How to Build Artificial Grassland in the Cold and Semi-Arid Regions? —A Case Study in Naqu

Dor JHee Town DRop*

Pratacultural Science Institute, Tibet Academy of Agricultural and Animal Husbandry Sciences, Lhasa 850009, China

Abstract Construction of artificial grassland is a key factor to solve the shortage of grass and forage balance in cold and semi-arid areas of high plateau, and it is the key measure to ensure the sustainable development of grassland animal husbandry in this area. At present, the artificial grassland construction is neither reasonable nor scientific, which restricts the healthy and rapid development of artificial grassland in the cold and semi-arid areas of high plateau. In this research, with Naqu Area in Tibet as a case, problems and current status in construction process of artificial grassland are analyzed in cold and semi-arid areas of high plateau. Suitable artificial forage species in Nagqu are elaborated, and recommendations for the construction and development of artificial grassland are discussed.

Key words Cold and semi-arid regions, Artificial grassland, Problems, Recommendations

1 Introduction

China's arid and semi-arid regions are roughly divided by 200 mm annual isohyet. In the arid regions, the annual precipitation is 200 mm or less; in the semi-arid regions, the annual precipitation is 200-400 mm. Some western and northern regions in China have an arid and semi-arid climate, with annual precipitation of less than 300 mm and annual evaporation of more than 1300 mm. Due to fragile ecological environment, irrational human use, global climate changes and other factors, the area of degraded natural grassland in China's semi-arid regions accounts for 75% -95%[1]. One of bases for degraded grassland restoration and grassland animal husbandry development is artificial grassland construction, but China's artificial grassland area is only 2.1% of total grassland area[2]. The latest Tibet's land survey finds that Tibet has 88 million ha of various kinds of natural grassland, forming the most important material basis for the survival of farmers and herdsmen. As of 2014, the area of the natural grassland that can be irrigated accounted for only 1% of the available grassland area; the fenced pasture area accounted for only 10%; the region's artificial forage grassland area was 114700 ha, but the mechanically operating rate on artificial forage grassland was less than 1%. Thus, it is imperative to improve the region's artificial grassland planting technology and benefit. In Nagqu, forage is obtained from natural grassland for the grazing-based grassland animal husbandry. Due to the influence of traditional values and the constraints of objective conditions, the grassland animal husbandry in Naqu has not completely gotten rid of the production mode of excessive emphasis on livestock but less stress on pasture, as well as imbalance between supply and demand of livestock and pasture. The artificial grassland construction has made great strides, but there are still many problems such as huge gap in quality and efficiency, and unreasonable construction, making the grassland protection construction and pasture production fail to meet the animal husbandry development needs in Nagqu's animal husbandry development. Cao Zhonghua *et al.*[3], Wei Xuehong *et al.*[4], and Ling Hui[5] report the studies related to the artificial grassland construction in Tibet, but experts rarely report the artificial grassland construction in cold semi-arid or arid regions. Taking Nagqu for example, this paper analyzes the current situation and problems related to the artificial grassland construction in the cold and semi-arid regions, and makes specific recommendations, in order to provide a theoretical basis for artificial grassland construction in Nagqu and similar regions.

2 Artificial grassland construction and research status

The artificial grassland construction in Nagqu started from the 1970s. Elymus nutans, siberian wildrye, annual meadowgrass, highland barley, oats and other gramineous forage grass varieties have been widely grown in Nagqu. In the late 1990s, Nagqu's artificial grassland construction entered a new phase, and it carried out artificial grassland construction. In order to produce more forage, the degraded grassland with poor vegetation conditions was used to grow pasture and establish artificial grassland. At the same time, the herdsmen were encouraged to plant grass around their houses. Subsequently, there were many problems in artificial grassland use management, and the forage yield was low. And even the pasture yield as well as grassland utilization level was not as good as that of natural grassland, leading to criticism and question from many experts and scholars. In recent years, all levels of departments have laid great emphasis on manual planting of grass, and farmers and herdsmen have a new understanding of

Received: July 13, 2016 Accepted: September 6, 2016
Supported by Spark Project of the Ministry of Science and Technology (2015GA840007); National Forage Industry Technology System Fund Project of the Ministry of Agriculture for Tibet Experiment Station (CARS-35); National Nonprofit Industry Research Project (201203006).
* Corresponding author. E-mail: 782034969@qq.com

artificial grass planting. The government continues to promote the use of derelict land, sandy land, degraded land and wasteland to plant grass and establish forage base[4-7]. In 2014, Nagqu's grass planting area reached 10500 ha, including 2200 ha of grass planted around houses and livestock pens, and 8300 ha of contiguous pasture. A lot of work has been done for artificial grass planting in Nagqu, but due to special environmental conditions and climate, low level of regionalization of grass planting, unscientific forage variety selection and forage production and utilization mode, it can not achieve the goal of high pasture yield and supplementary feeding for livestock in winter and spring.

3 Problems

3.1 Unreasonable selection of artificial grassland Nagqu is located in Qinghai-Tibetan Plateau, with average altitude of 4000—4800 m, annual average temperature of -2.8—1.6 ℃, average annual rainfall of 247.3—513.6 mm and annual evaporation of 1500—2300 mm. It is cold, and there is a large temperature difference between day and night. The pasture growth period is short, and there are large regional differences[8]. Therefore, the artificial grassland construction and geographical selection in Nagqu become particularly important. Currently, in order to produce forage and protect ecology, Nagqu always promotes the use of derelict land, sandy land, degraded land and wasteland to plant grass during the artificial grassland construction, but it ignores the regional division for grass planting and different soil conditions for pasture population structure building, resulting in poor artificial grassland construction effect.

3.2 Unscientific selection and matching of pasture varieties In recent years, regardless of pasture growing conditions, a large area of annual pasture is planted, and in drought years, the pasture yield is extremely low, and the bare ground after plowing can easily lead to grassland degradation and soil degradation. In special habitats of Nagqu and especially the mid-west, the soil is thin, humus content is low, and rare rainfall leads to soil degradation. Therefore, we can not ignore the reasonable selection and matching of forage varieties[4,7,9].

3.3 Lack of effective planting measures Like arable land, artificial grassland also needs intensive cultivation, and if there are no scientific agronomic measures in plowing, harrowing, sowing, fertilizing, irrigation and harvesting, it will have a significant impact on forage growth and yield. Currently, Nagqu's artificial grassland construction is in face of extensive production mode. Only by taking into account these measures can the high yield and quality of forage be achieved.

3.4 Lack of water conservancy facilities Currently, most of the artificial grassland in Nagqu still has no good water conservancy facilities, and it is difficult to ensure the pasture needs for water at different growth stages. Especially in drought years, there is a severe water shortage and pasture yield declines. With different precipitation in different years, there is a large difference in pasture yield, leading to low level of Nagqu's artificial grassland construction and pasture production, and the grass is planted at the mercy of the elements.

4 Conclusions and recommendations

4.1 Conclusions In this paper, with Naqu Area in Tibet as a case, problems and current status in construction process of artificial grassland are analyzed in cold and semi-arid areas of high plateau. Suitable artificial forage species in Nagqu are elaborated. Construction of artificial grassland is a key factor to solve the shortage of grass and forage balance in cold and semi-arid areas of high plateau, and it is the key measure to ensure the sustainable development of grassland animal husbandry in this area. Establishing the regionalized, standardized, improved variety-based effective forage supply zone in northern Tibet can provide support for the Naqu and Tibet's ecological safety, plateau characteristic agricultural base construction, farmer and herdsman's income growth, dramatic socio-economic development and moderately prosperous society construction.

4.2 Recommendations (i) Reasonable site selection and scientific farming. The counties in Nagqu should select the appropriate regions for overall arrangement based on local conditions; use the abandoned farmland, wasteland and other regions with microclimate, water conditions and good soil for scientific farming by some agronomic measures in plowing, harrowing, sowing, fertilizing, irrigation and harvesting; develop large-scale efficient and productive artificial grassland; use degraded land and sandy land as the vegetation restoration grassland; make full use of the land around houses and livestock pens to produce more high-yielding forage. (ii) Optimizing the planting structure of artificial grassland. In accordance with different pasture production and artificial grassland use needs, we can adopt single cultivation, mixed cultivation, interplanting and other measures. For the artificial grassland where grass is mainly mown, in order to increase pasture yield and improve forage quality, we can adopt the mixed planting of two or more forage varieties, such as barley grass + forage rape + oats, and highland barley + oats. In order to reduce the production cost of artificial grassland and achieve stable production for many years, it is necessary to promote interplanting of high-quality perennial forage varieties, such as lyme grass + annual meadowgrass + stinkgrass flower + oats + highland barley + forage rape. For the grassland used mainly for vegetation restoration and improvement, we can adopt mixed planting of perennial forage varieties, such as lyme grass, annual meadowgrass and stinkgrass flower. (iii) Improving supporting water conservancy facilities. Irrigation is an important part of the grassland construction, and it is necessary to focus on water and solve water conservancy problems so that irrigation can be done when there is drought in grassland and drainage can be done when there is heavy rain. There is a need to establish highly efficient supporting water conservancy facilities in order to lay a solid foundation for high and stable yield of artificial grassland. (iv) Improving

(To page 63)

provide important reference and application value for sewage treatment, aquaculture, and aerated irrigation of plants. However, this device still remains at the study and experimental stage. Thus, we will study how to produce water with high dissolved oxygen, so as to apply this device in actual production as soon as possible.

References

[1] DING YL. The current situation and development of the application of oxygen-addition technique [J]. Fishery Modernization, 1978(3):15 – 19. (in Chinese).

[2] LIU S, ZHU BZ, WANG W. Performance of rotating packed beds in increasing dissolved oxygen in water [J]. Chemical Industry and Engineering Progress, 2010(S2): 38 – 40. (in Chinese).

[3] LU B, GUAN JT, ZHANG JG, *et al*. Research situation of hydrodynamic high intensity sound source [J]. China Petroleum Machinery, 2002, 30(4): 45 – 48. (in Chinese).

[4] CHAKINALA AG, GOGATE PR, BURGESS AE, *et al*. Treatment of industrial wastewater effluents using hydrodynamic cavitation and the advanced Fenton process [J]. Ultrasonics Sonochemistry, 2008,15(1):49 – 54.

[5] CAI YZ. The design and study of ultrasonic micro bubbles generator and technique [D]. Hangzhou: Hangzhou Dianzi University, 2013:9 – 15. (in Chinese).

[6] SUN XY. Recent research advances of ultrasonic atomizer [J]. Industrial Furnace, 2004, 26(1):19 – 23, 32. (in Chinese).

[7] ZHANG LF, XIA WH. Cavitation and cavitation erosion [M]. Nanjing: Hohai University Press, 1989:24 – 27. (in Chinese).

[8] GAO QS. Further exploration of liquid cavitation mechanism [J]. Journal of Hohai University (Natural Sciences), 1999, 27(5):63 – 67. (in Chinese).

[9] ZHANG CC, LV XP, HAN PF. Application of liquid whistle ultrasonic generator for circulation water sterilization [J]. Chemical Reaction Engineering and Technology, 2012, 28(1):70 – 74, 86. (in Chinese).

[10] LI ZK, ZHANG ZH, GUO S, *et al*. Research on jet bubble generator for microbubble floatation [J]. Mining Research and Development, 2007, 27(5):54 – 56. (in Chinese).

[11] HE F, XIE JS, YANG JL. Effect of nozzle geometry on aerodynamics of free jet [J]. Chinese Journal of Applied Mechanics, 2001, 15(4):114 – 120. (in Chinese).

[12] YUAN Y, WU SJ, SU J, *et al*. Effect of nozzle shape of reed-whistle on cavitation flow field [J]. Technical Acoustics, 2009, 28(6):64 – 67. (in Chinese).

[13] LU HQ. The theory and application of jet pump technique [M]. Beijing: China Water Power Press, 1989. (in Chinese).

[14] PANG YZ, LI XJ. Design of water-air spurting aerator used under ice and in deep water and experimental study on its performance [J]. Transactions of the Chinese Society of Agricultural Engineering, 2003, 19(3):112 – 115. (in Chinese).

[15] JIANG LY, LU YY, WANG J, *et al*. Experimental study on optimal nozzle-to-throat clearance of jet aerator [J]. Fluid Machinery, 2010, 38(11):1 – 5. (in Chinese).

[16] LIU H, WANG JH. An experimental study of ultrasonic atomizer [J]. Journal of Jiangsu Polytechnic University, 2005, 17(1):31 – 33. (in Chinese).

[17] LUO ZY, DENG WH. Study onthe working characteristics of A6 cantilever reed [J]. Technical Acoustics, 1996, 15(4):166 – 169. (in Chinese).

[18] ASCE, ANSI/ASCE2-91. Standard measurement of oxygen transfer in clean water [S]. New York: American Society of Civil Engineers, 1992: 11.

[19] CHENG XJ, KUANG YQ, LIN WX, *et al*. Effects of arrangement of venturi aerators on aeration in re-circulating water [J]. Journal of South China University of Technology (Natural Science Edition), 2015, 43(3): 121 – 129. (in Chinese).

[20] LI X, PEI Y, YAO BS, *et al*. A generator and system of ultrasonic microbubble based on hydraulic combination [P]. China Patent, ZL201520358920.0, 2015 – 10 – 21. (in Chinese).

[21] PEI Y, LI X, YTAO BS, *et al*. A generator and system of ultrasonic microbubble based on hydraulic combination [P]. China Patent, ZL201510284880.4, 2016 – 02 – 24. (in Chinese).

(From page 63)

the management level. It is necessary to establish a scientific and rational management mechanism, and strengthen the management of some technical aspects concerning artificial grassland such as planting, irrigation, fertilization, rat destruction and harvesting, to improve the overall management level of artificial grassland and give full play to the role of artificial grassland. (v) Strengthening technical training. It is necessary to increase technical training regarding grass planting, and use herder professional organizations as platform to annually organize professionals to carry out grass planting technological training and forage production and processing knowledge dissemination in the pastoral areas, in order to improve the technological content in planting grass, and promote the continuous development of grass and animal husbandry industry.

References

[1] YANG KQ, HAO MD. A primary exploration on the causes of natural grassland degradation in semi-arid area of China and its recovery techniques[J]. Shaanxi Journal of Agricultural Sciences, 2008(5): 131 – 134. (in Chinese).

[2] ZHANG ZH. On strengthening the construction of artificial grassland and promoting the development of industrialization development [J]. Inner Mongolia Prataculture, 2015(2): 3 – 6. (in Chinese).

[3] CAO ZH, WEI J, YANG FY, *et al*. The status and development prospect of artificial grassland in Tibet[J]. Pruataculture & Animal Husbandry, 2007(4): 49 – 52. (in Chinese).

[4] WEI XH, ZHENG WL. A brief discussion on the construction of artificial grassland in Tibet[J]. Tibet's Science & Technology, 2005(5):53 – 54. (in Chinese).

[5] LING H. A brief discussion on the current situation and countyermeasures of grass industry development in Tibet[J]. Tibet's Science & Technology, 2006(2): 24 – 28. (in Chinese).

[6] HU ZL, REN AJ, WANG CH. A brief discussion on the role of artificial grass planting and the key cultivation techniques [J]. Inner Mongolia Prataculture, 2003, 15(2): 38 – 39. (in Chinese).

[7] WANG JL, LA B, DUOJI DZ, *et al*. Problems in the development of gorage industry in Tibet and the countermeasures [J]. Tibet's Science & Technology, 2013(3): 52 – 55. (in Chinese).

[8] Gansu Grassland Ecological Research Institute (GGERI), Naqu District Bureau of Animal Husbandry. Resources of grassland agriculture in Naqu District of Tibet [M]. Lanzhou: Gansu Science and Technology Press, 1991. (in Chinese).

[9] LA B. Study on the introduction of high-quality avena test in alpine pastoral areas[J]. Chinese Journal of Veterinary Medicine, 2014(6):197 – 198. (in Chinese).