrence of illness can be used to assess animal welfare. Cattle of all ages, both in traditional and modern housing systems, and under intensive and extensive management, suffer from a variety of endemic diseases, both infectious and non-infectious, as well as outbreaks of epidemic diseases, such as foot and mouth and BSE. Cattle also suffer from various forms of physical injury as a result of poor housing or management.

Health measures have long been recognized as potentially useful indicators of dairy cow welfare. When we try to use measures of the incidence or prevalence of illness as indicators of dairy cow welfare. While it may seem obvious that illness or injury reduces welfare, we argue that there are a number of unresolved problems in using health measures to assess dairy cow welfare. Dairy cow health problems are best related to dairy cow welfare to the extent that they are associated with the dairy cow's suffering (Wells *et al.*, 1998), either in the past, the present, or the future. While it may seem obvious that good welfare is dependent on good health, in order to be able to use measures of the incidence of different diseases to assess overall welfare, we need to be able to estimate the relative impact of these diseases.

2.8.2 Diseases and disorders

We discuss some of the more common health ailments useful for assessing dairy cow welfare. We discuss evidence that relates to the impact of these diseases on animal welfare, and the problems in detecting and measuring their incidence or prevalence in dairy production. High rates of mortality on a farm can be a direct indicator of welfare problems. Death itself provides an end of suffering, but the illnesses that eventually lead to death are often the source of considerable suffering to animals. Respiratory disease was found upon post-mortem to have suffered from a variety of ailments (Loneragan *et al.*, 2001).

Lameness: Lameness in cattle can result from a number of causes including infectious disease (such as digital dermatitis and foot rot) and hoof lesions (e.g. ulcers, hemorrhages, white line separation) that are associated with both metabolic challenges and physical injury to the hoof. Lameness is widely regarded as a major welfare problem for dairy cows (Farm Animal Welfare Council 1997) and the incidence of lameness has been included in a number of on-farm animal-welfare assessment schemes. In their "Delphi exercise", (Whay *et al.* (2003a) found that experts consistently ranked lameness as one of the most serious welfare problems for cattle. The majority of experts felt that the incidence on all dairy farms was sufficiently high to justify some intervention to reduce the incidence of lameness. Obtaining more objective information to assess the magnitude of the impact of lameness on animal welfare has proved difficult.

2.9. Challenges to Dairy Cow Welfare

The various challenges to dairy cow welfare can be roughly divided into acute challenges (such as branding, dehorning) that last for only a short period of time (seconds, minutes, or hours) and which consequently affect the dairy cow's welfare mostly for a relatively short period of time, and chronic challenges (such as the method of housing) that last considerably longer (weeks, months, or years) and that consequently affect the dairy cow welfare for much longer.

2.9.1. Painful Procedures

Procedures that cause pain and distress to animals are likely the most contentious of all animal welfare issues. Intentionally causing pain to another human is considered repulsive in most societies, and causing pain to animals normally generates a similar response. Despite these concerns, painful procedures like branding and dehorning are routinely performed on cattle without benefit of pain relief. In this section, we address how pain in dairy cow can be assessed and how painful but necessary procedures can be modified to reduce or prevent the pain that cattle experience.

2.10. Improvement of Dairy Cattle Welfare

In the second step of a welfare assurance scheme, results of the on-farm welfare assessment should be communicated to a farmer, as well as advice about housing and management interventions that can potentially lead to improved welfare (Figure 1). This gives him/her the opportunity to make interventions that can consolidate or improve the level of welfare (i.e. step 3 in Figure 1). The fact that animal welfare is a multidimensional concept, however, complicates coherent advice about housing and management interventions for overall welfare improvement. Changes in housing and management may have synergetic or opposing effects on different welfare indicators. So far, only few studies have investigated associations between housing and management factors and indicators related to different aspects of animal welfare simultaneously (Burrow *et al.*, 2012; Dwivedi, 2013). Knowledge of potential synergies and trade-offs of interventions is essential for farmers who aim to improve the overall level of dairy cattle welfare in their herd.

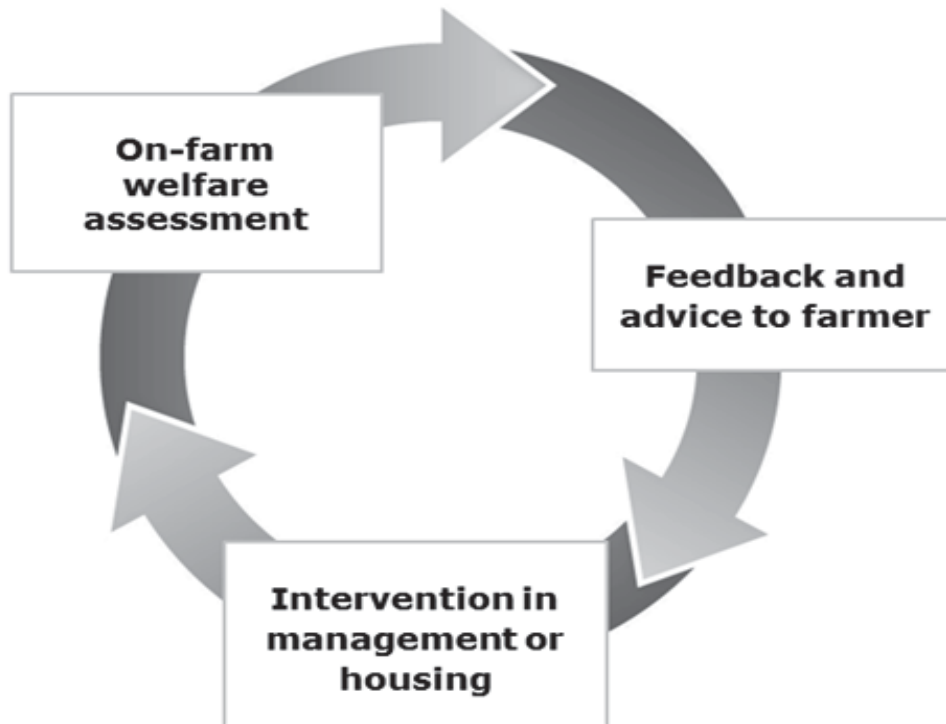


Figure 1. Cyclical process of a welfare assurance scheme for assessment and improvement of dairy cattle welfare.

Traditionally, on-farm assessment protocols use mainly housing and management-based indicators, which measure the state of the animal's environment and the way the animal is taken care of. Animal based indicators, however, are gaining preference over housing and management-based indicators for inclusion in on-farm assessment protocols. Animal-based indicators, which measure the state of the animal, are assumed to possess a higher validity than housing and management-based indicators because they are more closely linked to the actual welfare state of animals (Why *et al.*, 2003; Webster *et al.*, 2004).

3. MATERIAL AND METHODS

This study was conducted on the urban and per-urban areas of Tigray region and exploratory in nature and was based on a qualitative approach, which is ideal to generate data to interpret and understand point of views of people (Denzin and Lincoln, 2005; Guest *et al.*, 2012). In qualitative research, it is assumed that a convenience sample provides a rich and diverse set of responses when saturation (i.e., when the responses become repetitive) on the proposed topic is achieved (Robson and

McCurtain, 2016). Each participant received a consent form that they were asked to read and, if they agreed to participate, were required to sign before they began the survey. We invited participants to respond to a single open-ended question that had previously been used by Cardoso et al. (2016a): How do you imagine an ideal dairy farm and why are these characteristics important to you? This was followed by multiple-choice demographic questions (age, sex, education, area of residence, and involvement in animal production). Our intention was to reach a diverse group of respondents, so we recruited participants through different channels.

3.1. Study Area

The study was conducted in selected urban and pre-urban dairy farms of two selected zones of Tigray's regional state during the period of March-May, 2021. Most of the intensive and semi-intensive dairy farms in Tigray are concentrated in the Urban and peri-urban areas, and are basically based on exotic breed stock. Selection of farms in these study areas were based on availability of modern dairy farms (intensive/semi-intensive farms) and another farm selection criterion was to assess animal welfare situation at different agro-climatic condition within Tigray region. Adigrat, and Mekelle were selected to represent cold highland and/or intermediate climatic conditions respectively.

The urban, peri-urban dairy farmers are situated in and around the main city, Mekelle and in other towns including Adigrat, Wukro and others, which have a high milk demand for the growing population in these areas. However, the high population growth and density are causing the shortage of grazing land on which dairy cow production is challenged. Farm selection process would be based on purposive and willingness of the farm owners and due to the inclusion criteria of dairy cow welfare situation in various agro-ecological zones. The temperature regime of the region varies from hot to very cool temperature. The geography of Tigray region constitutes lowlands (Tropical zone known as Kolla, when it is below 1830 meters in elevation and average annual temperature is above 27 °C with annual rainfall about 510 mm), mid-highlands (Subtropical zone also known as Woina dega includes the highlands areas of 1830 - 2440 meters in elevation with average annual temperature of about 22 °C and annual rainfall between 510 and 1530 mm) and Cool highlands also known as dega. Dega is above 2440 meters in elevation with an average annual temperature of about 16 °C and annual rainfall between 1270 and 1280 mm ("Ethiopia Basic Facts |

Ethiopia About Ethiopia,” available at <https://www.ethiovisit.com/ethiopia-basic-facts/64/>) and our study areas are selected to include the three different climate zones according to elevation, and the description each study areas is given below.

Mekelle: This city is located in the northern edge of Ethiopia 773 km away from Addis Ababa, the capital city of Ethiopia. It lies between latitude 13° 29' North and longitude 39° 28' East with an elevation of 2254 meter above sea level, which Woina dega (Subtropical zone). The estimated population of the city in 2020 is 524,000 (Hagos *et.al.*, 2020)

Adigrat: The city of Adigrat is located in northern Ethiopia around 893 km far from Addis Ababa. It lies between latitude 14° 16' North and longitude 39° 27' East with an elevation of 2,457 meter above sea level. The projected population of the town for 2013 was estimated at 95,353 (Gebreslassie *et al.*, 2020).

3.2. Methods of Data Collection

A questionnaire survey and observational types of studies were conducted for the assessment of the Knowledge, Attitude and Practice (KAP) of dairy farms welfare in selected dairy farms. Forty-seven dairy farms were selected for sampling because they have a concentration of dairy farms in the region. The major inclusion criteria of the farms in this study were, dairy farms should have at least 5 dairy cows and farm owners should be willing to participate in the study and all lactating cows/pregnant heifers in the selected farms were included. In addition, farms should have been with in the urban and preI-urban areas of the purposively selected farms and the farmers were informed of the visit by the field veterinarian and each farm was visited accordingly.

Materials

The interview was made using a semi-structured questionnaire. A total of 47 dairy cow farms in and around Mekelle, Adigrat and Wukro were included in this study.

Questionnaire Survey: A semi structured questionnaire was presented to each purposively selected dairy farm. The questionnaire was developed in English and translated by the researcher in to local language (Tigrigna) and the interview were conducted in the local language and administered to the dairy farm owners, workers or managers, who live in or work in the selected dairy farms. Besides that, they were briefly told about the objective of the survey and asked for their consent before the interview was commenced. To avoid bias among interviews and to validate the

accuracy of the information, the questionnaires were administered by the researcher who spoke and understood the language of the respondents, with support from field veterinarians of the respective districts.

Data were collected through face-to face interview by using semi-structured questionnaires to collect animal- and management linked data related to welfare. The questionnaire was carried out by asking and observing dairy farms characteristics followed by specific questions related to assessment on the KAP of dairy farms welfare in selected dairy farms of the study areas. The interview was conducted on respondents from the selected dairy farms. Respondents were asked with indicators of KAP on dairy cows' welfare including several dairy farm husbandries, management, and health-related practices including the socio-demographic distributions and characteristics of respondents, characteristic size, type, and nature of farms, feeds given and feeding protocol followed, challenges faced and others. Information about frequency of feeding, frequency of watering and other related to management were also included.

Observational Study: Together with the interview, observational study was further conducted through side by side in the same dairy farms in the study area. During the visit, clinical examinations of dairy cows for any sort of health problems or abnormalities were carried out. A well-designed separate format was prepared for this purpose and filled by the researcher to increase the reliability of the information collected through the questionnaire survey. The type of flooring and floor cleanliness was assessed by visual inspection. Assessment of management parameters from records and conducting the questionnaire-based farmer survey was done by only one observer. Available farms were selected and each farm was visited two times and data were collected using direct observation of the cows and their environment, health and welfare status were recorded each time. Dairy cows' welfare assessment requires the use of multiple indicators including: animal, resource and management-based indicators (AHAW, 2014). Furthermore, the conditions of animals' shelter, floor, and stocking density, cleanness of their barn were observed and recorded. The interview study was a part of a wider interview study comparing of different farms. In this thesis, only the interviews with the respondent of the farms were used. The method of the interview study was to use semi-structured qualitative interviews

3.4. Data Analysis

The collected data were analysed based on qualitative measurements. Basic descriptive statistics were used for the calculation percentages of different variables knowledge, attitudes, and practices [KAP] and data were expressed at the farm level, as percentages of the assessed farms. Rate of type of dairy cow welfare reported by the farmer was calculated based on questionnaire results. The mean percentage calculated from the data obtained during the visits of each farm. The analysis of results from the on-farm data collection about farm descriptions the variables that are used as criteria for small scale farm description.

3.5. Ethical Considerations

Though, Ethiopia doesn't have legislation on animal welfare, the use of an ethical basis for animal welfare standards would be based on the OIE guidelines listed on species specific, but generally based on accepted principles on how animals should be treated and used by humans. Data was collected appropriately (without fabrication, falsification, manipulated or cheated/plagiarized data, if there is any conflict of interest between parties, data will be treated accordingly) based on research ethics. The interview study used the recommendations from the owners of 47 farms. All informants voluntarily agreed to being interviewed. No questions contained sensitive personal matter or sensitive ethical issues regarding the informants involved. All the presented results preserve anonymity.

4. RESULTS

4.1. Questionnaires Survey Result

4.1.1. Sociodemographic characteristics of respondents

The sociodemographic profile of each group of participants is presented in Table 1. The majority of dairy farmers who participated in our study lived in urban areas, where as the majority of participating agricultural advisors and lay citizens lived in pre-urban areas. All the selected respondent took part in the study were 38 males and 9 females. The majority (36%) of the respondent had preparatory education, whereas 14% were illiterate. About 76.6% of the respondent was engaged in dairy farming on a full –time basis, while 23% of the farmers were engaged in various livelihood activities besides dairying. The majority (53 %) of the respondent had more than 10 years’ of experience in dairy farming.

In all, 55.3% of the respondents follow hygienic-status of the watering system. In the order decreasing percentage of respondents, the most frequently reported dairy cattle management problem were design of housing, availability and quality of feed storage, feeding practice, protection from heat and cold, hygiene of housing. Hygiene of housing was reported as a major cause of management problem. According to the respondents, although natural pasture was the main source of feed used all year-round, its availability and quality declined in the dry season, resulting in poor performance and loss of animal condition. The majority of respondents mentioned that lack of capital prevented them from feeding concentrate to their lactating cows. The only mineral supplement used was common salt (100%), which respondents perceived to increase milk yield.

Table 1. Socio-demographic characteristics of respondents of the study

Variable		Frequency	%
Gender	Male	38	80.5
	Female	9	19.15
Age in years	18-30 (youth)	8	17.02
	30-50(middle)	20	42.55
	>50 (old)	19	40.43
Education	Illiterate	7	14.89
	Primary	2	4.26
	Secondary	8	17.02

	Preparatory	17	36.17
	College	13	27.66
Level of experience	<18 years	6	12.77
	18-30 years	6	12.77
	>50 years	25	53.19

4.1.2 Dairy cow feeding and watering experience

All types of ingredients, as well as completed compound feeds, require special care during storage to prevent deterioration in quality and loss. Good storage is essential because the value of the feed that you present to your animals depends on it. Feed spoils during storage. Whether it deteriorates quickly or slowly depends partly on its quality when you receive it but very largely on how it is stored on the farm. Environmental factors, such as moisture (feed moisture content and relative humidity), temperature, light, and oxygen influence deteriorative changes and losses in feedstuffs. Ingredients should be stored for as short a period as possible and compounded feeds used quickly, especially in tropical conditions. Whereas the visited farms, 19.15% (n=9) had no feed storage. But hygiene status-feeding trough 91.4% (n=43) of the farm is clean although this manual will not provide the answer for each and every “specific situation” it does provide the (theoretical) knowledge and guiding principles to help farmers in their feeding management. In addition to the feeding-practice 72.3% (n=34) of the farms were good because feeding management is one of the most important aspects in a commercial dairy farm. It is not only determining milk production levels, but it also has a major impact on the health and fertility levels on the dairy farm. Proper feeding management also influences economic results of the dairy farm to a very large extend. Higher levels of milk production also ensure an efficient use of feed resources reducing the amount of greenhouse gas emissions per litre of milk. The respondents (farms) did not develop a good understanding of problems encountered when milking cows are fed with unbalanced diets, for example the metabolic diseases associated with poor nutrition. Because 27.6 % (n=13) of the farms had fair feeding-practice.

High yield milking cow could drink 15 to 20 L water/d during the hot season. Other factors influencing water intakes include dry matter intake, diet composition, humidity, wind speed, water quality (sodium and sulphate levels), and the temperature

and pH of the drinking water. However, as the respondents said that they provided free access of water but in terms of hygiene status of the water, only 55% (n=26) of the farms provided clean water to their dairy cows. The body of a dairy cow is composed of 70% to 75% water. Milk is about 87% water. Water is not a feed as such because it does not provide specific feed nutrients. However, water is essential to regulate body temperature. As well, water is involved in digestion, nutrient transfer, metabolism and waste removal. Water has structural and functional roles in all cells and all body fluids. An abundant, continuous and clean source of drinking water is vital for dairy cows. Whereas depending on the visual observation 45% (n=21) of the farms provide dirty water.

4.1.3. Housing experience

Cattle are housed in a wide range of ways, especially from a global perspective. The method of housing varies according to the reproductive state of the animal and geographical area, varying from country to country, and from region to region within countries. Even within a geographical region and for one type of animal, farmers still have a wide choice of housing techniques. The choice of housing is often made depending on the local climatic conditions, cost of building materials and construction, cost of labour, and availability of local materials. The way that the choice of housing affects animal welfare will also depend greatly on local factors.

Most of the farms had a shelter for their cows with a corrugated iron roof and stalls but no bedding and a small loafing area. A total of 80.8 % (n=38) of the farms had earthen floors in alleys between rows of stalls i.e. poor, 10.64% (n=5) had brick floor faire. Only 8.5% (n=4) of the farms had a combined soil and sand area brick for loafing is good. Very few farms had a separate room for calving, even though parturition in alleys or loafing areas increases the risk of infection. Removal of faces and cleaning of the stall floors on most of the farms was done twice per day 57.4% (n=27) good and once per day 4.2% (n=2) poor. Cleanliness of cows and their housing is dependent on many factors, including stocking density, floor type, bedding material and type of shelter. For these reasons we suggest that direct comparisons between different types of housing systems are generally not very informative. This is particularly true for behavioural measures, which we suggest are more likely related to the specific design features of the housing system, but is also true for health problems. Hygiene of the housing facility of the farms are 70.7% (n=33) poor, 8.5%

(n=4) good and 29.7%(n=14) of the farm is fair because Cows lay on floor with no bedding on wet or moist brick floor to have an increase, risk of lameness and limb injuries. Cow walking through excreta also have to alter their gait while walking. All of the farms were housed together, except calves which were housed in the family dwelling. Housing conditions affect animals throughout their life. Images of modern housing systems, such as veal calves in individual veal crates, have figured prominently in public concern about the welfare of farm animals. Many modern housing systems involve keeping animals indoors, in a restricted space, at high density, and often separated from other animals. Whereas on the basis of visual observation, the cattle house was assessed to be with poor ventilation 8.5% (n=4), faire ventilation 51% (n=24) and good ventilation 40.4% (n=19)

Table 2. Respondent response on microclimatic-condition

Variables		Microclimate condition		
		Poor	Fair	Good
Respondents gender	Male	2	14	22
	Female	-	4	5
Respondents – occupation	Full-time	1	14	21
	Part-time	1	4	6
Type of farming	SSDF	2	16	20
	MSDF	-	2	3
	LSDF	-	-	4

4.2. Knowledge, Attitudes, and Practices of Dairy Cows Welfare

Improving dairy cowl welfare is a human responsibility and influenced by a person's values and experiences. Thus, it is critical to have an in-depth understanding of the knowledge, attitudes, and practices (KAP) of dairy cow welfare among animal owners. A cross-sectional survey covering a range of species and dairy cow welfare aspects was carried out on a total of 47 farms. Item response theory models (IRT) were fitted to the data from KAP items to estimate the probability of correctly answering an item. This was used as a function of the respondents' KAP level. Overall, the highest percentage of desirable scores was recorded for the knowledge scale (76.6%, 36/47) and the lowest was for the practice scale (4.26%, 2/47). There was an incremental correlation was found between knowledge of the farmers and their

attitude toward animal welfare and self-reported practices. Generally, households practicing mixed crop-livestock farming system had better animal welfare knowledge, attitude, and practice than pastoralist. KAP demonstrate the need for targeted training to improve animal well-being (i.e., housing, management, nutrition, disease prevention and treatment, responsible care, humane handling) across livestock holding communities in Tigray.

4.2.1. Dairy Cow Welfare Knowledge.

Dairy cow welfare is an important aspect that affects the health and productivity of dairy animal. This study on the knowledge and opinion of dairy cattle farm welfare (DCW) was also anticipated in the selected areas of the study. A total of 47 dairy farmers participated in the survey. Two farms (4.26%, 2/47) had poor knowledge on having enough space to move freely, whereas (27.6%.13/47) and (21.2% 10/47) farms had satisfactory on freedom from hunger and malnutrition (f1) and free from injury, pain (f3) respectively. Farmers with higher education (61.7%29/47) had good knowledge. The respondents recorded the lowest score for knowledge the animal free from fear and distress is (17%, 8/47) which related to animal-human relationship (bad handling lead to fear toward the owner). The respondent knowledge of animal welfare standards were closely associated with level of education i.e. (61.7%, 29/47) Of the respondent has vet. profession, breeds of cows kept, herd size and production level. The desired present of correct knowledge, an average of responses above 50% was recorded only for four (4) statements.

4.2.1.1 *Sources of knowledge and information*

What kind of knowledge is needed to develop effective interactions with farm animals, and how may the acquisition of such knowledge be fostered by the skills and attributes of a farmer? Skills that develop during interaction with others often are not explicit, and may lead to tacit knowledge. It is often difficult for a farmer to describe this learning process, it tends to be intangible and related to the immediate context and situation. Through farmers' literature, meetings and advisory services, however, the process can be shared with colleagues, who are fellow 'experts' in the field. Such insight emerges from continuous observation, association, analysis, prognosis and weighing of different courses of action; it is not explicitly reflective in a way that enables a farmer to explain what is being done and why.

Sources of knowledge and information of the visited farms were (17%, 17/47) from school and (17%, 17/47) from friends and media (61.7%, 29/47) from veterinarian professions. Farmers have a number of competing demands and each has to work with a different set of contingencies, including building infrastructure, stockman ship levels, different commercial requirements, different breeds of animals, different soil types, different production systems, different climates, factors which necessarily presume that farm assessment is a process of negotiation.

An assessor may rigorously follow a pre-determined list of points. Another may walk round with a notebook. Increasingly, laptops and other electronic reader/writers are being employed as a mechanism by which the audit process maybe made faster and more consistent in its reporting. Respondents knowledge on animal welfare standard was good (57.4%, 27/47) and low (4.2%, 2/47). This could lead to awkward situations between farmer and assessor, however, currently, the phrasing of many of the questions make it obvious how one could remedy the situation, and through lines of questioning the assessor can and does share practical sets of knowledge.

4.2.1.2 Frequency percentages of stockpersons responses to DCW knowledge questions (n=47)

Frequency percentage of the stock persons to the DCW knowledge statements are presented in Table 2. The association of sex, age, religion, education level, occupation, and marital status of the respondent with knowledge related to dairy cow welfare was analyzed using chi-square. The farms were significantly associated with knowledge of respondents or farms ($P < 0.05$).

Knowledge of dairy cow welfare of the farms were 38.3% (n=18) medium and 57.45% (n=27) good. Likewise, the educational status of the respondents found to be statistically significantly associated ($P < 0.05$) with knowledge status of vet. Profession 61.7% (n=29) high knowledge towards DCW followed, school and elementary level. According to the collected data 27.6 % (n=13) of the farms have good practice on human-animal improvement, however 17% (n=8) of their knowledge on animal fear and distress have not any knowledge. About half of the respondents 72.3% (n=34) good with statement freedom of animals from malnutrition, hunger and thirst most of the time legal requirement during animal handling but 27.6% (n=13) of the farms were fair on the same statement related to dairy cow welfare. And more than 61.7 % (n=29) of the farms were determined good knowledge on animal should have enough

space to move around freely conversely, 4.2% (n=2) of the farms have poor knowledge on the same statement.

The adequate knowledge of animal handling among respondents is a prerequisite for optimal productivity of DCW. Farmers there for need training to understand basic concepts in dairy cow welfare. Because knowledge is affected by education, training both seen to be lacking in majority respondents interview aspects consider important for DCW. It is important that respondent be made aware of the potential benefit of training since appropriate training can increase DCW knowledge and change respondent practise.

No one has more experience in observing the expressive repertoire of individual farm animals than the farmer i.e. twenty five of the respondent (53.1%, 25/47) has greater than 50 years age and (12.77%, 6/47) less than 8 years age and this expert knowledge should play a prime role in the management of animal health and welfare. Although practical knowledge is complex and not easily measured, it should be taken seriously when examining factors influencing welfare. About half the participants (farms) 57.4%(n=27) expressed good knowledge and the adequate knowledge of animal handling among stockpersons was a prerequisite for optimal productivity and dairy cow welfare (Hems worth and Coleman, 2011) with legal requirements during dairy cow handling by expressing their normal behavior. On the other hand, 4.26 % (n=2) of the farms low knowledge on understanding the concepts of DCW. Recognition of farmers' non-reflective expertise opens up a more general discussion about the nature of knowledge and the importance of experience. The importance of such knowledge is increasingly recognized in the field of dairy cow health care. And, 76.5% (n=36) of the stock persons have good knowledge related to the level of freedom from injury, unnecessary pain and discomfort (F3).

The role of the nurse is health care, not disease treatment. The subject of interest is the patient, not the disease. Taking care of patients is considered something you just pick up through daily routine and practice, something naturally transferred among colleagues. Thus nursing becomes explicit and controllable, and open to quality inspection. A nurse who makes the bed properly is a good nurse, because that is how the profession is now defined. A parallel can easily be drawn with the role of the farmer.

As argued above, practical expert knowledge can be viewed as crucial to being a good' farmer. However, this knowledge must be made more explicit, and standards

must be formulated for what constitutes good practice. On the other hand, about 61.7% (n=29), 44.6%(n=21), and 72.3%(n=34) in urban and peri-urban areas of these three statement farms have a good knowledge on enough space to move freely, freedom to express their normal behavior and freedom from malnutrition, hunger and thirst respectively. But assessment aspects of dairy cow welfare of 21.3% (n=10) fair on health problems such as lameness, lesions on the body and limbs. For the farms allowing the cows turnout in pad dock, pasture or both and prolonged hunger 27.6 % (n=13) is fair with regard to the overall classification of the farms considered not poor.

None of the farmers had heard of the term DCW. However, farmers of 76.5%(n=36) of the dairy farm agreed that cows should have free access to feed and water and they demonstrated that they believed that animal suffering and its alleviation have important relationship with animal comfort. Knowledge is affected by education and training, both of which seem to be lacking in majority of the stockpersons interviewed, the three aspects (KAP) were considered important for dairy cow welfare. Therefore, stockpersons need education and training to understand basic concepts on the knowledge of dairy cow welfare. All these factors limit stockpersons access to vital dairy cow welfare knowledge.

Table 3. Knowledge of respondents about dairy cow welfare (n=47)

Knowledge of respondents about five freedom points	Poor		Fair		Good	
	Ur	Pu	Ur	Pu	Ur	Pu
1. What is your knowhow level on freedom of animals from malnutrition, hunger and thirst most of the time?	0	0	9	4	25	9
2. What is your knowledge level that animal should have enough space to move around freely?	1	1	13	3	20	9
3. What is your knowledge level that animal should have freedom from injury, unnecessarily pain & discomfort?	1	0	7	3	26	10
4. What is your knowledge about animal fear and distress?	7	1	15	6	12	6
5. What is your knowledge level on freedom to express majority of their normal behaviour?	0	0	13	7	21	6

4.2.2 Farmers and Stock people Attitudes on DCW

From the result only one item from the attitude scale (my animal have enough water to drink). The respondents above 50% desired response for only one statement. The

group analysis result showed that 46.8% (22/47) had fair on consuming dairy product from poorly managed farm.

The farmers understanding of dairy cow welfare, as defined by the five freedoms of animal welfare and their assessment indicator, was evaluated by interviewing them .The following closed questions were asked (yes or no)whether the farmer had heard of animal welfare (translated into the native language) whether they thought the following were important for animal welfare access to feed and water at all times, minimization of pain ,distress , and suffering , veterinary treatment and comfortable housing.

4.2.2.1 Frequency percentages of stockpersons responses to DCW Attitude

The approach we follow in this paper to measure attitudes towards DCW follows. In our application, consumers were informed that farmers and other stakeholders involved in rearing DCW in different ways, while compliance with these animal friendly practices could be guaranteed through a certification or a label issued by public authorities. We found that attitudes not only differ across countries but also across regions within the same country, and that this difference is mainly driven by a different attitude towards farmers' compliance with DCW.

Among the most important targets to meet is building robust and well-governed public health and animal health system compliant with the WHO and OIE international standards. Additional targets consist of emphasizing the importance of cross-sectional collaboration and coordination, together with motivating trainees to abandon traditional behaviours and better inform decision-makers to obtain the necessary political, legal, and financial support. Hence an understanding of public awareness and practices of farmers has received much attention nowadays could be a useful tool in developing and improving existing dairy cow welfare. Therefore, the research was conducted with the objectives to assess community knowledge and attitude on DCW and to assess the practice of the society on integrated in improving dairy cow welfare in the selected areas of Tigray regions. The attitude of respondents on dairy cow welfare, prevention, control, and advantage of training with their educational level was assessed and the study revealed that statistically significant differences ($P < 0.05$) were encountered.

According to the respondent surveyed, 44.6% (n=21) of the farms should have good attitude on follow the government animal product for sale in the market about animal

welfare standards. Of those who have a positive perception on DCW having college and university level education. But 12.7% (n=6) of the farms actively avoided this practice didn't have a positive perception on dairy cow welfare were illiterate. However, no significant association ($P>0.05$) was seen among the different control method attitudes of DCW.

Frequency percentage of the stockperson responses to the dairy cow welfare Attitudes statements are presented in table 3. Among factors that affect stockpersons contribution to dairy cow welfare, attitude have been widely studied, possibly because they influence future behavior regardless of individuals current knowledge and explains why an individual might adopt one practice over alternatives (Macias, Glasauer,2014). There for attitude strongly influence the practices of stockpersons toward dairy cow welfare. Owing to the fact that almost all of the stockpersons strongly agree with the standard dairy cow welfare attitude statements. However, this was in contrast with their attitudes toward stocking of consuming dairy products from poorly managed farms where only 38.2%(n=18) of the stockpersons have good attitudes on avoiding to consume dairy product from poor managed farms but a total 14.8%(n=7), of the farms have poor attitude.

Table 4. Respondents attitude on dairy cow welfare (n=47).

Attitude of respondents about freedom points	Poor		Fair		Good	
	Ur	Pu	Ur	Pu	Ur	Pu
1. What is the degree of concerns on consuming dairy products from poorly managed farms? (F5)	4	3	15	7	15	3
2. Do you think that government should follow animal product for sale in the market about animal welfare standards s.	5	1	3	7	16	5

4.3. Observational Welfare Results

4.3.1 Dairy Cow Welfare Practice

The environmental, economic, and social sustainability of products of animal origin inevitably go through the requalification of farming techniques and the implementation of new and best practices for animal welfare and agricultural sustainability that farmers can implement. Housing and equipment within the barn represent threats to animal welfare. For this reason, many works, research projects,

recommendations and scientific opinions focus primarily on the adequacy of housing conditions. Regardless of the farming system used, animals should have the ability to interact socially, express their own affiliate behaviors and related positive emotions, manifest exploration and play activities, and maintain a stable social hierarchy. Housing of animals older than 6 months: All animals are loose housed and have access to an outdoor area (exercising area) with a total surface of at least 4–5 m²/head or to a pasture (grazing) for at least 60 days/year, with adequate shelter from sun and rain. Whereas design housing of the visited farms are 25.5 % good and while 27.6 %, was poor. Facilities for delivering feed and water should be designed, constructed, and installed in such a way as to minimize the possibility of feed and water contamination and negative consequences deriving from competition between animals. The animal's diet should be of high-quality regarding ingredients: their origin must be known, and they must be stored in suitable environments to prevent alterations or contamination with toxic or harmful substances. According to our observational survey, results of hygiene-housing facilities were poor as 70.2% (33/47) was found to be poor indicator of DCWS, while majority of the hygiene status of feeding areas were found as 91.5% (43/47), which is good indicator on DCWs. About and hygiene-status of watering trough was 44.7 % (21/47) followed by ventilation 40.4% (19/47). The followed by hygiene-status of watering 55.3% (26/47).

Table 5. Observational assessment of dairy cow welfare (n=47)

Dairy cow welfare practice	Poor	Fair	Good
1 Hygiene –status of watering	21	-	26
2 Hygiene – status of feeding	4	-	43
3 Hygiene - housing facility	33	10	4
4 Housing-design	13	22	12
5 Ventilation	4	24	19

Altogether, the Orthodox of farmers gave names to all or some cows in the herd have good knowledge 42.5% (20/47) practicing on human-animal improvement. In a further study, farmers in the region offered 3 complementary explanations for their habit of calling cows by name: the practical need to refer to them and call them during management, cultural habit, and the expression of their emotional proximity to the cows. Animals should have the ability to interact with the respondent of male good 36% (17/47) socially, express their own affiliate behaviours and related positive

emotions, manifest exploration and play activities, and maintain a stable social hierarchy. Some management respondent of occupation partial on the dairy farm 2% (1/47) practices negative for dairy cow welfare stood out in the survey, especially in farms of the pasture-based and extensive groups: the use of the milking pallor to carry out veterinary treatments, the habit of tying cows during milking, and the presence of livestock and companion animals within the milking pallor. The environmental, economic, and social sustainability of products of animal origin inevitably go through the requalification of SSDF 21.2% (10/47) techniques and the implementation of new and best practices for DCW welfare and agricultural sustainability that farmers can implement.

Some management practices considered 2% (1/47) negative for dairy cow welfare stood out in the survey, especially in farms of MSDF pasture-based. However, in contrast with these practices, average flight distances found in this study suggest overall positive or neutral human–animal relationships. This may be explained by some positive routine management practices i.e. 8.5% (4/47) which may involve interactions with positive reinforcing outcomes.

Table 6. Responses on practicing human-animal improvement (n=47)

Variables		Practicing-human-animal improvement		
		Poor	Fair	Good
Respondents sex	Male	1	20	17
	Female	-	6	3
Occupation	Full time	-	19	17
	Partial	1	7	3
Religion	Orthodox	1	24	20
	Muslim	-	1	-
	Protestant	-	1	-
Types of farming	SSDF	6	22	10
	MSDF	1	-	4
	LSDF	-	-	4

4.3.2. Health Management and Welfare Practice

The cleanliness of cows and their housing is dependent on many factors, including stocking density, floor type, bedding material, type shelter, temperature, and humidity level. Frequency of cleaning the floor has a direct relationship with cleanliness and in

our study removal of fascies and cleaning of the floor of the stall floor was done only once or twice a day and on same farms less than once per day. The hind quarter, tail, and udder are most likely to become dirty from manure and diarrheic faces. Similar to other study, we also found some association between dirty body regions i.e. hygiene-housing facility of the visited farms were (70.2%, 33/47) poor, (51%, 24/47) fair and other housing (flooring) and management factors (cleaning) because removal of faces and cleaning of the stall floors on most of the farms was done twice per day 57.4% (n=27) good and once per day 4.2% (n=2) poor. The udder and the teat are affected by the cleanliness and dryness of the stall surface but teat cleanliness is also affected by the milking procedure. To ensure hygienic milk with drawl, teats are usually cleaned before every milking, thus, in our study; teats were cleaner than other body parts. Very few farms of MSDF (6.3%, 3/47) had good on separate room for calving and using bedding even though parturition in alleys or loafing areas increase the risk of reproduction tract infection and calf disease, in particular, navel. Respondents on occupation partial on dairy farm (8.5%, 8/47) cows lay on floor with poor bedding, on wet or moist brick floor with uneven and abrasive surface and would therefore be expected to have an increased risk of lameness and limb injury. Farther more, an earthen floor with pooled urine will lead to cow having dirty coats. Cows walking through excreta also have gait while walking. The injuries to different parts of the body that were recorded in this study appeared linked to the different risk factors arising from the type of housing environment. These lesions cause pain and demonstrated the close relationship between improperly designed or maintained animal facilities and the number of cows that are lame or injured or have hock lesions. Of all the health parameter measured in our study, it was the prevalence of limb lesion that related to milk output of the cow.

Table 7. Response on using bedding of dairy cow welfare (n=47)

Variables		Practicing-using-bedding		
		Poor	Fair	Good
Respondents sex	Male	11	13	14
	Female	3	4	2
Occupation	Full time	10	13	13
	Partial	4	4	3

Religion	Orthodox	14	16	15
	Muslim	-	-	1
	Protestant	-	1	-
Types of farming	SSDF	14	12	12
	MSDF	-	2	3
	LSDF	-	1	3

4.3.3. Frequency Percentages of Stockpersons Responses to DCW Practices

Frequency percentage of the stockperson's responses to the dairy cow welfare practice statements are presented in Table 4. Feeding - practice of the farms were 72.34% (n=34) faire, 27.6 % (n=13) is good. As we all are aware that safe and quality milk is being produced from healthy animals using management practices that are sustainable from an animal welfare, social, economic and environmental perspective. This study was carried out to find the common animal welfare practices being practiced by randomly selected 47 dairy farmers in the urban and per -urban areas of Tigray region. For the study, a door-to-door survey was conducted using semi-structured interview schedule to collect primary data on various dairy animal welfare practices like calf rearing, feeding, housing, breeding, health care and milking welfare keeping in mind the "Five Freedoms" concept for animal welfare. Data from the study revealed that, Feed cows always at the same time. Make sure that feed is easily accessible. Cows need/want routine. Feed enough so that the feeding manger will never be empty and accept feed leftovers. Hygiene status –feeding of the farm 91.4% (n=43) is clean the feeding manger at least once a day (feeding mangers with a smooth easy to clean surface also leads to reduced heating up of feed). In this situation cows will eat in small portions throughout the day ensuring that the rumen is always full and functioning well, 59.5 % (n=28) good in feeding frequency of the dairy per-day. Another aspect is the cost of feeding. In virtually all commercial livestock farming systems the purchase of feed and/or the cost of growing fodder is the most expensive item of the production costs. Because of these high costs 40.4% (n=19) of the farms have fair in feeding frequency of the dairy per-day. Although this thesis will not provide the answer for each and every "specific situation" it does provide the (theoretical) knowledge and guiding principles to help farmers in their feeding management. On the other hand 57.4%(n=27) of the farmers have good housing system for lactating dairy cow but majority of the stockpersons did not

always engage in good animal practices example 29.7 %(n=14) of the farmer have poor watering frequency of the dairy per-day and 29.7(n=14) poor in using bedding material for lactating cow. It is well established that animal handling is a very demanding profession (Hems worth and Coleman, 2011), hence adhering to existing good animal handling practices requires a level of motivation that the stockpersons do not have. They were also providing necessary amount of greens and concentrates to their animals and in some parts of district, they had maintained the standards of feeding welfare by exposing their animals to green pastures. Regarding the breeding welfare practices, majority of the respondents were practicing artificial insemination method and also got their animals examined after 90days of insemination, which was a good breeding welfare practice. Majority of them had provided proper prophylactic measures to their animals from contagious diseases for their health welfare. They were milking their animals twice a day in the same place where they usually tied them. Majority of them were following good milking welfare practices by cleaning their hands, utensils and udder of the animal before milking.

Table 8. Respondents practices on dairy cow welfare (n=47)

Practices Statement	Poor		Fair		Good	
	Ur	Pu	Ur	Pu	Ur	Pu
1. Feeding frequency of the dairy cow per day(F1)	0	0	14	5	20	8
2. Watering frequency of the dairy cow per day(F1)	11	3	16	7	7	3
3. What is the use bedding material for the lactating cows in the farm? (F2)	11	3	13	4	10	6
4. Special needs of the housing (F2)	2	0	12	6	20	7
5. What is the management practices the animal freedom from injury, unnecessarily pain and discomfort? (F3)	2	1	16	6	16	6
6. How do you handle dairy cow to express majority of their normal behavior? (F4)	10	3	14	7	10	3
7. What do you do to animal to protect them from unnecessary fear and stress? (F5)	4	1	20	9	10	3

5. DISCUSSION

This study is in an assessment of knowledge, attitude and practice of the respondents on dairy cow welfare in the selected urban and peri-urban of Tigray region. It has provided valuable insight and baseline data to better understand the housing equipment and management practices for conducting resource-based research that enhance the dairy cow welfare in the study area. The study was a door to door survey conducted using an inter-view to collect the data on various items or indicators and conducted using data collection instruments, such as questionnaires' and personal observations.

According to this observational survey, result of hygiene-housing facilities was found as 70.2% (33/47), which is poor indicator of DCW, while majority of the hygiene status of feeding areas was 91.5% (43/47), which is good indicator of DCW. The hygiene-status of watering trough was 55.3% (26/47), which above average, and the final observed parameter was on the housing designs of the farms, which can be explained in terms of ventilation was found only 40.4% (19) in good status, indicating that most of the housing facilities were not accepted according to the standard OIE guidelines (Table 5). Generally, our observation findings were not what is anticipated from the intensive and semi intensive farms.

In accordance with the objectives set for the study, the data was collected and analyzed qualitatively. Our results indicated that the majority (80.5%) of the farmers were males (Table 1). This indicates that the involvement of females in dairy cow farming is small. The age of respondents was also completed during the investigation and was categorized in to three groups, 18-30 (youth), 31-50 (Middle) and greater than 50 (old), it was found that majority (83%) of the farmers were in their middle (42.55%) and old (40.43%) age group as presented in Table 1. From this, it can be anticipated that most probably dairy cattle farming is followed after having adequate experience and gaining the knowledge about the faming management. Similar findings have been reported elsewhere that the majority of the livestock owners were under the middle and old age group (Dwivedi, 2013; Fregonesi and Leaver , 2002).

Based on herd size, respondents were classified in to three categories, small scale dairy farm (5-15), medium scale dairy farm (16 to 25) and large-scale dairy farm (above 25) dairy cows. Table 2 depicts that the majority of the farmers (81%) were SSDF, while 11% and 8% were MSDF & LSDF respectively. Our finding is

consistent with Dwivedi (2013), who reported that 82% of the livestock owners had small herd size. Majority of the respondents (79%) had dairy as their main occupation, the rest 21% were working as their part time job (Table, 2).

Knowledge about animal welfare standards was also other criteria used to evaluate the status of farmers awareness using the 5F standard parameters. Responses from respondents of both urban (U) and peri-urban (PU) farms were collected and presented in Table 3, as poor, fair and good, based on their level of knowledge to answer each question precisely. Comparing the urban and peri-urban famers, majority of the farmers in the urban area has relatively good knowledge of animal welfare standards (Table 3). The same finding has been reported on dairy cows elsewhere (Dwivedi, 2013). This may lead us to speculate that, the difference may be due to the difference in general knowledge or academic status of the respondents.

When we analyze the attitude of respondents, good opinion of urban respondents toward animal welfare have been revealed, which is an important for better improvement of animal welfare (Table 4). Similar results reported in other studies (Dwivedi, 2013; Fraser *et al.*, 1997). Whereas contradicting result has been observed in other study (Barbusse, 1999). None of the farmer heard the term DCW before, however, 76.5% of the dairy farms' opinions agree that cows should have free access to feed and water. It is well established that animal handling is a very demanding profession on dairy cow welfare (Hems and Coleman, 2011), hence adhering to existing good animal handling practice, our study showed that 72% (34/47) was responded good.

6. CONCLUSION AND RECOMMENDATIONS

In this study, the stockpersons demonstrated a high level of dairy cow welfare knowledge than attitude and practice. Of the major concerns are poor practice related to the frequency of watering per-day, using of bedding for lactating cow and expressing of normal behavior. Most of the farmers were not having good level of animal welfare knowledge. Though, there is no standard regulation to be implemented, there is a need for establishment/formulation and proper implementation of animal welfare standards, which is a multidisciplinary task has to be involved in the region. Veterinary professionals were the most important stockholders in the actual activities that were perceived from the respondents; hence they need further refreshing training on animal welfare issues to better improve their welfare. Good knowledge of animal welfare improves animal wellbeing by having enough space to move freely, to express normal behavior, about the animal free from fear and die stress are helping to eliminate situations involving extreme stress and suffering. Dairy cattle welfare, is the most important aspect of animal welfare, because at this DCW has a major concern in many countries. Poor animal welfare has an impact on the dairy farm production and public health importance. Therefore, DCW has a guarantee for consumer to buy products from healthy dairy cattle.

The assessment of the KAP of the respondent on dairy cow welfare described in this paper served as an input for Tigray dairy cow welfare assessment program. Further studies are required at a regional level to verify how the level of dairy cow welfare in Tigray using quantitative and qualitative measures of animal welfare indicators.

7. REFERENCES

- Albright L J 1987. Dairy Animal Welfare: Current and Needed Research. *Journal Of Dairy Science*, 70, 12, 2711-2731.
- Anonymous, 1992. Report of the scientific veterinary committee (animal welfare section) on the welfare of dairy cows kept in different production systems. Report: VI/5291/92-EN.CEC, Brussels, 147 pp.
- Barbusse H. (1999): A review of the animal needs index (ANI) for the assessment of Animal Wellbeing in the housing systems for Austrian proprietary Products and Legislation *Livestock Production Science*, (61): 179–192.
- Bernardino, F., J. Foregoes, C. Winkler, D. M. Venire, M. A. G. vo Keyserlingk, And D M. Weary. 2009. The stall-design paradox: Neck rails increase Lameness but improve udder and stall hygiene. *J. Dairy Sci.* 92: 3074- 3080
- Barnett, J.L., Coleman, G.J., Hems worth, P.H., Newman, E.A., Fewings-Hall, S., Zinc, C., 1999. Tail docking and beliefs about the practice in the Victorian dairy Industry. *Aust Vet J.* 77,742-747.
- Brakemen, H.W., Shucked, Y.H., Lam, T.J., Beiboer, M.L., Benedict us, G., Brand, A., 1999a. Management practices associated with the incidenrate of Clinical mastitis. *Journal of Dairy Science.* 82, 1643-1654.
- Brand, A., 1999a.. Management practices associated with the incidence rate of clinical Mastitis. *Journal of Dairy Science.* 82, 1643-1654. Broom, D.M. & K.G. Johnson, 1993. *Stress and Animal welfare* Chapman Hall, London, 211pp.
- Broom, D.M., 1991. Assessing welfare and suffering. *Behavioural processes*, 25(2-3): 117-123.
- Broom, D.M., 2003. Causes of poor welfare in large animals during transport, *Vet. Res. Commune.* 27, 515–518
- Brunt, J., Ersbøll, A.K., Alban, L., 2002. Risk factors for metritis in Danish dairy Cows. *Preventive Veterinary Medicine*, 54, 179-190.
- Broom, D. M. 1986. Indicators of poor welfare. *Brit. Vet. J.* 142: 524-526.
- Broom D.M. (2004). Welfare. In *Bovine Medicine: Diseases and Husbandry of Cattle* Ed.A.H. Andrews, R.W. Blowzy, H.Boyd and R.G. Eddy 955-967, Oxford: Blackwell Blokhuis JH 2008. International cooperation in animal Welfare: the Welfare Quality Projector. *Acta veterinarian Scandinavia* 50 (Suppl. 1): S10.
- Broom DM 2011. A history of animal welfare science. *Acta Biotheor*, 59(2):121-37.

- Burrows, E., T. Rousing, P. T. Thomsen, N. D. Often, and J. T. Sorensen. 2012. Effect of grazing on the cow welfare of dairy herds evaluated by a Multidimensional index. *Animal* 17:1-9.
- Chapinal, N., A.K. Barrientos, M.A.G. von Keyserlingk, E. Galo, and D.M. Weary. 2013. Herd-level risk factors for lameness in dairy cows.
- Dawkins, M.S., 1988. Behavioral deprivation: A central problem in animal welfare. *Applied Animal Behaviour Science* 20: 209-225.
- DeVries, T.J., Keyserlingk, M.A.G., Weary, D.M., 2004. Effect of feeding space on inter-cow distance, aggression, and feeding behavior of free-stall housed Lactating dairy cows. *Journal of Dairy Science*, 87, 1432-1438.
- Duncan, I.J.H. & J.C. Petherick, 1991. The implications of cognitive processes for Animal welfare. *Journal of Animal Science* 69: 5017-5022.
- Duncan, I.J.H., 1981. Animal rights – animal welfare: a scientist ‘s assessment. *Poult. Sci.*, 60, 489-499.
- Dwivedi, P.K. 2013. Dairy animal welfare practices followed by different stakeholders in Kumaon Region in Uttarakhand. Ph. D. thesis, Indian Veterinary Research Institute, Izatnagar, U.P. India.
- EFSA Panel on Animal Health and Welfare (AHAW) 2009. Scientific report on the Effects of farming systems on dairy cow welfare and disease. Annex to The EFSA Journal 2009:1143.
- EFSA Panel on Animal Health and Welfare (AHAW) 2012. Scientific Opinion on the use of animal-based measures to assess welfare of dairy cows. EFSA Journal 2012;10 (1):2554, 81 pp.
- FAWC. 1992. Farm Animal Welfare Council updates the five freedoms. *Vet. Rec.* 131:357.
- Fraser, D. 1995. Science, Values and Animal Welfare: Exploring the 'Inextricable Connection'. *Anim. Welf.* 4: 103-117.
- Fraser D 2008. *Understanding Animal Welfare: The Science in Its Cultural Context.* Wiley-Blackwell, Oxford, UK.
- Fraser, D. and Matthews, L.R., 1997. Preference and motivation testing. In: *Animal Welfare.* Appleby MC, Hughes BO (eds). Oxon: CAB International. 159-73.
- Fraser D 2008. *Understanding Animal Welfare: The Science in Its Cultural Context.* Wiley-Blackwell, Oxford, UK.

- Fraser, D., D.M. Weary, E.A. Pajor & B.N. Milligan, 1997. A scientific conception of Animal welfare that reflects ethical concerns. *Animal Welfare* 6: 187-205
- Fourchon, C., F. Beauteous, N. Braille, and H. Seeger's. 2001. Incidence of health Disorder in dairy farming systems in western France. *Livest. Prod. Sci.* 68:157-70.
- Fregonesi, J.A. and Leaver, J.D., 2002. Influence of space allowance and milk yield Level on behavior, performance and health of dairy cows housed in straw Yard and cubicle systems. *Livestock Production Science.* 78, 245-257.
- Gebreslassie Gebrehiwot, T., Mekonen, H.H., Hailu Gebru, T., Kiros, K.G., Gebresilassie, B., Teklu, G., Tesfay Tadese, H. and Hailelassie, Y., 2020. Prevalence and associated factors of early postnatal care service use among mothers who had given birth within the last 12 months in Adigrat town, Tigray, Northern Ethiopia, 2018. *International Journal of Women's Health*, pp.869-879.
- Grant, R.J. and Albright, J.L., 2001. Effect of animal grouping on feeding behavior and intake of dairy cattle. *Journal of dairy science*, 84, pp.E156-E163.
- Hagos, W.G., Muchie, K.F., Gebru, G.G., Mezgebe, G.G., Reda, K.A. and Dachew, B.A., 2020. Assessment of knowledge, attitude and practice towards rabies and associated factors among household heads in Mekelle city, Ethiopia. *BMC Public Health*, 20(1), pp.1-7.
- Haskell, M. J., L. J. Rennie, V. A. Bowell, M. J. Bell, and A. B. Lawrence. 2006. Housing system, milk production, and zero-grazing effects on lameness and leg injury in dairy cows. *J. Dairy Sci.* 89: 4259-4266
- Hansen, M., Misztal, I., Lund, MS., Pedersen, J., Christensen, LG., 2004. Undesired Phenotypic and Genetic Trend for Stillbirth in Danish Holsteins. *J. Dairy Sci.* 87, 1477–1486
- Hristov S, Vučinić M, Relić R, Stanković B 2006. Unsolved gajenja, dobrobiti Ponašanje Farmakis životinja. *Biotechnological u stočarstvu*, 22, 73 - 84.
- Hughes B.O. and Duncan I.J., 1988. The notion of ethological 'need', models of Motivation and animal welfare. *Anim. Behav.* 36, 1696–1707
- Hristov S., Stanković B., Zlatanović Z., Plavšić B. 2011. The most significant predisposing factors and causes of lameness of dairy cows, *Proceedings of International Scientific Symposium of Agriculture "Agrosym Jahorina 2011"* 82-9.
- Jones, P., 2015. Thermal environment. In *Metric Handbook* (pp. 127-162). Routledge
- Lacetera, N., 2019. Impact of climate change on animal health and welfare. *Animal Frontiers*, 9(1), pp.26-31.

- Loberg J., Lidfors L. 2001. Effect of stage of lactation and breed on dairy cows' Acceptance of foster calves. *Applied Animal Behaviour Science* 74 (2): 97-108
- Lorz, A., 1973. *Tierschutzgesetz*. C.H. Beck'sch Verlagsbuchhandlung, München, 272 pp.
- Mason, G. & M. Mends, 1993. Why is there no simple way of Measuring animal welfare? *Animal Welfare* 2: 301-319.
- Macciotta, N.P.P. and Atzori, A.S., 2020. How to manage cows yielding 20,000 kg of milk: Technical challenges and environmental implications. *Italian Journal of Animal Science*, 19(1), pp.865-879.
- Meyer, K., 2001. Estimates of direct and maternal covariance functions for growth of Australian beef calves from birth to weaning. *Genet. Sel. Evol.* 33, 1–28.
- Milchviehhaltung. In: *Kompendium der Tierhygiene*. Müller, W. and Schlenker, G. (eds.), 92
- Moberg, G.P., 1985. Biological response to stress: Key to assessment of animal well Being? In: G.P. Moberg (Ed), *Animal Stress*. American Physiological Association, Bethesda, pp. Müller, W. and Schlenker, G., 2003. *Hygiene der Munksgaard*, L. and Krohn, C.C., 1990. Construction of tie-stalls for dairy cows. In: Rep. 682, National Institute of Animal Science, Denmark, p. 31.
- Murphy, M.R., 1992. Water metabolism of dairy cattle. *Journal of dairy science*, 75(1), pp.326-333.
- Lu, M. and Wang, N.S., 2017. Spoilage of milk and dairy products. In *The microbiological quality of food* (pp. 151-178). Woodhead Publishing.
- OIE (Office International Epizooties) 2011. *Terrestrial Animal Health Code*. From <http://www.oie.int/index.php?id=169&L=0&htmfil45>.
- Pulina, G., Tondo, A., Danieli, P.P., Primi, R., Matteo Crovetto, G., Fantini, A., Ørskov, E.R., Reid, G.W. and Kay, M., 1988. Prediction of intake by cattle from degradation characteristics of roughages. *Animal Science*, 46(1), pp.29-34.
- Pulina, G., Tondo, A., Danieli, P.P., Primi, R., Matteo Crovetto, G., Fantini, A., Macciotta, N.P.P. and Atzori, A.S., 2020. How to manage cows yielding 20,000 kg of milk: Technical challenges and environmental implications. *Italian Journal of Animal Science*, 19(1), pp.865-879
- Research and Development in Farm Animal Welfare. FAWC 2009. Opinion on the welfare of the dairy cow. Farm Animal Welfare Council, London, pp. 16.
- Rom, B., 1989. *Koens nærmiljø*. Statens Jordbrugstekniske Forsøg, Horsens, Denmark, Report 42.

- Rushen J and de Passille AMB 2011. Behaviour, welfare and productivity of dairy cattle. *Can.J. Anim. Sci.*, 78 (Suppl.): 3-12.
- Rushen J, de Passille AM, von Keyserlingk MAG and Weary DM 2001. *The Welfare of Cattle*. Springer, Dordrecht, 310 pp.
- Rushen, J. and de Passillé, A.M. 2003. Behaviors, welfare and productivity in dairy cattle. *Canadian J.Anim.Sci.* 78 (Suppl), 3-2170 48.
- Rushen, J. & A.M.B. de Passille, 1992. The scientific assessment of the impact of Housing on animal welfare: A critical review. *Canadian Journal of Animal Science* 72: 721-743.
- Sandoe, P., M.H. Giersing & L.L. Jeppesen, 1996. Concluding remarks and perspectives. *Acta Agriculturae Scandinavica Section A, Animal Science, Supplement 27: 109-115.*
- SCAHAW (Scientific Committee on Animal Health and Animal Welfare), 1999. Report on Animal Welfare Aspects of the Use of Bovine Somatotrophin.. Directorate General Health and Consumer Protection. Report of the Scientific Committee on Animal Health and Animal Welfare (SCAHAW).
- Schoener, T.W., 1971. Theory of feeding strategies. *Annual review of ecology and systematics*, 2(1), pp.369-404.
- Schrader, L., Keil, N., Rölli, D., and Nydegger, F., 2002. Einfluss eines erhöhten Tier-Fressplatzverhältnisses auf das Verhalten von Milchkühen unterschiedliche Ranges im Laufstall. *KTBL, Darmstadt*, 17-22.
- Somero, 2010. The social behavior of dairy cows: some differences between pasture. And cubicle system. In: Unshelm, J., Van Putten, G., and Zeeb, K., *Proc.Int. Conger. Appl. Ethol., KTBL*, 171-180.
- Spinka, M. 2006. How important is natural behaviour in animal farming systems? *Appl. Anim. Behav. Sci.* 100, pp. 117–128.
- Stafleu, F.R., F.J. Grommers & J. Vorstenbosch, 1996. Animal welfare: Evolution and erosion of a moral concept. *Animal Welfare* 5: 77-84.
- Stull, C.L., Payne, M.A., Berry, S.L., Hullinger, P.J., 2002. Evaluation of the Scientific justification for tail docking in dairy cattle. *JAVMA*. 202, 1298 1303.
- Stumpf, S., Nydegger, F., Wechsler, B., and Beyer, S., 2000. Untersuchungen zum Tier-Fressplatzverhältnis und zur Fressplatzgestaltung bei der Selbstfütterun von Fahrsilo. *KTBL Darmstadt*,.103-110.
- Sumner, L.W., 1996. *Welfare, Happiness and Ethics*. Clarendon Press, Oxford, pp. 239

- Von Keyserlingk, M. A. G., A. Barrientos, K. Ito, E. Galo, and D. M. Weary. 2012. Benchmarking cow comfort on North American frees tall dairies: Lameness leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows'. *Dairy Sci.* 95: 7399-7408.
- Von Keyserlingk GAM, Rushen J, de Passille MA and Weary M D 2009. Invited review: the welfare of dairy cattle—Key concepts and the role of science *J. Dairy Sci.* 92:4101–4111.
- Waiblinger, S., Reichmann, V., Troxler, J., Dreiseitel, H., Haller J., Windischbauer, G., 2001b. Einfluß eines Vorrückfressgitters auf Druckbelastungen und Schäden an den Schultern von Milchkühen. In: *Bau, Technik und Umwelt In der landwirtschaftlichen Nutztierhaltung. Institute für Agrartechnik Der Universität Hohenheim*, 462-465.
- Wells, S.J., Garber, L.P., Wagner, B.A., 1998. Papillomatous digital dermatitis and associated risk factors in U.S. dairy herds. *Prev. Vet. Med.* 38, 11–24.
- Wiepkema, P.R., 1982. On the identity and significance of disturbed behaviour in Vertebrates. IN: W. Bessei (Ed), *Disturbed Behaviour in Farm Animals*.
- Whitaker, D.A., Kelly, J.M., Smith, S., 2000. Disposal and disease rates in 340 British Dairy herds, *Vet. Rec.* 146, 363–367.
- Whay, H.R., Main, D.C.J., Green, L.E., Webster, A.J.F., 2003a. Animal-based measures for the assessment of welfare state of dairy cattle, pigs and laying hens: Consensus of expert opinion. *Anim. Wolf.*, 12, 205-21.
- Webster, A.J.F., 2009. The Virtuous Bicycle: A delivery vehicle for improved farm Animal welfare. *Animal Welfare.* 18, 141-14
- Webster, A. J. F. 2005. *Animal Welfare: Limping towards Eden*. Blackwell Publishing Ltd., Oxford, UK.
- Welfare Quality. 2009. *Welfare Quality® Assessment Protocol for Cattle*. Welfare Qualit Consortium, Lelystad, Netherlands
- Winckler C., Capdeville J., Gebresenbet G., Hörning B., Roiha U., Tosi M., Waiblinger S. (2003). Selection of parameters for on-farm welfare-assessment protocols in cattle and buffalo. *Animal Welfare Volume (12):* 619-624.
- Zucali, 2016. Consequences of reduction of number of individual feeder on feeding behaviour and stress level of feedlots steers. *Appl. Anim. Behav. Sci.*, 41, 27-35.