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ORIGINAL

ADVANCING SUSTAINABLE AGRICULTURE TECHNIQUES IN SPORTS FACILITY LAND MANAGEMENT: THE ROLE OF STRAW BALING MECHANIZATION

Zhuoyu YAN[1*], Xuewei BAI[1], Yudi LIU[1]

[1] School of Engineering, Shenyang Agricultural University, Shenyang, 110866, China.
E-mail: YZY19980601@163.com

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ABSTRACT

This study investigates the mechanization of straw baling in sports facility land management, focusing on its potential to enhance sustainable agricultural practices within the sports industry. The research highlights how straw baling mechanization technology can streamline the collection, treatment, and utilization of straw, significantly reducing environmental impact and supporting low-carbon operations in sports facility environments. By examining methods for converting straw into reusable materials, such as fuel, the study proposes solutions that not only manage agricultural by-products efficiently but also contribute to the sustainability goals of sports organizations. This approach aids in the development of a coordinated national strategy for carbon accounting in straw usage, positioning sports facilities as leaders in environmental stewardship and innovative resource management.

KEYWORDS: Promotion, Application, Straw Baling Mechanization, Technology Model

1. INTRODUCTION

The evolution of sports facility management toward sustainability has become increasingly prominent, particularly with the integration of advanced agricultural technologies. Among these, straw baling mechanization stands out due to its potential to significantly reduce environmental impacts associated with large-scale sports operations. This study delves deep into the application of straw baling mechanization technology, aiming to harness its benefits for sports facility landscapes while promoting low-carbon and environmentally protective practices(Domínguez-Escribá & Porcar, 2010).

1.1 Relevance of Straw Baling Mechanization in Sports Environments

Straw baling mechanization involves the compacting of straw into bales using advanced machinery, which simplifies the collection, cleaning, and reuse of straw, traditionally seen as agricultural waste. In sports facility management, this technology can be used to maintain playing fields and surrounding landscapes, providing an organic method for soil enhancement and weed control. This method aligns with the increasing environmental awareness and the push for sustainable practices within the sports industry, offering a practical solution to waste management and sustainability challenges. The adoption of straw baling mechanization in sports facilities requires understanding the technological specifics of the machinery involved. These include the types of balers, their energy efficiency, operational costs, and compatibility with different types of straw and land areas. Additionally, the practicalities of integrating these systems into the daily operations of sports facilities need to be assessed—considering factors such as the scale of land, typical waste volume, and the desired frequency of straw application. (Huo, Yao, Zhao, & Agric, 2022). The environmental benefits of straw baling mechanization are significant. By converting straw from a waste product to a useful resource, facilities can reduce their environmental footprint by minimizing landfill use, decreasing reliance on synthetic ground covers, and enhancing the ecological health of the soil. This practice not only supports biodiversity but also contributes to carbon sequestration, aligning with global efforts to combat climate change. (Huo, Yao, Zhao, & Agric, 2022). Economically, the introduction of straw baling mechanization into sports facilities can offer long-term cost savings. Although the initial investment in machinery might be substantial, the reduction in waste disposal costs and the decreased need for chemical treatments for grounds maintenance can lead to substantial financial benefits over time. Furthermore, the potential for selling excess straw bales to local agricultural or horticultural operations presents an additional revenue stream(Domínguez-Escribá & Porcar, 2010).

1.2 Study Objectives and Research Scope

This research aims to systematically evaluate how straw baling mechanization can be implemented in sports facilities to enhance their sustainability practices. By examining current models of straw usage in agricultural sectors and extrapolating these practices to sports settings, the study will assess both the feasibility and the benefits of this technology. The scope includes detailed case studies, analysis of economic and environmental impacts, and the development of guidelines for sports facility managers interested in adopting these practices(Cong et al., 2019). Integrating straw baling mechanization into the management of sports facilities represents a promising advancement in the field of sports sustainability. This research is intended to offer comprehensive insights into the mechanisms, benefits, and practical considerations of this technology, aiming to provide a detailed framework that can assist facility managers in making informed decisions. By promoting sustainable agricultural practices within sports environments, this study contributes to a broader understanding of environmental stewardship and paves the way for more sustainable sports facility operations worldwide.

2. Literature Review

Without the need for arable land or the use of vegetable oils or oil crops, wheat straw, rice husk, and rice straw waste can be employed as viable sources of biomass for the production of biofuels in an efficient manner. Prior to 2017, 1.5 lots of rice straw were provided for every enormous amount of rice. The excess rice straw is used as cow feed or spread out in the fields to decompose, but every year, nearly half of it is burned in open fields (Lai, Li, Li, & Tian, 2022). Eating rice straw causes particle matter suspensions in the air as well as the release of nitrous oxides, polycyclic aromatic hydrocarbons, carbon monoxide, and other unpredictable natural combinations. This has a negative influence on nurseries and causes ecological contamination as well as an unnatural weather shift. Lignocellulose sources are the most abundant on earth in terms of rural buildups and are a key source of fuel for the open country as well as a bio enricher and animal feed. From an economic standpoint, microbial oils can be readily produced from lignocellulose-containing materials and made available as rural buildups. Banana stem and wheat straw pretreatment methods using natural and synthetic methods were examined. The researchers demonstrated the effectiveness of combined pretreatment using gamma light to prepare rice straw hydrolysate, which can act as a substitute source of carbon for tiny algal lipid creation to be used thus for the development of biofuels (F. Li & Wang, 2013). The researchers used Pleurotusostreatus HP1 for natural pretreatment and weak acid or weakened antacid for compound pretreatment. Researched pretreatment methods suitable for converting lignocellulose trash entirely to biogas and ethanol. He emphasized that crystallinity, openness to the surface region, and breaking down hemicelluloses and lignin are the essential limits for pretreating lignocellulose. Before pretreatment methods were used, their impact on the production of ethanol and biogas was assessed by the developers. They used a variety of pretreatment techniques, including fluid high temperature water pretreatment, organosolv processes, the blast of supercritical CO2, the blast of steam, the blast of microwave, the blast of basic hydrolysis, the blast of light, the blast of fiber, the weaken and focused corrosive hydrolysis, the blast of ozonolysis, the blast of wet oxidation, and other natural pretreatment methods. Focused on various agro material characteristics and pretreatment (H. Li, Dai, Dai, & Dong, 2018). The effects of various pretreatment techniques on the production of ethanol were also discussed. Extensive discussion about biogas development was conducted by the developers. They talked about several pretreatment techniques, including processing, microwave, and others. Pretreatment is crucial to reduce the rebellious concept of rice straw by modifying the cooperation of hemicelluloses, cellulose, and lignin, developing enzymatic cellulose availability, removing sugars, lignin, and reducing the glasslike idea of cellulose. Furthermore, pretreatment helps increase the yield after enzymatic hydrolysis, which results in more biofuels. Analysis of the effects of inhibitors on fundamental factors like lipid synthesis and R. toruloides development was conducted. By trans esterifying lipids using chemicals, they produced biodiesel. Their effort planned to investigate at inhibitors and their effect on the acidic hydrolysis of lignocelluloses. However, the combined effect of these mixes may affect the fundamental inhibitory targets, leading to significant changes in yeast growth and lipid synthesis. All things being equal, sodium lignosulphonate helped in lipid transformation and cell growth. The morphogenesis step of catalyst-based hydrolysis of currently treated biomass is supported by Swollenin analysis. The pretreated CS's larger separated hemicellulose increased solubility of the monomer and oligomer sugars (Liu, Qi, Wang, Jiang, & Geng, 2021). Swollenin didn't produce particularly strong connection when combined with the exoglycanase and endoglucanase mono portions of cellulose. Expanded therefore plays a crucial role in the morphogenesis stage, improving hemicellulose access and limiting access to the cellulose component of lignocellulose substrates. Without using any additional supplements, centered on the production of lipids involving Lipomycesstarkeyi in a glucose arrangement. Yeast cells were placed in a nourishing culture for proliferation in the earlier stage. The yeast cells were once again suspended in the glucose solution in the subsequent step to get larger lipid yields. On the development of lipids, the impact of inoculum age, cell thickness, and glucose fixation early in culture was considered. The findings of the review demonstrated that lipid gathering and yeast cell genesis may be spatially segregated to achieve additional improvement and upgrades. The two-step ageing cycle demonstrated extraordinary dedication and application for converting limitless materials into biofuels. By observing cellulose’s adsorption to lignin-containing cellulose, the morphogenesis of PPRS, and re-hydrolysis, unravel the primary rate-restricting factor in the hydrolysis of popping pretreated rice straw (PPRS). The results demonstrated a relationship between the surface area of cellulose and the stacking of catalysts that was anticipated to significantly increase cellulose adsorption and speed up enzymatic-based scarification of PPRS. concentration directly reduced the toxicity of furfural and vanillin combinations and affected cell growth. After detoxification, R. toruloides used the acidic sugarcane bagasse hydrolysate as a carbon hotspot for its growth and produced lipids. Using chemical transesterification based on lipase catalysis in the tert-butanol framework, the extracted lipid was subsequently converted into biodiesel. SBH that had been prepared with sulfuric acid was used to create and organize lipids using R. toruloides. RSM was used to raise the maturational thresholds. a survey on the factors that affect popularity yield (Ma et al., 2022). Temperature and alcohol content ratios were noted. This biodiesel was better than petro diesel in its qualities. It is non-toxic, biodegradable, and sustainable and has no Sulphur or aromatics. Its Eco friendliness has increased recently. It is safe for the ecosystem when used in diesel motors without modification. The review's findings suggested a successful method for transesterification using sodium hydroxide and methanol to create distinction.

3. Material and Methods

3.1 Methodology and flow chart

In this study, he categorized the usage of straws into five categories according to the classification method commonly used in China. Compost, fodder, fuel, substrate, unrefined substances from straw. Also known as the "Five Materials Applications" plot (Figure 1). When I searched the literature using the keyword "straw", “five material usage", "five-layered straw use", "technology and the norm", "fossil fuel byproducts", "carbon bookkeeping systems", and "China". Need was given to articles distributed throughout 2010–2021, and the query items were limited to dissemination in English and Mandarin. The utilization of technology, the five straw use techniques as they exist now in China, the method used to account for fossil fuel byproducts, and how the five straw use strategies have affected those byproducts are the main subjects of this article. The aim of the study was to provide recommendations for resolving China's straw consumption and falling fossil fuel use by product, as well as to identify prospective research avenues and noteworthy breakthroughs.

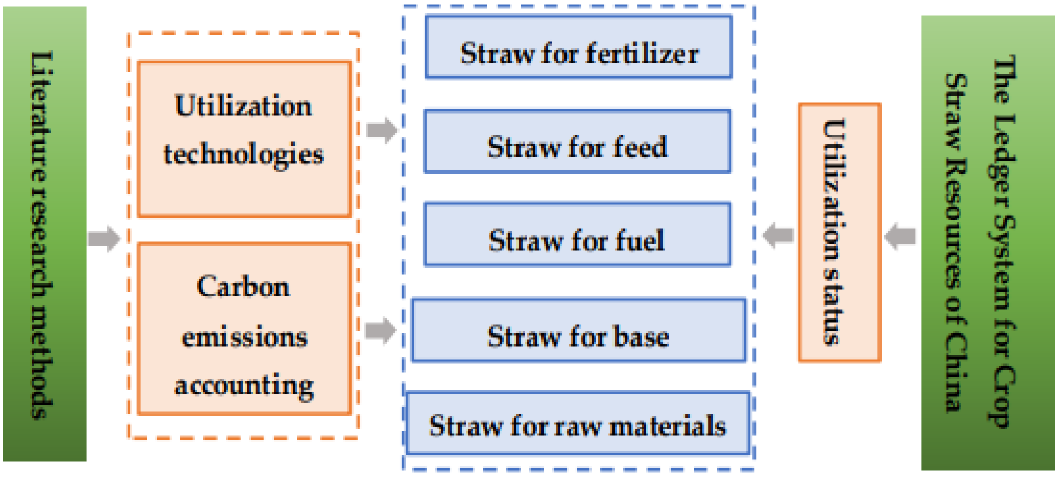

Figure 1: Accounting for carbon emissions and the use of straws

3.2 Research area

Based on growth conditions, climatic factors, and the method used to evaluate straw assets during the "Subsequent Enumeration of China's Pollution Sources," China has been classified into six locations for this study. I was. China's east, northwest, north, southeast, and southwest, as well as the middle and lower parts of the Yangtze River Basin, were all affected (Table 1).

Table 1: Areas of research

REGIONS	NORTHEAST	NORTHWEST REGION	NORTHERN REGION	SOUTHEAST REGION	SOUTHWEST REGION	MIDDLE AND LOWER REACHES OF THE YANGTZE RIVER
CITIES AND PROVINCES	Liaoning, Heilongjiang, Inner Mongolia, and Jilin	Beijing, Xinjiang, Shaanxi, Gansu, Qinghai	Beijing, Shandong, Hebei, and Tianjin	Fujian Hainan Guangxi Guangdong	Yunnan, Tibet, Chongqing, Sichuan, and Guizhou	Shanghai Jiangsu Hubei Hunan Anhui Zhejiang Jiangxi

4. Ways of Using Straw

4.1 FDSUM and carbon emissions

This section presents FDSUM and associated CO2 reduction potential.

4.1.1 Straw as fertilizer

Straw is a rich source of phosphorus, potassium, calcium, magnesium, nitrogen and various other natural elements. It is an excellent source of biomass and can be used as compost to return to the fields. The method of using straw as compost effectively combines two of his categories: backhand techniques and instant techniques (Ren, Yu, & Xu, 2019). Techniques that allow straw to be easily returned to the field include deep furrow, turning, mixed cover cultivation and no-cultivation mulching. Return-to-field straw was widely used in many large agricultural regions of China (Table 2). Returning straw to the field is a legitimate scenario, ruling out serious disease, insect infestations, or ongoing trimming problems. Improved bioreactors, rapid decomposition of fields, and carbon-based compost production techniques. During the complex resuscitation procedure, the straws are first collected near the field and stacked or covered with furrows. Before being reapplied to fields as fertilizers, they are broken down in degradable inoculants, microbial strains, human and animal manures, or pyrolysis. Recent studies have shown that composting straws is the most rational, cost-effective and environmentally friendly way to use straws.

In fact, straw composting can improve soil structure, promote soil maturity, and increase soil organic matter levels. In addition, it is important to address the environmental problems caused by excessive synthetic composting and straw use. For example, straw manure contains fewer additives and releases slower than synthetic compost. It can even temporarily reduce yields before the effects of increased crop production become apparent. In addition, excess straw returned to the field, insufficient mowing and reuse depth, excessive stubble volume, and inadequate nitrogen fertilization can all affect crop development and yellowing. Additionally, bacteria, insect eggs, and grass seeds released from straws can cause weed and pest problems. Numerous exploratory studies have shown that ignorance of the laws of straw degradation and best practices are the main reasons for these problems (Santos, Fonseca, Coutinho, Trindade, & Jensen, 2021). It is important to understand the impact of straw returned to the field and the conditions that economically support the growth of weeds, insects and diseases. Broadly speaking, changes in regulations regarding horticultural management practices, the application of synthetic compost and pet face, and the amount of straw returned to fields can successfully counteract the negative effects of field re-dressing.

Table 2(a): Technologies for using straw as fertilizer are compared

UTILIZATION TECHNOLOGIES	ADVANTAGE	SHORTCOMING	SUITABLE APPLICATION AREA
BOTH SHALLOW AND DEEP PLOUGHING	has a high handling productivity and can handle a lot of straw, breaking the lower part of the furrow, increasing dirt natural matter, preparing soil, further developing soil water maintenance limit, and getting rid of irritants and sicknesses.	The price is a little too high. in order to lessen the issue of microbial decomposition of straw and harvest development seeking out sources of nitrogen, a specified amount of nitrogen compost should be used.	Fairly, corn stalks are returned to fields in Upper East China, cotton stalks to fields in Northwest China, and straws to fields in North China, all over vast tracts of land that are reasonably flat.
MIXTURE BURIAL AND ROTARY TILLAGE	The cycle is straightforward, and the action is advantageous. Often shorter handling times and lower costs.	Increases the chance and intensity of bugs and infections and causes free soil, lessened mass thickness, and unhappy soil structure. It also affects seed germination and attachment, unfortunate dry spell obstruction, and housing opposition of the harvests.	suitable for the wheat-maize revolution in North China as well as the rice-wheat pivot and rice-assault turn in the middle and lower portions of the Yangtze River. For sloped dry soils with significant soil erosion, this is absurd.

Table 2(b): Technologies for using straw as fertilizer are compared

UTILIZATION TECHNOLOGIES	ADVANTAGE	SHORTCOMING	SUITABLE APPLICATION AREA
NUTRIENT-RICH MULCHING	There is more basic interaction and fewer seasons of mechanical passing. little expense **to** reduce the effects of wind, water, and ineffective water dissipation, the land is covered in straw and piled high with stubble. The regular precipitation's rate of development is sped up as a result.	To reduce weeds and irritations, There is a requirement for techniques including crop turning, compound bathing, and mechanical/manual weeding.	In areas of Upper East China, Northwest China, North China, Southeast China, and Southwest China, rain-fed horticultural corn can be grown.
RAPID RIPENING IN THE FIELD	effectively speeds up straw's breakdown; isn't area or season-explicit; reduces labor and time spent handling; is simple to use; and cuts down on crop diseases.	High labour expenditures on lopsided and uneven terrain.	unacceptable in cooler, northwesterly regions with dry soil and high soil entropy. The southeast and southwest regions, as well as the middle and lower compasses of the Yangtze Stream, are suitable for double editing due to their high rates of straw creation.
BIOREACTOR	By being transformed into heat, organic matter, and nutrients necessary for crop development, successfully improved soil structure, decreased insect and disease damage, and reduced soil moisture.	Necessitates a strategic position, a temperature in the reactor shed, improved ventilation systems, and effective moisture removal.	It is widely utilized in areas where straw resources are plentiful because it is more suited for the growth of nursery crops.

The most significant method of using straws in China is for composting, which accounts for the largest amount. In China's six major districts in 2020, compost was used to produce about half of the straw. These were all above the average level for the general public. In these regions, the use of straw as a fertilizer is less common due to cold winter temperatures, low summer rainfall, and low soil microbial levels in the Northwest and Upper East (Shang, Song, & Yang, 2020). Straw compost is not widely used because the southwestern region's terrain is dominated by mountains and hills, which is unfavorable for horticultural hardware activities and therefore has high labor costs.Promising results have been found in recent studies on how reusing straw can boost soil carbon sequestration and natural carbon storage. There is a lot of support for using straw as a carbon sequestration method frequently on farmland. In 1986, a straw recycling experiment at the Lausanne Institute in the United Kingdom demonstrated that recycling straw into the field significantly sped up the natural accumulation of carbon in the soil. A twofold rice concentrate on in India found that the concurrent utilization of rice straw and inorganic nitrogen compost brought about a yearly carbon sequestration pace of 0.35 tons per hectare (t/ha), which is the best soil carbon sequestration. One of Jin et al.'s claims states: The strategies implemented by various Chinese agricultural leaders were also evaluated in the study. The investigation also discovered that this technology's results did not exactly match the written information, indicating that its use in China is problematic and requires additional research. They compared it to the rules for inventory established by the Intergovernmental Panel on Climate Change (IPCC). Che and co. Utilize the Everyday Presence Cycle Evaluation (LCA). In the Guanzhong Plain of Shaanxi Province, the utilization of protected crops has demonstrated significant potential for carbon sequestration and emission reduction. It is common knowledge that preservation culture has a significant potential for lowering the amount of byproducts from fossil fuels. According to a number of investigations, the commitment of straw to composting has a slightly greater commitment to the reduction of fossil fuel byproducts than any of the other five significant straw usage strategies. Although some studies have claimed that using straw as fertilizer has the ability to sequester carbon, further research is necessary to fully understand how straw use affects soil carbon content in China given the country's complex functioning environment? Because of its vast territory, remarkable topography, and diverse common conditions, China produces various straw recycling technologies and straw types that are appropriate for various regions (Shi, Jia, & Wang, 2017). Deciding whether returning straw under different commonplace settings and returning straw-bringing innovations can sequester carbon will require more examination.

4.1.2 Straw as fodder

The main components of wheat straw are cellulose, hemicellulose and lignin. Although low in protein, supplementing the right amount of forage can meet a pet's basic nutritional needs. Therefore, straw-based forage is an essential part of the diet of domestic ruminants. Chinese ranchers have long used straw as a food source for herbivores. China's straw industry currently consumes about a quarter of the total amount of straws that can be collected and used domestically. This industry has contributed significantly to the consequent change and important fundamental transformation of the hydroponics industry in China. Sale of straw as animal feed when using agricultural waste as a resource. Straws can be processed in ways that increase digestibility and nutritional value, retain smaller ingredients and proteins inside, aid transport and capacity, and increase nutrient content. can interfere with pet consumption. Treated straw has several advantages, which are becoming more well-known and can be used to care for a wide variety of animals. Physical, material, and natural methods make up the majority of straw feed utilization technologies in China. Technology for straw green (yellow) capacity, straw alkalization/ammonification, straw briquette feed handling, straw cut/processing, straw germination construction, straw puff, and other similar technologies Table 3). It is widely used for straw green (yellow) capacity technology, straw cutting and processing technology, and straw germination building technology due to its advantages of basic technology, wide acceptance, low cost, and ease of long-term storage. Handled straw has a long shelf life, high feed change rate, low supplement dosage, and excellent flavor. Most importantly, animals gain strength and antiviral properties from handled straw. Because of the continuous progressions in biotechnology and current cultivating rehearses, straw-based feed will be offered utilizing a growing assortment of modern methodologies. High feed nutrient content, long storage times, and low production costs are all common features of these methods.

Table 3(a): Technology comparison for using straw as feed

TECHNOLOGY	ADVANTAGES	DISADVANTAGES
TECHNOLOGY WITH A GREEN (YELLOW) CAPABILITY	Reduced supplement misfortune, high feed change rate, simple long distance stockpiling, cleansing, sterilization influence, and so on.	It cannot be consumed as a single feed for an extended period of time, which may result in loose stools, complicated meal preparation, and significant differences in the nutrition of green (yellow) stored feed.
TECHNOLOGY OF STRAW ALKALIZATION/ AMMONIFICATION	Improvements should be made to the healthfulness of the straw, the admittance rate, the absorbability, the return rate, the productivity of the rearing process, the pay of ranchers, etc. It cannot just be fed to animals; it must be treated with a release of smelling salts.	It cannot satisfy farmed animals' growing nutritional needs when used as a sole source of feed. In order to prevent smelling salts from injuring, etc., it must typically be fed to ruminant animals like adult steers and sheep.
THE TECHNOLOGY FOR HANDLING STRAW BRIQUETTE FEED	Small size, high specific gravity; easy for long-distance stockpiling; easy for transportation; high acceptability; high feed admission rate and helpful maintenance; low-valued, etc.	The level of rural mechanization and specialists has somewhat larger requirements, the briquette straw feed's nourishment is considerably deficient, and so forth.

Table 3(b): Technology comparison for using straw as feed

TECHNOLOGY	ADVANTAGES	DISADVANTAGES
TECHNOLOGY FOR HANDLING AND CUTTING STRAWS	Both the home season of cellulose, hemicelluloses, and lignin in the rumen, which is essential for the processing and retention of domestic animals, as well as the rate at which straw is cared for, the simplest cycle with the highest production and lowest cost, should be increased.	There are a number of problems with machines for manipulating and cutting straws, such as the need for a lot of opposition management, the quick wear of the moving sharp edge, the high cost, and the inability to adjust the distance between the moving and fixed blades.
STRAW-EJECTING CONSTRUCTION TECHNOLOGY	We focused on satisfying the needs of the solvent components, the edible and absorbable components, and the attractiveness; we further developed caring for significant worth; we further developed pointers, include feed entry rate, absorbability, feed return tempo, and daily weight gain.	Straw feed may lose minerals, catalysts, microbial inhibitors, proteins, and amino acids due to environmental conditions such temperature, moisture, pressure, touch, and others.

The second most common use of straw in China is for animal feed. The demanding nature of the livestock industry is directly related to the high utilization of straw in these three locations. In the middle and lower reaches of North China, South China, and the Yangtze River Basin, numerous factors, including local economic, social, and environmental conditions, frequently limit and influence the development of animal husbandry. Additionally, rural mechanization, stockpiling and transportation infrastructure, and a high degree of straw diversity have emerged as a result of these regions' moderate financial and technological growth. Consequently, more crop straws are collected and used as filler and fertilizer. Most of the time, straw is used as feed for herbivores like cattle and sheep. The use of it signifies the growth of China's animal husbandry industry. The primary source of methane emissions is livestock farming. During processing, ruminant animals like dairy cows, cows, and sheep produce a lot of methane. 86 tons of methane are produced annually during intestinal maturation.

Adding feed additives, lactobacilli, or altering the ratio of feed to straw feed can reduce ruminant methane emissions. Additionally, straw that is fed to cattle and sheep prior to treatment is superior to straw that is simply returned to the field in terms of carbon sequestration (G. Wang, Liao, & Jiang, 2020). Li oversaw his four-year experimental study, which used an immediate estimation approach, and found that returning treated straw to fields increased the amount of ozone-depleting substances emitted from animal farms, while reducing carbon emissions. found that the capacity of the soil to store the can also be increased. Backhand his capacity for carbon sequestration and divergence reduction increased 3.47 times his capacity compared to returning the straw immediately to the field. Please read al. Through field tests combining practical estimation approaches and mass balance calculation studies, we found that maize stalks serving as feed and returning to the field after being digested by animals had the greatest impact on carbon sequestration and shedding reduction. We found that CO2 and NO2 emissions were significantly reduced compared to fields that directly recycle straws and fields that do not recycle straws. In regions of China with well-developed livestock and poultry agricultural sectors, straw is an excellent source of animal and poultry feed. It also serves as a window on how to improve straw-use habits and reduce emissions of ozone-depleting substances. Straws used as animal feed also ensure good natural and energy cycles in agriculture. China should now promote straw care technology that is more widely available, cleaner, and contains more straw additives that are ideal for animal and poultry growth, the inventor said. To improve material properties and soil richness, pet and poultry straw deposits may require retreatment depending on soil conditions.

4.1.3 Straw as Fuel

A large source of biomass energy is straw. In the end, 1 t of conventional coal can be replaced by the nuclear energy contained in 2 t of straw. Therefore, increasing straw use can really help cut down on the need for vital energy, provide useful clean energy, contribute to the natural development of the nation, and help cut down on CO2 emissions. As a result, straw fuel is becoming more and more the subject of rational analysis. The primary developments in China's straw-to-fuel use can be summarized in terms of "four alterations and one zap mode" (cementing, carbonization, gasification, liquefaction, and use for energy). These use strategies have developed with the assistance of newly developed specialized frameworks, well-established standard frameworks, and contemporary models.

Straw cogeneration, straw pyrolysis gasification, straw carbonization, straw-to-biogas, straw-to-cellulosic ethanol production, straw relieving, straw pyrolysis gasification, straw-to-ethanol production, straw relieving, straw carbonization, straw-to-cellulosic ethanol production, straw-to-ethanol production, and other innovations in gasification are typical subcategories of the technology. In general, straw can be used as a fuel in a number of different ways, each with its own advantages and disadvantages (Table 4). Benefits like great natural execution, potential energy reserve funds, high power age limit, and potential for profound handling into high worth added products make the transformation of straw into fuel (particularly straw biochar) and straw Restoring of is making a promising improvement in China.

Table 4: A comparison of various methods for converting straw to gasoline

TECHNOLOGIES	TYPES	ADVANTAGES	DISADVANTAGES
RESTORING TECHNOLOGY FOR STRAWS	Expulsion of screws, cylinder stepping, compacting of elliptical shapes, and roll-in tail framing.	High warm efficacy; wide range of applications; ease of use, transportation, and storage.	High creation costs, low mechanical wear resistance, high power use, and short life duration.
TECHNOLOGY OF PYROLYSIS AND CARBONIZATION	charcoal in straw.	Cheap price, lots of calories, lots of uses, and excellent competence.	Because natural materials use a lot of energy, they break down quickly, and they demand a lot of specialized work, they need to be extremely resistant to fire and moisture.
TECHNOLOGY FOR GASIFICATION OF STRAW	pyrolysis gasification and bio gasification.	Excellent creation controllability and little impact from everyday events; primarily relies on warm productivity; broad range of uses.	Slow progress; few benefits as they increase; little productivity; high piece rate.
TECHNIQUE FOR LIQUEFACTION OF STRAW	Liquification caused by pyrolysis or hydrolysis.	Reusing, being easily applied, having low transportation costs, and adding value.	Low gas age rate, long ageing duration, high pre-treatment, and transportation costs for natural resources.
ERA OF THE STRAW TECHNOLOGIES	Age of direct ignition power Age of coterminated power era of gasification power Cogeneration	climatically friendly distributed power technology. Combustible, inexpensive, and acceptable power usage that respects the environment. hardware with flexibility, cheap cost, and minimal contamination Generate heat and power; adept at using high intensity energy.	These initiatives, when compared to coal-fired power facilities, are high risk, pricey, and ineffective. Testimony from debris affects framework activity. Low power age rate and a slow progression of events. Low intensity cost with no measurable financial advantage.

As of right present, China has banned the use of straws as fuel because the country hasn't yet created a comprehensive structure for the industry. However, the price of choosing, storing, and carrying straw is still fairly high. Moreover, the technology for pressing and transporting straw is still in its infancy, and the equipment's quality is only moderately high. Due to their high yields, high sales, good storability, and affordable transportation costs, straw from corn, wheat, and rice plays a significant role as one of the primary sources of straw-to-fuel conversion. There is frequently a lot of interest in using straw as a fuel because of the long winters and low temperatures in northern China (Figure 2). Additionally, significant amounts of straw fuel were found to be used in the middle and lower reaches of the Yangtze River in Anhui and Jiangsu provinces. In contrast to the upper, middle, and lower reaches of the Yangtze River, the southwestern region frequently has a lower level of rural development (H. Wang et al., 2020).As a result, the immediate combustion of traditional biomass like straw continues to be the primary source of energy consumed by rural life. Because ranchers directly use straw for cooking and heating, this region typically has a high ratio of straw to fuel.

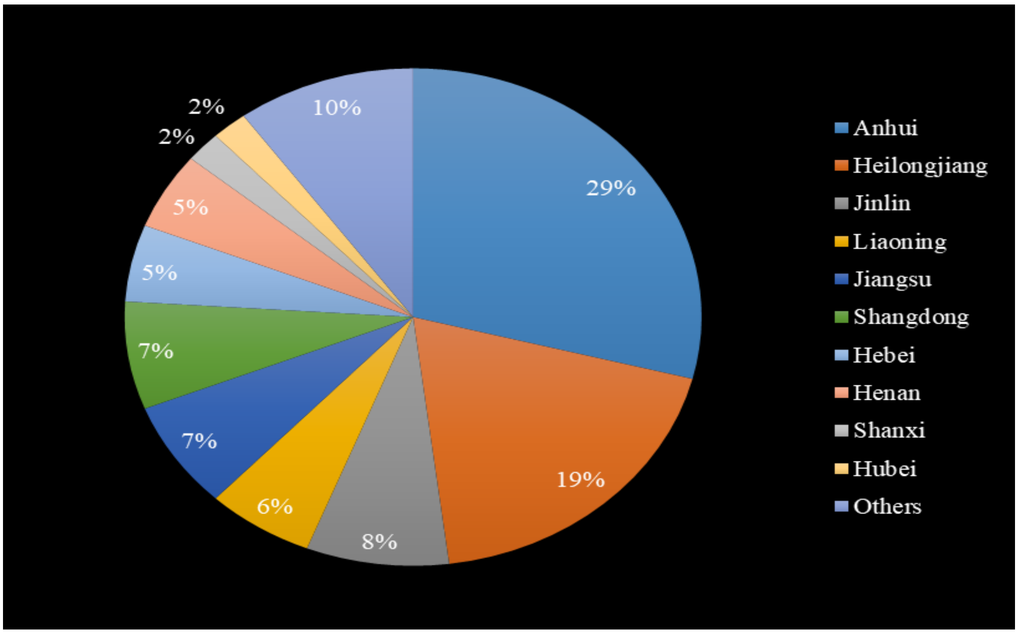

Figure 2: Top 10 provinces for extensive straw fuel use

The usage of fossil fuels and their consequences can be successfully decreased by using straw as fuel. A finite and manageable source of zero- or negative-carbon energy is straw. The GHG emissions of warming innovations, such as the usage of straw bundles, the fabrication of briquette fuel, and the co-production of charcoal gas in Beijing utilizing maize stalks as natural materials. using the Life Cycle Evaluation (LCA) technique. The researchers discovered that the byproducts of these fossil fuels only weigh between one-tenth and one-seventh of what coal does, pointing to a possible specialized path for China's provincial energy reform. Using the life cycle appraisal approach, Chen et al. assessed China's big and medium-sized biogas complete utilization frameworks. According to the analysis, using biogas to its full potential can provide good energy and natural composts with exceptional biological and financial advantages. This indicates how straw biogas technology has the ability to reduce byproducts of fossil fuel use. Yang et al. discovered that using petroleum derivatives in place of fossil fuels and carbon sequestration from biochar could reduce GHG emissions to 136.45 g/MJ with great financial results. They concentrated on using biomass pyrolysis polygene allocation method to manage straw into biochar naturally. In this vein, advances in the utilization of straw as fuel, such as straw pyrolysis co-creation and straw anaerobic ageing, have a wide range of possible applications.

4.1.4 As a Basis Material, straw

Using straw as a substrate actually refers to a specific creation equation using straw as a raw building block, combined with auxiliary materials in the growth of soilless development. This creative formula leads to the creation of the culture medium. In addition, edible mushrooms can be grown in this medium along with young and mature plants. Vitamins can be administered to promote growth, prevent infection and deworm. Base material inventions include edible growth development technology, straw plan development substrates, and compartment technology. The technology of processing straw into raw materials is advanced with a high degree of specialization and high affordability, and has high applicability. Among the top five uses of straw, the amount of straw used as a raw material is relatively low. Straws can successfully reduce the need for wood by completely or partially replacing wood as a development substrate. Concentrates on show that rice and bean straw can to some degree supplant sawdust development in hardwoods yet advance dim development (Y. Wang, Wang, & Bi, 2020). The ratio of straw substitutes is between 25% and 35% In the case, the development of mycelium and fruiting bodies is equivalent to using deciduous tree sawdust as a growth substrate. Using unrefined materials like rice straw powder, cottonseed husks, bagasse, and maize cob can boost the biotransformation competency for the creation of clam mushrooms by 100 to 150%. Using the outflow factor method, the impact of employing straw as a foundation material on the decrease of fossil fuel wastes. By using straw as a development base, it is possible to lower production costs, encourage straw consumption, and deal with issues related to natural contamination, such as asset waste and byproducts of fossil fuels.

4.1.5 Raw Material: Straw

Because straw has a lot of cellulose and lignin and degrades quickly, it can replace wood as a natural material that is safe for the environment and can be used for modern processing. To plan various contemporary unrefined components, straw-to-unrefined substance use typically employs a progression of creation cycles. These cycles include those for straw fake board creation, composite material creation, clean pulping, woven network creation, polylactic corrosive creation, wall material creation, and film readiness. In China right now, fake board production, clean pulping technology, and weaving network technology are the main ways that straw is used as a natural material. Cellulose and lignin in straw are major natural ingredients, and new developments have been made to use straw to promote biodegradable polymeric materials that can replace wood, plastics and Nano-cellulose gems. Advantages of new straw materials include expanded raw material resources, plasticized planning, environmental aspects, low-cost applications, and low-carbon recycling. From the perspective of energy saving, CO2 reduction, housing, and recycling, the spread of straws is very important, and perhaps equivalent to that. Straw is used much less frequently than his other three usage scenarios, but it is used more as a natural resource in China than as a building soil. Due to a number of factors, including the silicified wax layer on the outer layer of the straw and improved access to the straw, the use of straw-based faux panels in construction projects in China is decreasing. However, there are some practical issues with using straws to make paper. Examples include lengthy planning cycles, a need for a lot of plastic, low yields, and relatively high construction costs. The high cost of selecting, storing, and transporting straws, the immature straw selection, storage, and transportation systems, and the absence of a stable inventory over the long term are just a few of the issues that plague straws. not suitable for use as a refined product. from straw. Waste paper pulp and wood pulp are the raw materials that China's paper industry uses the most, and the proportion of naturally occurring non-wood pulp materials is only minor. The ubiquity of crude wood mash has prompted far reaching deforestation, antagonistically influencing the paper business' capacity to develop economically (Wu et al., 2022). China has invested a ton of energy exploring non-wood unrefined substances, particularly in rustic straw pulping and papermaking innovation, and has long attempted to foster prescribed procedures for guide improvement in different papermaking tries. rice patch. This is done to address the unquestionably tense connection between the organic market for natural materials used in papermaking and rural resources. It has been demonstrated that using straw instead of wood to make paper could reduce emissions of greenhouse gases. Chen and co. directed more examination on how straw-based sheets from the Wanhua Regular Board Organization associated with material balance estimations. The GHG emissions of straw and wood were measured so that fake boards that consume or degrade straw could be made.

5. Discussion

In the beginning, straw use in China took the form of a five-layered usage model that combined the common usages of straw as fuel, base material, and manure. It was then complemented by the use of straw as a natural substance. The use of straw is characterized by growth, industrialization, and high value and has been developed to satisfy the needs of agricultural applications and straw-to-fuel use. The local traits and factors that have influenced how each place has built its own use structure over time include the common habitat, asset distribution, modern turn of events, financial turn of events, and social turn of events (Figure 3).

Figure 3: Use of straw in various Chinese regions

The advantages of straw use—low cost, high creation proficiency, and positive activity—make it simple to increase straw use, according to China's five-layered straw use model. Furrowing and profound furrowing, turning culturing, mulching, and no-culturing mulching are all methods for returning straw to the field as manure. Its use should be complemented by realistic regulations and management techniques for straw decomposition in order to prevent soil compaction, disease spread, and irritation. Due to the advantages of basic technology, such as less supplement misfortune, high feed change rate, great taste, and long stockpiling time, the straw green (yellow) capacity technology, straw cutting and manipulating technology, and straw expelling building technology have a seriously encouraging application potential for straw-to-take care of use. Additionally, providing a predetermined quantity of roughage throughout handling is an essential step in addressing the nature of straw rummaging and reducing the emissions of fossil fuels resulting from its use. Due to its high warm productivity, significant potential for energy savings, and impact on emanation reduction, the straw-to-fuel usage technique of straw carbonization and cementing has received a lot of attention(Zhang, Cao, & Lyu, 2021). The evaluation of straw-to-fuel has become increasingly logical as a result of the development of extreme focus creation hardware, a decrease in the cost of production, and a reduction in the amount of energy used in the process. Even though straw is used extensively in China, only a small amount is actually utilized as a natural substance and foundation material. Nonetheless, the technology is crucial and has bright prospects. Specifically, substituting straw for wood chips has a significant positive effect on expanding forest carbon sinks, minimizing the negative effects of using fossil fuels, and protecting the environment. Currently, straws are used in China to account for fossil fuel by-products in one of two ways: calculation-based and estimation-based techniques. Mass balance strategies and efflux factor strategies are further subcategories of computational techniques. In light of his three aforementioned procedures, IPCC inventory strategies, life cycle assessment (LCA) methodologies, CDM philosophies, and modeling methodologies have all been established and implemented. The LCA and runoff coefficient approaches are typically utilized in China's accounting for the utilization of fossil fuel by-product straw. In contrast, hypothetical and experimental studies frequently employ the actual estimation method and material balance method. Additionally, some tests utilized the modeling approach. Particularly the use of rice straw, wheat straw, and corn straw as fuel). Due to variations in study topics, framework restrictions, research baselines, and straw types, the results of the most recent assessments can still be examined and dissected.

6. Conclusion

This study on the application of straw baling mechanization in sports facilities underscores the significant potential of integrating agricultural technologies into sports environmental management. Our findings reveal that straw baling mechanization not only addresses waste management efficiently but also contributes to sustainability efforts by reducing the carbon footprint of sports facilities. The technology enhances soil health through organic mulching, contributes to reduced use of chemical treatments, and aligns with global sustainability goals. Further research should continue to explore the scalability of straw baling mechanization across different sports settings and climates to fully understand its versatility and adaptability. Additionally, engaging stakeholders in the sports industry to understand their perspectives on adopting such technologies will be crucial in driving broader implementation. Sports facility managers, policymakers, and environmental specialists should collaborate to refine these practices, ensuring they are economically viable and environmentally beneficial. Ultimately, the adoption of straw baling mechanization presents a forward-thinking approach to sports facility management, promising a sustainable future where environmental health and sports performance coexist synergistically. This research serves as a foundational step towards redefining how sports facilities approach sustainability, offering a model that can be replicated and adapted globally.(Zhao, Lu, Tian, Jia, & Guo, 2019).

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