# Scientific and Social Research

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# Scientific and Social Research

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# The Urban Competitiveness of Southwest Cities in China Based on Factor Analysis

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**Abstract:** Factor analysis is an important way of data mining which can be performed using MATLAB, Python, and so on. We studied the urban competitiveness of Southwest cities in China using factor analysis. Two factors were extracted among 22 original variables. The factor score of cities was obtained using Python and were classified into three categories: Chongqing, Chengdu, Kunming and Guiyang are the first-tier cities; Baoshan, Pu'er, Lincang and Lijiang cities are of the lowest tier; the remaining cities belong to the second tier.

**Keywords:** Data mining; Factor analysis; Urban competitiveness

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## 1. Introduction

Factor analysis is an important way of data mining. The purpose of it is dimension reduction [1–3]. In this study, factor for urban competitiveness. Urban competitiveness refers to a city's competitive advantage compared to other cities, its ability to create wealth. It is a comprehensive reflection of a city's production capacity, quality of life, social progress and external influence in a certain period [4,5]. A city with a good competitiveness can not only improve the living standards of people in the region, but also promote the overall competitiveness of a country as well [6-8]. Therefore, the study of city competitiveness has been a hot topic for discussion.

We studied the urban competitiveness of 33 cities in southwest China using factor analysis in this paper. Among 22 original variables, we extracted two factors and obtained a comprehensive evaluation of the competitiveness about cities.

## 2. Factor analysis and original variables

### 2.1. Factor analysis

Factor analysis originated in the early 20th century, when scholars such as K. Pearson and C. Pearman made statistical analysis to define and measure intelligence [9]. Factor analysis is used to describe the covariance or correlation between the original variables with several potential and unobservable random variables (factors). It reflects most of the information of original variables with fewer independent factors, which can be expressed by mathematical models. $P$ represents the original variables, the mean value of each variable (or after normalization) is 0, and the standard deviation is 1. Each of the original variables is expressed as a linear combination of factors as shown below.

$$\begin{cases} x_1 = a_{11}f_1 + a_{12}f_2 + a_{13}f_3 + \cdots + a_{1k}f_k + \varepsilon_1 \\ x_2 = a_{21}f_1 + a_{22}f_2 + a_{23}f_3 + \cdots + a_{2k}f_k + \varepsilon_2 \\ \cdots\cdots \\ x_p = a_{p1}f_1 + a_{p2}f_2 + a_{p3}f_3 + \cdots + a_{pk}f_k + \varepsilon_p \end{cases}$$

The above model is the mathematical model of factor analysis, which can also be expressed as $X = AF + \varepsilon$ in matrix form. $F$ represents the common factor, since they appear in the linear expression of each original variables; $A$ represents the factor loading matrix; $a_{ij}(i = 1,2,\ldots,p; j = 1,2,\ldots,k)$ represents factor loading, it is the load of the i-th original variable on the j-th factor; $\varepsilon$ represents special factors; it means the part of the original variables that cannot be explained by common factors and its mean value is 0.

The goal of establishing the mathematical model of factor analysis is to obtain the load matrix. This can be done using SPSS, MATLAB, Python, and many more. Python is used in this paper.

### 2.2. Original variables

There are many factors that affect the competitiveness of cities, such as the GDP, the fiscal revenue, the educational development, the infrastructure condition, and the degree of opening. After analyzing a large number of indicators in "2020 China City Statistical Yearbook" [10], 22 original variables were selected and the following indicator system was constructed (**Table 1**).

**Table 1.** Urban comprehensive strength evaluation index system

| Level indicators | The secondary indicators | Unit | Serial number |
|---|---|---|---|
| Economic development index | Gross regional product | 100 million yuan | $X_1$ |
| | GDP Per capita | 100 million yuan | $X_2$ |
| | Total retail sales of consumer goods | 10,000 yuan | $X_3$ |
| | Local general public revenue | 10,000 yuan | $X_4$ |
| | Local general public expenditure | 10,000 yuan | $X_5$ |
| | Annual savings balances of financial institutions | 10,000 yuan | $X_6$ |
| | Average wage | 10,000 yuan | $X_7$ |
| | Profits of industrial enterprises above designated size | 10,000 yuan | $X_8$ |
| | Ratio of tertiary industry to GDP | Percent (%) | $X_9$ |
| Degree of openness | Actual utilization of foreign capital | 10,000 dollars | $X_{10}$ |
| | Total import and export | 10,000 yuan | $X_{11}$ |
| Technology and education | Number of students in institutions of higher learning | Person | $X_{12}$ |
| | Number of students in secondary vocational schools | Person | $X_{13}$ |
| | Books in the public library | 10,000 volumes | $X_{14}$ |
| | Number of patents granted | – | $X_{15}$ |

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| Level indicators | The secondary indicators | Unit | Serial number |
|---|---|---|---|
| Infrastructure | Number of urban employees insured by basic medical insurance | Person | $X_{16}$ |
| | Hospital beds | Piece | $X_{17}$ |
| | Number of hospitals | – | $X_{18}$ |
| | Per capita electricity consumption | Degree | $X_{19}$ |
| | Green area | Hectare | $X_{20}$ |
| | Drain length | Kilometers | $X_{21}$ |
| | Investment in fixed assets of public facilities | 10,000 yuan | $X_{22}$ |

## 3. Mathematical model and main results

### 3.1. Premise of factor analysis

One of the main tasks of factor analysis is to extract and synthesize the overlapping information in the original variables into factors, so as to finally achieve the purpose of dimension reduction. Therefore, it requires a strong correlation between the original variables. The correlation between the original variables can be determined using the following ways.

(i) Calculate the correlation coefficient matrix

Calculate the correlation coefficient matrix of the original variables and observe its correlation matrix. If most of the correlation values in the correlation coefficient matrix are less than 0.3, the variables are weakly correlated, then these variables are not suitable for factor analysis.

(ii) Calculate anti-Image correlation matrix

The reflection image matrix mainly includes negative partial covariance and negative partial correlation coefficient. If the absolute value of most other elements (except the main diagonal element) in the image correlation matrix is small, and the value of the diagonal element is close to 1, it means that these variables are strongly correlated and are suitable for factor analysis.

(iii) Bartlett's test of sphericity

Bartlett's test of sphericity takes the correlation coefficient matrix of the original variable as the starting point. As for the null hypothesis, $H_0$, the correlation coefficient matrix is the unit matrix. If the observed value of the statistic is large and the corresponding probability P is less than the given significance level $\alpha$, the null hypothesis should be rejected and the original variables are considered suitable for factor analysis. Otherwise, the null hypothesis is accepted thus the original variables are considered not suitable for factor analysis.

(iv) Kaiser–Meyer–Olkin (KMO) test

The KMO test is used to compare the simple correlation coefficient and partial correlation coefficient between variables. The KMO value is between 0 and 1. The closer the KMO value is to 1, the stronger the correlation between the variables, and the more suitable the original variables are for factor analysis. The closer the KMO value is to 0, the weaker the correlation between variables, and the less suitable they are for factor analysis. A commonly used KMO metric will be as the following: > 0.9 means a good fit, 0.8 means suitable, 0.7 means normal, 0.6 means not suitable, < 0.5 means not suitable.

By using Python to obtain the correlation coefficient matrix and through the analysis of the correlation coefficient matrix, the variables we selected are suitable for factor analysis.

### 3.2. Extraction of common factors and comprehensive score

The characteristic roots from correlation coefficient matrix were obtained. And the cumulative sum of characteristic roots are as follows.

[16.96924052 18.7946781 19.90447637 20.62479234 21.21245723 21.50483717 21.74137291 21.84583375 21.92468486 21.94986647 21.96799909 21.97854387 21.98565612 21.99039744 21.99336265 21.99545513 21.99693689 21.99850156 21.99865236 21.99888999 21.99952717 22.]

The cumulative contribution rate of two factors is 0.854. There are usually two ways to determine the number of factors. One way is to select the characteristic roots with eigenvalues greater than 1. The other way is to select the number of characteristic roots with cumulative variance contribution rates greater than 0.85 as the number of factors. In this study, two factors were selected using the latter way. The factor analysis model is as follows:

$$
\begin{aligned}
X_1 &= 0.98942079f_1 - 0.12456659f_2 + 0.00552336 \\
X_2 &= 0.62563469f_1 + 0.21127558f_2 + 0.56421493 \\
X_3 &= 0.98741399f_1 - 0.12342195f_2 + 0.00977126 \\
X_4 &= 0.98923312f_1 - 0.13591814f_2 + 0.00294806 \\
X_5 &= 0.91271988f_1 - 0.37681267f_2 + 0.02499427 \\
X_6 &= 0.99374621f_1 + 0.06319377f_2 + 0.00849924 \\
X_7 &= 0.35457916f_1 + 0.06841186f_2 + 0.86963142 \\
X_8 &= 0.88227252f_1 - 0.21631166f_2 + 0.17482347 \\
X_9 &= 0.51198086f_1 + 0.27904327f_2 + 0.6603413 \\
X_{10} &= 0.96383675f_1 + 0.1889675f_2 + 0.03520754 \\
X_{11} &= 0.98565196f_1 + 0.06091338f_2 + 0.02473054 \\
X_{12} &= 0.9419085f_1 + 0.07658956f_2 + 0.1070938 \\
X_{13} &= 0.91119646f_1 - 0.34144132f_2 + 0.05313571 \\
X_{14} &= 0.93435233f_1 + 0.29142504f_2 + 0.04193414 \\
X_{15} &= 0.98963798f_1 + 0.13696161f_2 + 0.00189423 \\
X_{16} &= 0.97793352f_1 + 0.18735713f_2 + 0.00849015 \\
X_{17} &= 0.96868006f_1 - 0.14847978f_2 + 0.03961606 \\
X_{18} &= 0.83088756f_1 - 0.14221722f_2 + 0.28942364 \\
X_{19} &= 0.40645385f_1 + 0.2286361f_2 + 0.7828528 \\
X_{20} &= 0.97766424f_1 - 0.14560721f_2 + 0.02298138 \\
X_{21} &= 0.98141916f_1 - 0.15092655f_2 + 0.01403791 \\
X_{22} &= 0.83088756f_1 + 0.71916276f_2 + 0.07644893
\end{aligned}
$$

From the factor analysis model, f1 is named as economic factor because of its high load on multiple variables of economic development indicators. f2 has a high load on the level of public facilities and general public financial expenditure, thus it is named as infrastructure factor.
Furthermore, we obtained the score function of factors and calculated the score for each factor. The comprehensive score and the ranking of cities are shown in **Table 2**.

**Table 2.** Comprehensive score and ranking

| | f1 | f2 | Score | City |
|---|---|---|---|---|
| 1 | 3.57297 | 4.16697 | 3.63066 | Chengdu |
| 0 | 4.03169 | -3.67407 | 3.28326 | Chongqing |
| 25 | 0.837016 | -0.303642 | 0.726229 | Kunming |

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| | f1 | f2 | Score | City |
|---|---|---|---|---|
| 19 | 0.445344 | 0.423721 | 0.443244 | Guiyang |
| 6 | -0.0283619 | 0.326737 | 0.00612715 | Mianyang |
| 21 | -0.0163058 | -0.311717 | -0.0449976 | Zunyi |
| 5 | -0.171641 | 0.21961 | -0.13364 | Deyang |
| 13 | -0.173891 | -0.348925 | -0.190891 | Yibin |
| 4 | -0.2023 | -0.30557 | -0.21233 | Luzhou |
| 11 | -0.208872 | -0.362142 | -0.223758 | Nanchong |
| 10 | -0.259974 | -0.0716109 | -0.241679 | Leshan |
| 26 | -0.224109 | -0.409889 | -0.242153 | Qujing |
| 2 | -0.321599 | 0.255137 | -0.265583 | Zigong |
| 15 | -0.298853 | 0.0344467 | -0.266465 | Ya'an |
| 27 | -0.284108 | -0.131855 | -0.26932 | Yuxi |
| 12 | -0.310757 | 0.0551049 | -0.275222 | Meishan |
| 9 | -0.344354 | 0.161885 | -0.295186 | Neijiang |
| 23 | -0.289756 | -0.349647 | -0.295573 | Bijie |
| 20 | -0.335131 | 0.041507 | -0.29855 | Liupanshui |
| 8 | -0.331803 | -0.00463521 | -0.300026 | Suining |
| 3 | -0.366606 | 0.214795 | -0.310137 | Panzhihua |
| 24 | -0.349972 | 0.000958733 | -0.315887 | Tongren |
| 22 | -0.363265 | 0.0963613 | -0.318624 | Anshun |
| 14 | -0.355813 | -0.0114632 | -0.322368 | Guang'an |
| 16 | -0.366945 | 0.0153659 | -0.329813 | Dazhou |
| 7 | -0.381841 | 0.116953 | -0.333396 | Guangyuan |
| 18 | -0.405158 | 0.163164 | -0.349959 | Ziyang |
| 29 | -0.367155 | -0.226113 | -0.353456 | Zhaotong |
| 17 | -0.408007 | 0.071547 | -0.36143 | Bazhong |
| 28 | -0.411991 | -0.00839964 | -0.372792 | Baoshan |
| 31 | -0.419961 | 0.0332214 | -0.375946 | Pu'er |
| 32 | -0.435534 | 0.0105441 | -0.392209 | Lincang |
| 30 | -0.452976 | 0.111649 | -0.398137 | Lijiang |

In terms of comprehensive scores, Chongqing, Chengdu, Kunming, Guiyang all scored more than 0, which means they belong to the top-tier. Chongqing has the highest score in terms of economic factor, which means that the economic development of Chongqing ranks first in southwest China, while Chengdu ranks second.

Except Mianyang, the comprehensive scores of the remaining 28 cities are all less than 0. Among them, Baoshan, Lincang, Pu'er and Lijiang are the minority communities in Yunnan Province, and they belong to the lowest tier of cities.

The remaining cities belong to the second-tier, in which most of the cities are located in Sichuan Province.

## 4. Conclusion

Factor analysis is an important way of data mining with the main purpose being dimension reduction. It is used to measure urban competitiveness in this study, which was performed by using Python. Among 22

original variables, two factors were extracted and scores were obtained for each city. The competitiveness of Southwest cities was evaluated through the scores obtained. In fact, factor analysis can be used for more original variables other than economy, such as education, psychology, and many more.

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# Exploration and Practice of Ideological and Political Education in the Investment Course

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**Abstract:** Taking the reform of the specialized curriculum of the Investment Course as an example, this paper proposes that the education law should be followed and dual education goals of professional knowledge and curriculum ideology and politics should be set up. The article first analyzes the current situation of ideological and political reform of college courses, then puts forward the goal and realization path of ideological and political reform of investment course based on the characteristics of investment courses and college students.

**Keywords:** Educational law; Ideological and political reform; Realization path

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## 1. Introduction

Ideological and political education is one of the important contents in establishing morality and nurturing people in colleges and universities, which is related the important elements in nurturing talents. Tertiary education is an important period for young students to shape their thinking, so the cultivation of ideological politics and value orientation is particularly important. For a long time, ideological and political education in colleges and universities has been mainly undertaken by ideological and political theory courses, while professional courses have undertaken the task of teaching professional knowledge and new trends in professional development, with less involvement in ideological and political education. This paper takes the "Investment" course as an example to explore how to tap the ideological and political education function of professional courses through teaching reform.

## 2. The current situation of ideological and political reform of college curriculum

At present, the social situation has changed. The structure and content of ideological and political education for college students should also be constantly innovated to improve the affinity of ideological and political education and promote the all-round development of students. Other than relying on the traditional ideological and political theory courses, ideological and political education should also be incorporated into other disciplines.

In recent years, with the advancement of the educational reform process, the teaching mode of colleges and universities has been constantly innovated, the ideological and political teaching in specialized courses have been gradually reformed, and the number of papers regarding ideological and political research of various courses has also increased year by year. It is found that the research highlights and trends of curriculum ideological and political education are mainly focused on four aspects.

The first one is the discussion of the basic issues of curriculum ideological and political education,

which mainly covers the significance and necessity of curriculum ideological and political education [1-3], and also the connotation and basic requirements of curriculum ideological and political education [4-7]. The second one is regarding the path and mode of curriculum ideological and political education, such as comprehensively using various teaching methods, promoting the integration of modern information technology into curriculum ideological and political education, and innovating the mode and coordination mechanism of curriculum ideological and political education [8-10]. The third aspect is the development and research of ideological and political courses in various disciplines. Most of the disciplines involved are medical science and engineering, while relatively few art, foreign language, and comprehensive literacy disciplines are involved [11-14]. In terms of humanities and arts majors, the reform and exploration of art courses, tourism courses, history courses and language courses are the main focus [15-18]. In the aspect of comprehensive quality specialty, it focuses on the reform and exploration of college students' career planning courses, physical education courses and innovation and entrepreneurship courses [19]. The fourth element is the exploration of problems and improvement in the development of ideological and political education curriculum, covering the problem-oriented curriculum ideological and political reform [20-21] and the value-oriented improvement and perfection of curriculum ideological and political education [22-25].

## 3. Characteristics of the Investment Course and the students

### 3.1. Course characteristics

The Investment Course is a compulsory course for finance majors, which focuses on financial investment. The course mainly involves asset selection, pricing, and market operation rules in the capital market. Through this course, students can systematically understand the theory of investment and gradually establish the correct investment concept. They will also be able apply the basic principles of Marxism depending on national conditions, and also based on a practical and realistic analysis of China's securities market. Besides, this course helps students establish a correct financial concept, that is, securities investment is not just about managing risks and gaining benefits. Instead, the real reward for financial practitioners is the satisfaction brought by providing financial services for the neediest people. They will also able to learn investment dynamically and developmentally, and make scientific and reasonable investment decisions and judgments by combining theory with practical operation on the basis of mastering the classroom content. The Investment Course is practical and application-oriented. In the teaching process, we should pay attention to the complementarity and mutual development of teaching and practice.

### 3.2. Student characteristics

The advantages of post-00's students (students born in the 2000s) lie in their wide range of knowledge, many sources of information, and huge interest in current social affairs. Many students are very interested in investment. However, due to the lack of in-depth and systematic financial education, and the lack of understanding of basic concepts and theories in the field of investment science, many students give up easily due to the difficulty of this course. Due to the strong practicality of this course, some students think that investment analysis and software operation are difficult, which leads to a negative learning attitude. In terms of information acquisition, the typical problem is that most of the information acquired are fragmented (such as through WeChat, Weibo, Tiktok and other platforms), and their interest shifts easily. Their thinking is rigid, and their systematic logical thinking ability needs to be improved. They are expressive, but lack motivation to participate in lessons actively. They are fickle-minded and are easily distracted during the lessons.

Therefore, teachers should design the difficulty of the lessons based on the characteristics of students of different majors, pay attention to case updating in teaching, and introduce more practical cases that students are interested in and enthusiastic about (such as Kweichow Moutai and Alipay), so that students

can become the main body of learning and discussion. Teachers mainly play the role of a "catalyst" as they need to trigger students' systematic thinking through fruitful interactions, and stimulate students' learning interest and innovative spirit. At the same time, teachers should attract students with physical props, pictures, stories, and so on, and connect with the students. After class, the students' interest and enthusiasm in learning can be further cultivated by allowing them to explore cases, complete case analysis and share them in class.

## 4. Ideological and political goal orientation of the Investment Course

The ideological and political education in professional courses should be "silent," and should be integrated into the professional knowledge, and prevent the phenomenon of hypocrisy. Other than focusing on curriculum design, the students' absorption of knowledge should also be considered. The teaching subject of ideological and political course is college students, and the goal should be set based on the students' current ideologies. Before class, the focus is on communication with students; in class, the focus is on integrating ideological and political content through discussion, answering questions, and other ways. The main impact and influence of students' thoughts and behaviors should be taken into account, and focus on the actual ideological and political goals of the curriculum. For example, a widespread phenomenon among the students of the Investment Course is that many of them believe that the purpose of investments is acquiring wealth, thus ignoring the professional ethics that should be observed in the investment process.

Therefore, following the curriculum characteristics and educational requirements of the Investment Course, integrating the ideological and political elements of the curriculum, the ideological and political goal of the Investment Course is to ensure that the students are clear about the laws regarding financial investment adhere to it. Besides, the course also aims to sort out the correct social and financial values, cultivate a high sense of social responsibility and work responsibility, as well as good ideological and moral character, social ethics, and professional ethics through the study of market securities.

## 5. Method of integrating of ideological and political education into the teaching of the Investment Course

To fully integrate the ideological and political education into the Investment Course, first of all, harsh preaching should be avoided. Instead, design teaching that are popular with students, and achieve the teaching goal of "moistening things without sound" (unconsciously instilling an ideology). We should learn to listen to the students' voices, excavate and analyze teaching cases from the perspective of students, fully meet students' expectations and needs, and promote the effective combination of professional knowledge and ideological and political content.

As far as the Investment Course is concerned, it can promote the integration of ideological and political content in professional teaching from the following aspects.

The first one is to integrate national development and rejuvenation into the classroom against the backdrop of the international situation. The fate of a country is inseparable from its investment performance. China's securities market is developing gradually with the growth of the national macro-economy. As an emerging market with rapid growth, it has made remarkable achievements in a short period of just more than ten years, and has gradually embarked on a standardized and orderly development track compared to China before liberation where food and clothing were still a problem, let alone the construction of the securities market. Therefore, if a country is strong, its people will be strong. We should focus on integrating professional knowledge into the national development to encourage the students' family and the general public.

The second aspect is to cultivate students' legal awareness and morality by integrating market violations. Law and morality are two keys for the establishment of a public order, good customs and a

harmonious and stable society. Investors or business operators with capital, shareholding, information, and other advantages in the securities market should firmly mold the spirit and concept of rule of law in their minds, and should pay attention to the shaping of the spirit of honesty, trustworthiness, and respect for law. Wu Lianmo's case of manipulating the market is a typical case of violating the law by manipulating the market with the advantages of capital, shareholding, and information. As the actual controller and chairman of the board of directors of the listed company, Wu Lianmo frequently bought and sold shares of the company by using nearly 40 accounts (enterprises, others, institutions, and more) under his control, making illegal profits of more than 80 million yuan. The securities regulatory authority gave a fine of 510 million yuan and banned Wu Lianmo from entering the market for life. China's legal system and regulatory agencies have never condoned violations of laws and regulations, and have always posed heavy restrictions on acts that disrupt the market. Securities participants shall participate in the market according to law. Therefore, we should emphasize cultivating students' legal ethics. At the same time, students should be reminded to follow the law, and be honest and trustworthy in their future career. Besides, their ideals and beliefs also need to be strengthened, and embody the socialist core values and the abide by the socialist concept of the rule of law.

## 6. Conclusion

Taking the reform of the specialized curriculum of Investment Course as an example, this paper proposes that the educational laws should be followed and dual education goals of professional knowledge and curriculum ideology and politics should be set up. The article first analyzes the current situation of ideological and political reform of college courses, and puts forward the goal and realization path of ideological and political reform of investment course based on the characteristics of investment courses and college students.


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## Disclosure statement

The author declares no conflict of interest.

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# Study on Suitability of Artificially Planted Native Mangroves in Coastal Areas of Guangzhou

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**Abstract:** At present, the mangrove species planted in the coastal area of Guangzhou is relatively single, and the dominant species is mainly the non-petal *Sonneratia caseolaris* (alien species). From 2020 to 2021, after the observation of the growth of mangroves on the north shoreline of the Humen Bridge (Guangzhou Section) in Nansha District, Guangzhou, it is shown that the dominant local mangrove species suitable for growth in the coastal area of Guangzhou are *Kandelia obovata* and *Aegiceras corniculatum*.

**Keywords:** Mangroves; Guangzhou; Native species; Suitability

***Online publication:*** November 30, 2022

## 1. Introduction

After collecting data [1-3] and on-site investigation, there are 12 families, 15 genera and 17 species of mangroves in the coastal area of Guangzhou, including 8 families, 9 genera and 10 species of true mangroves, and 6 families of semi-mangroves. There are 7 genera and 7 species, and there are 16 main mangrove communities. At present, the species of mangroves under artificial cultivation are relatively single, the dominant species are mainly non-petal *Sonneratia caseolaris* (alien species), and the local dominant species are *Aegiceras corniculatum*, *Kandelia obovata* or sea hibiscus.

## 2. Research methods

### 2.1. Basic situation

In 2020, a key bay renovation project will be carried out on the north coastline of the Humen Bridge (Guangzhou Section) in Nansha District, Guangzhou City, with a 955 meters long coastline, of which 0.49 hectares of locally grown mangroves and about 4,300 surviving mangrove trees are planted [4]. At the beginning of the design of the restoration plan, the local mangrove "*Aegiceras corniculatum* + *Avicennia marina* + *Kandelia obovata*" combination community was selected according to the results of a field survey and comprehensive consideration of the shoreline restoration site.

### 2.2. Tracking and monitoring methods

The mangrove planting time in this study area was October 2020. From November 2020 to November 2021, a total of four tracking and monitoring of mangrove growth were carried out using the sampling method. One fixed quadrat (10 × 10 $m^2$) was set for each mangrove community, all planted mangrove seedlings were numbered in each fixed plot. A measuring tape and vernier caliper was used to accurately measure and record the height, crown area, ground diameter, and height of each plant. 10 plants were randomly

selected in each plot, and the photosynthetic efficiency of the plants was detected by a portable chlorophyll fluorescence meter [5,6]. The monitoring times were the beginning of November 2020, the end of December 2020, the end of May 2021, and the end of September 2021.

## 3. Monitoring analysis

### 3.1. Morphological monitoring and analysis

#### 3.1.1. *Kandelia obovata* community

In the first monitoring, all the plants in the plot were numbered and listed, and there were 60 *Kandelia obovata* in total. The second monitoring found that the number of plants did not change. All plants survived and most of them grew well. The survival rate was 100%, which means that the plants could well adapt to the natural environment in the region. In the third monitoring, after the dry season from December to April, the number of plants decreased by 13, but the surviving plants were still growing well. The fourth monitoring showed that the average ground diameter and average crown area increased significantly after the vigorous growth period from 5 to 19 months. The management and protection units replanted after the third monitoring, so the number of plants in the community increased, and the average crown area did not increase significantly after replanting. (**Figures 1 and 2, Table 1, and Figure 3)**

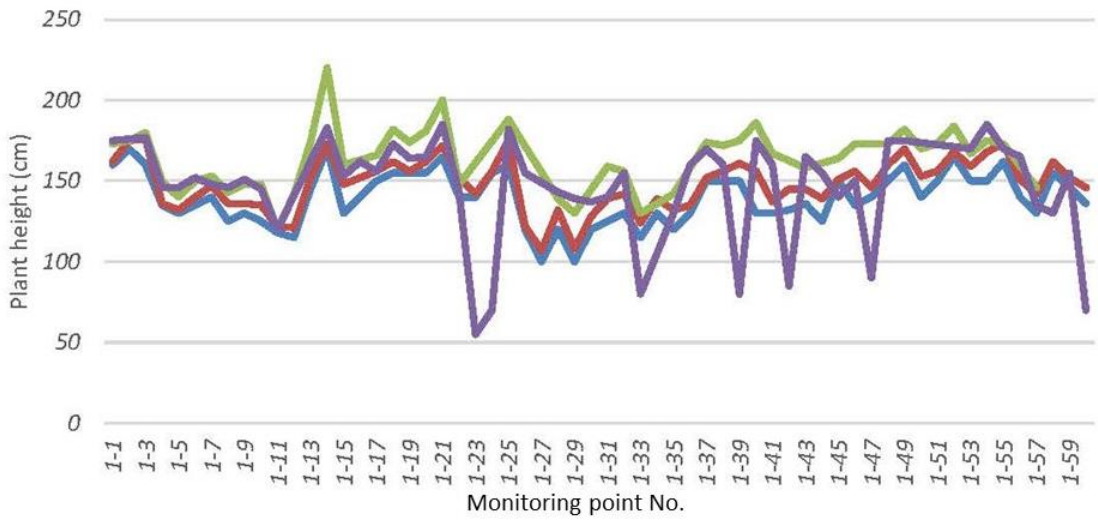


**Figure 1.** Height comparison of *Kandelia obovata* plants (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

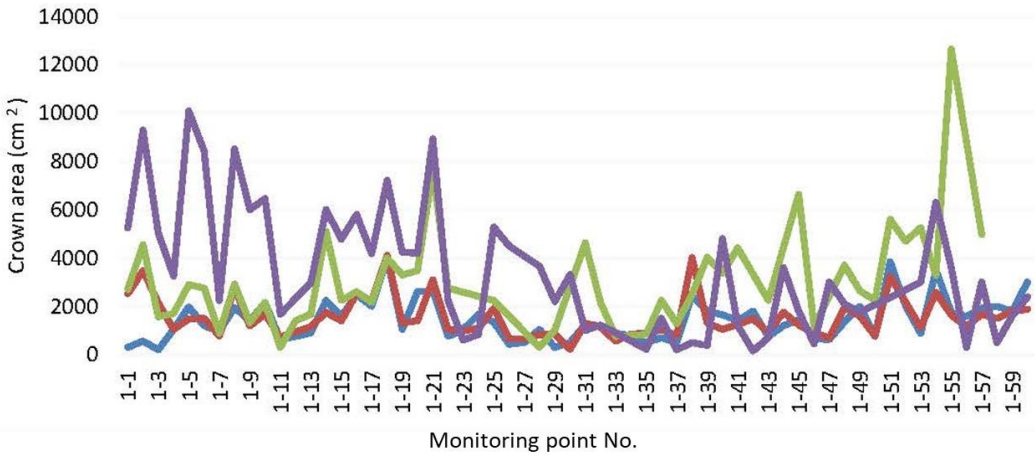


**Figure 2.** Comparison of crown area of *Kandelia obovata* (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

**Table 1.** Comparison table of the average data of four monitoring times of *Kandelia obovata*

| Session/Content | Quantity | Average height (cm) | Average ground diameter (mm) | Average crown area (cm $^2$) | Survival rate (%) |
|---|---|---|---|---|---|
| 1 | 60 | 140 | 28 | 1596 | 100.0% |
| 2 | 60 | 148 | 33 | 1528 | 100.0% |
| 3 | 47 | 161 | 34 | 3086 | 78.3% |
| 4 | 55 | 146 | 40 | 3443 | 91.7% |

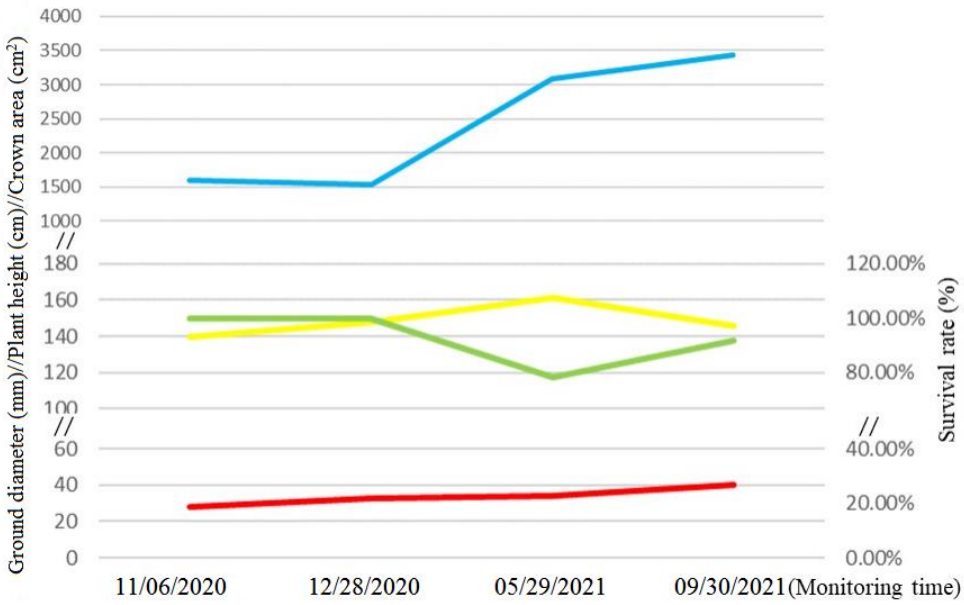


**Figure 3.** Average data of four monitoring times of *Kandelia obovata* (Note: yellow line represents height [cm], red line represents ground diameter [mm], blue line represents crown area [cm$^2$], green line represents survial rate [%])

### 3.1.2. *Aegiceras corniculatum*

During the first monitoring, there were a total of 70 plants in the plot. There was no change in the number of plants in the second monitoring, and all the plants survived and grew well, indicating that the *Aegiceras corniculatum* seedlings can well adapt to the environment in this area. In the third monitoring, after a dry season, the number of plants decreased by 11, but the growth of the surviving plants was still very good, indicating that they had a strong ability to adapt to the environment in this area. At the fourth monitoring, a period of vigorous growth could be seen compared to the results of the previous three monitoring, the average ground diameter and average crown area increased significantly, and the number of plants remained unchanged, indicating that the community was in a relatively stable state, and is showing good growth. (**Figure 4, Figure 5, Table 2 and Figure 6**)

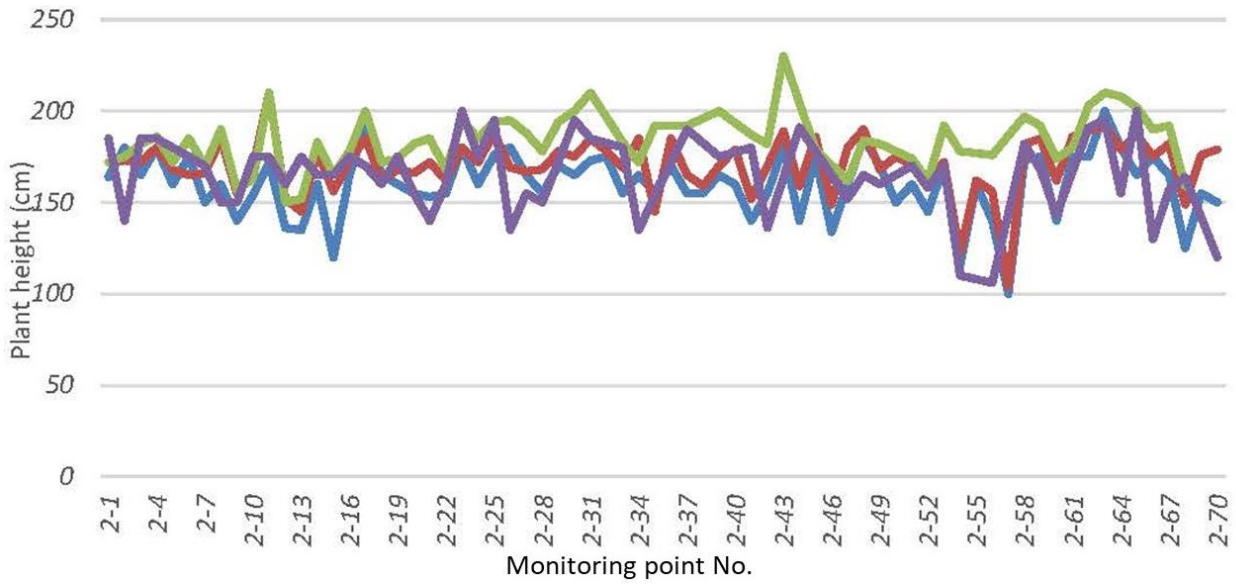


**Figure 4.** Comparison of heights of *Aegiceras corniculatum* plants (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

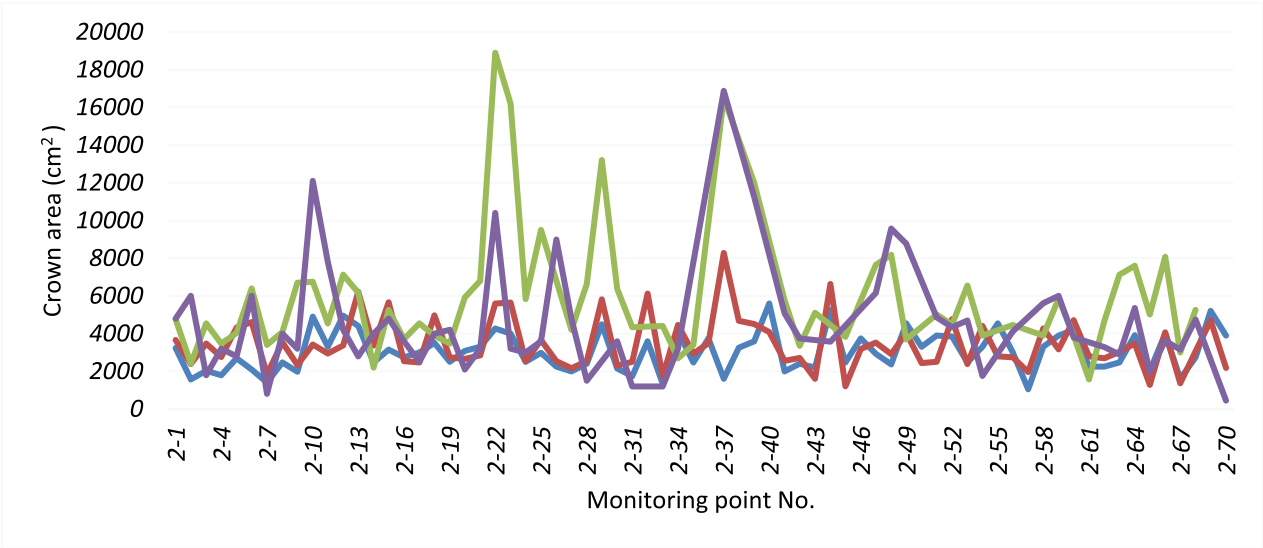


**Figure 5.** Comparison of crown areas of *Aegiceras corniculatum* (Notes: blue line represents the first monitoring, brown line represents the second monitoring, green line represents the third monitoring, and purple line represents the fourth monitoring)

**Table 2**. The average data comparison table of the four monitoring of *Aegiceras corniculatum*

| Session/ Content | Quantity | Average height (cm) | Average ground diameter (mm) | Average crown area ($cm^2$) | Survival rate (%) |
|---|---|---|---|---|---|
| 1 | 70 | 160 | 30 | 3055 | 100.0% |
| 2 | 70 | 170 | 30 | 3442 | 100.0% |
| 3 | 59 | 184 | 35 | 5903 | 84.3% |
| 4 | 59 | 165 | 43 | 4601 | 84.3% |

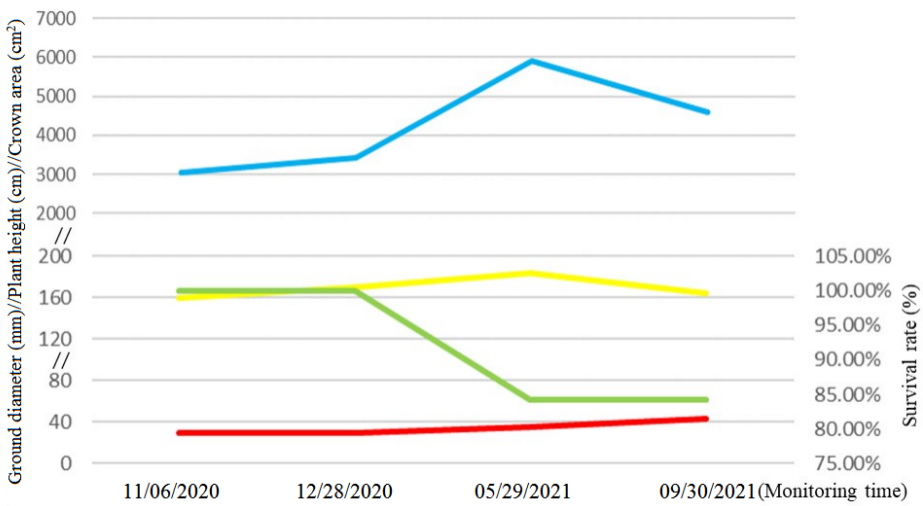


**Figure 6.** Average data of four monitoring times of *Aegiceras corniculatum* (Note: yellow line represents height [cm], red line represents ground diameter [mm], blue line represents crown area [$cm^2$], green line represents survial rate [%])

### 3.1.3. *Avicennia marina* community

In the first monitoring, a total of 123 *Avicennia marina* were planted in the plots. The second monitoring found that the species of plants in the community changed greatly. Some *Kandelia obovata* and *Aegiceras corniculatum* were planted in the plot. The number of plants could not be recovered either. After renumbering, a total of 141 plants were measured. During the third monitoring, the plant species in the plot were still *Avicennia marina*, *Kandelia obovata* and *Aegiceras corniculatum*. Compared to the second monitoring, the position of the plants changed, and some plants died and disappeared, and the plant numbers could not be completely restored. The overall survival rate of the plots was 79%. In the fourth monitoring, the average ground diameter increased significantly, but the survival rate decreased to 70%. The plot was located in an area with severe tidal erosion, the surface backfill was mostly washed away, and the root system was more exposed, so the survival rate is low, and from the comparison of ground diameter and crown area, the growth condition of *Avicennia marina* community is average, which is suitable for the local environment. Due to repeated replanting in this sample area, plant height and crown area are no longer compared separately. (**Table 3** and **Figure 7**)

**Table 3.** Comparison of the average data of four times of monitoring of *Avicennia marina*

| Session/Content | Quantity | Average height (cm) | Average ground diameter (mm) | Average crown area ($cm^2$) | Survival rate (%) |
|---|---|---|---|---|---|
| 1 | 123 | 108 | 21 | 563 | 100.0% |
| 2 | 141 | 115 | 16 | 1324 | 114.6% |
| 3 | 111 | 112 | 21 | 2512 | 78.7% |
| 4 | 99 | 103 | 29 | 1954 | 70.2% |

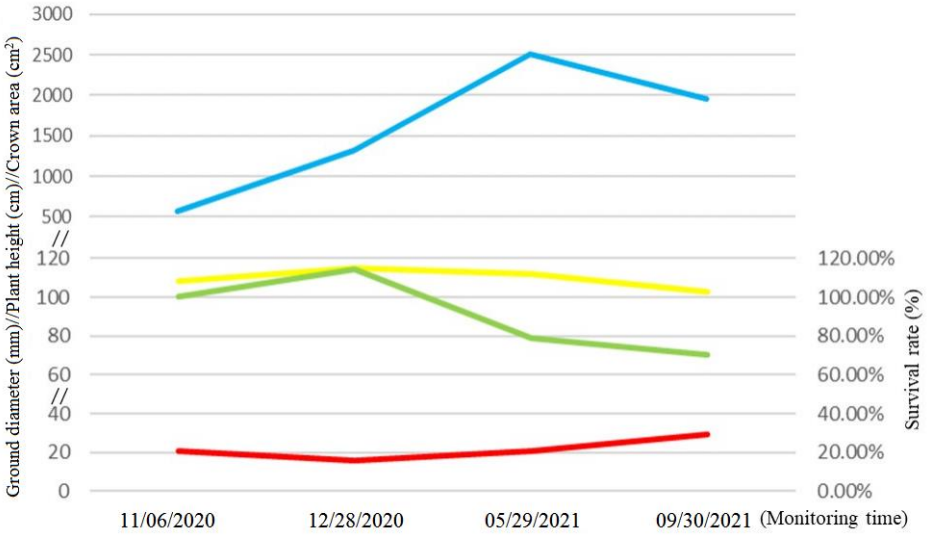


**Figure 7.** Comparison of the average data of four times of monitoring *of Avicennia marina* (Note: yellow line represents height [cm], red line represents ground diameter [mm], blue line represents crown area [$cm^2$], green line represents survial rate [%])

### 3.2. Chlorophyll fluorometer monitoring data analysis

In order to detect the photosynthetic activity of mangrove seedlings, 10 randomly selected plants in each plot were scanned by a portable chlorophyll fluorescence meter. From the monitoring data, the levels of photosynthesis of the three mangrove communities are still generally low, indicating that plants are still subject to greater environmental stress or human disturbance. During the first monitoring, the plants of each community had just been planted, and the plants were in the slow seedling stage. The levels of photosynthesis of the second monitoring is generally lower than the value of the first, which may be related to the low temperature in winter during the measurement. The levels of the third monitoring, which was in May increased significantly, indicating that the growth state of the plants significantly improved compared to the previous two monitoring, indicating that the plants were in a period of vigorous growth. Compared with the third time, the value of the fourth monitoring has a small increase, and the overall photosynthesis level is high. (**Figure 8**, **Figure 9**, and **Figure 10**)

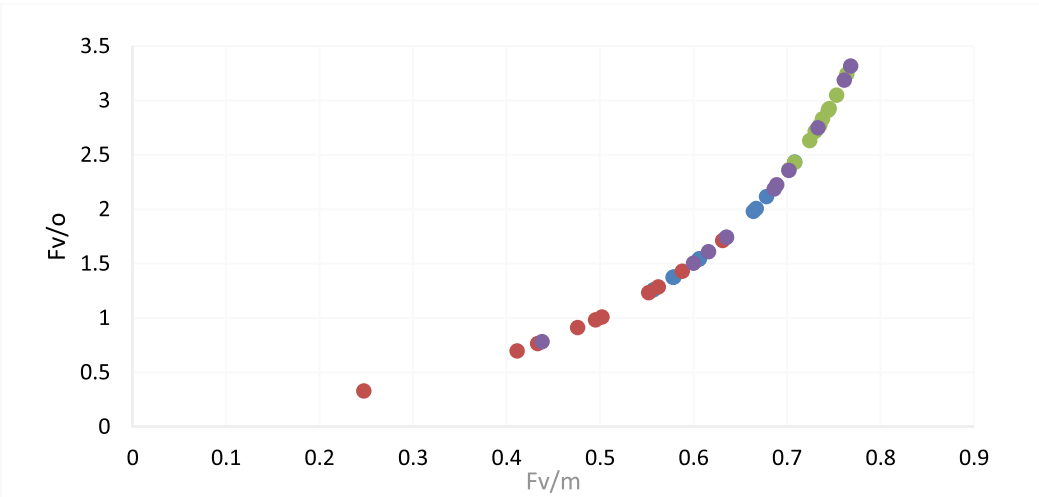


**Figure 8.** Chlorophyll fluorescence meter monitoring data of *Kandelia obovata* (Notes: blue spot represents the first monitoring, brown spot represents the second monitoring, green spot represents the third monitoring, and purple spot represents the fourth monitoring)

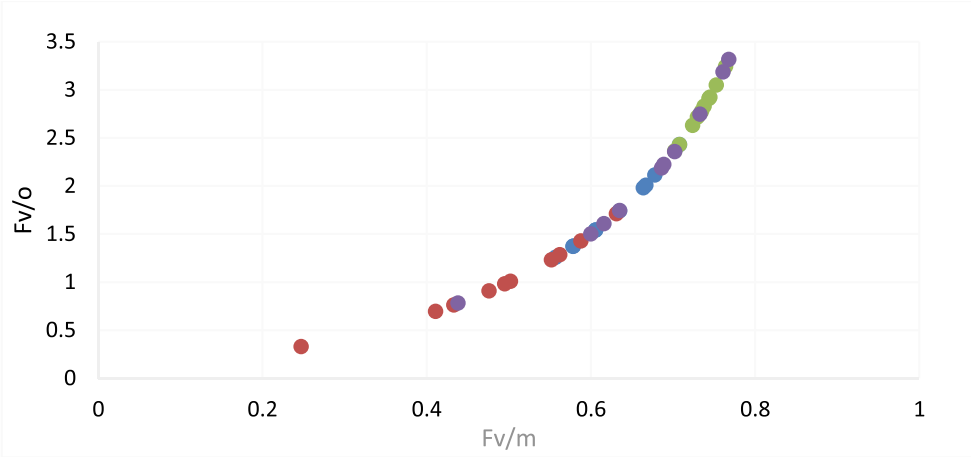


**Figure 9.** Chlorophyll fluorescence meter monitoring data of *Aegiceras corniculatum* (Notes: blue spot represents the first monitoring, brown spot represents the second monitoring, green spot represents the third monitoring, and purple spot represents the fourth monitoring)

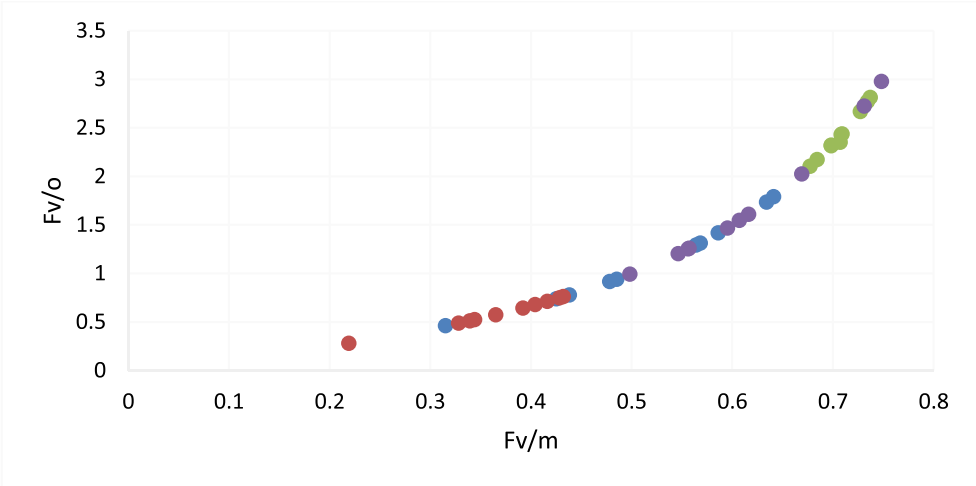


**Figure 10.** Chlorophyll fluorescence meter monitoring data of *Avicennia marina* (Notes: blue spot represents the first monitoring, brown spot represents the second monitoring, green spot represents the third monitoring, and purple spot represents the fourth monitoring)

## 4. Conclusions and recommendations

### 4.1. Conclusion

(1) According to the growth monitoring of the three communities in the study area, the *Kandelia obovata*, the *Aegiceras corniculatum* and the *Avicennia marina*, one year after artificial planting, it can be found that the overall growth state of the *Kandelia obovata* and the *Aegiceras corniculatum* is good, and the growth environment of the region affects the growth of the plants. The adaptability is good, and the growth state of the *Aegiceras corniculatum* community is continuous and more stable.

(2) This study area is one of the demonstration bases for artificial planting of native mangroves in the coastline ecological restoration project, which is managed by a professional maintenance team in order to ensure the effect of coastline ecological restoration. The overall survival rate has decreased after the third monitoring is completed. Afterwards, each colony was replanted. The average height and average crown width basically decreased in varying degrees. But from the overall view of various monitoring data, it does not affect the basic judgment of "the adaptability of *Kandelia obovata* and *Aegiceras corniculatum* to the growth environment in this region" [7,8].

### 4.2. Recommendations

(1) There are few silty coastlines in the coastal zone of Guangzhou. It is recommended to carry out mangrove conservation and restoration work in suitable areas in estuaries and shoals to achieve the purpose of promoting silt deposition, improving estuary water quality, and expanding the habitat of marine fish and birds [9].

(2) The territorial government should strengthen the management and protection of mangroves, intensify man-made restoration and protection in the sparsely growing mangrove areas, and establish a mangrove reserve within the area [10].

(3) Strengthen the continuous monitoring of alien invasive species, take timely measures to eradicate the spread of alien invasive species, and closely monitor the planted *Sonneratia caseolaris* forest [11].

### Disclosure statement

The author declares no conflict of interest.

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# Experimental Study of a Solar Still Desalination System

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**Abstract:** Solar still is a simple equipment for the fresh water production in the regions where water is scarce and is rich in solar energy sources. In this paper, a solar still unit was built and tested in the south of China to investigate its water production. The test results show that the fresh water production is affected by average solar irradiation intensity, the production of the unit averaged at 6.27 kg/day, the water production decreased to 1.9 kg/day when the daily average solar radiation decreased to 236 W/m$^2$. At the same time, the test result show that because of the difference between the ambient and seawater temperatures, the solar still could produce water at night, and the daily production could increase to 7.55 kg/day when the daily average solar radiation is 533 W/m$^2$.

**Keywords:** Solar desalination; Solar still; Fresh water production

***Online publication:*** November 30, 2022

## 1. Introduction

Water is the basic need in human civilization, all forms of life cannot live without water. Currently, there is one severe problem which is the shortage in water production. Although water occupies the largest proportion on Earth, only 2.53 percent of water is freshwater which can be directly utilized for agriculture and other industries. Water stress and the risk of water scarcity are now common concerns. As of today, 771 million people (1 in 10 people) lack access to clean water [1]. By the year 2025, it is estimated that 1/4 of the world population will be affected by water scarcity, and 2/3 will experience water-stressed conditions. By 2030, 1/2 of the world population will experience high water stress [2].

In this context, desalination has a growing role to play in meeting the demands for fresh water. There are various methods of desalinating sea and brackish water. These include flash distillation, multi-effect distillation, membrane distillation, reverse osmosis, forward osmosis, ion exchange, and seawater greenhouse technology [3,4]. Many coastal regions around the world such as Bangladesh, and the Middle East and North Africa, are now dependent on treated saline water [5]. In terms of desalination methods, solar stills have several advantages including simplicity, low cost, ease of maintenance, and low environmental impact. However, the main drawbacks of solar stills include the requirement of large installation areas, lower productivity, and higher land cost associated with the larger land requirement [6].

In this case, the primary concern is to increase their productivity and test them out in disparate regions and conditions. According to Abujazar et al., the productivity of a solar still is influenced by ambient conditions (solar radiation, ambient temperature, wind velocity, etc.), operating conditions (brine water depth, saline concentration, and more), and design conditions (cover angle, insulation, etc.) [7]. According to the meteorological data obtained from Bangladesh Meteorological Department (BMD), Bangladesh

receives an average of 3.125 kWh/m$^2$-day solar radiation during the summers (March–June) with a sunshine hour of 4.4 h–7 h; in the winters, there is an average of 2.31 kWh/m$^2$-day solar radiation (October–March) with a sunshine hour of 6 h–9 h. In addition, it is possible for Bangladesh to apply solar still using local labor and low-cost readily available materials, and even illiterate people can operate solar still due to its very simple operations, thus increasing its productivity, as pointed out in several literature [8-14]. Badran and Abdullah have coupled the sun tracking system to the solar still and have observed a 22% increase in productivity and a 2 % increase in overall efficiency [15]. Srithar et al. has optimized the orientation and inclination of the glass cover and has lowered the condensation loss. Also, they used different materials for basins to improve heat capacity and radiation absorption capacity and enhance the evaporation rate. They suggested rubber as the best basin material to improve absorption, storage, and evaporation [16]. Moreover, many experimental and theoretical studies were conducted to investigate the effect of using phase change materials (PCM) as a storage system on the productivity of the solar still [17,18]. A detailed review of the Nano-enhanced phase-change materials was carried out in which the ideal characteristics of nano-enhanced PCM was discussed, as well as thermo-physical properties, applications, and the challenges and future prospects of nano-enhanced PCM [19]. In this essay, we will not only demonstrate recent prevalent and popular material but also the factor that influences the results of research to a certain extent. For example, the brine depth is studied to select an optimum water depth for the fabricated solar still. With an optimized water depth, the effect of basin water salt concentration on productivity was also studied using synthetic saline water. Subsequently, real seawater was used on the solar still and the productivity was compared to using synthetic saline water. Lastly, the water quality was tested based on several parameters to determine the efficiency in removing dissolved impurities as well as suspended particles and to ensure the quality of distilled water was up to WHO standards.

In a previous work, we built a solar still to investigate the performance of the system in south China, and also the effect of PCM on the variation of temperature of the system subjected to a constant heat rate [20] and variable heat source (mimicking the solar energy) [21]. In this work, the role of PCM on the temperature variation of the water in the still was investigated. Moreover, the effect of PCM on the water production was measured as well [22]. The PCM used was tricosane (candle wax) since it is stable, cheap, safe, and easily available. The melting point and the latent heat of fusion of the PCM are 47.65 °C and 234 kJ/kg respectively [23]. The experiments were conducted from April-August 2018 in Muscat, Oman. The effect of various variables like the amount of PCM, the solar irradiation intensity, the ambient weather conditions, and variation of the water temperature on the unit productivity were investigated.

## 2. Experiment description

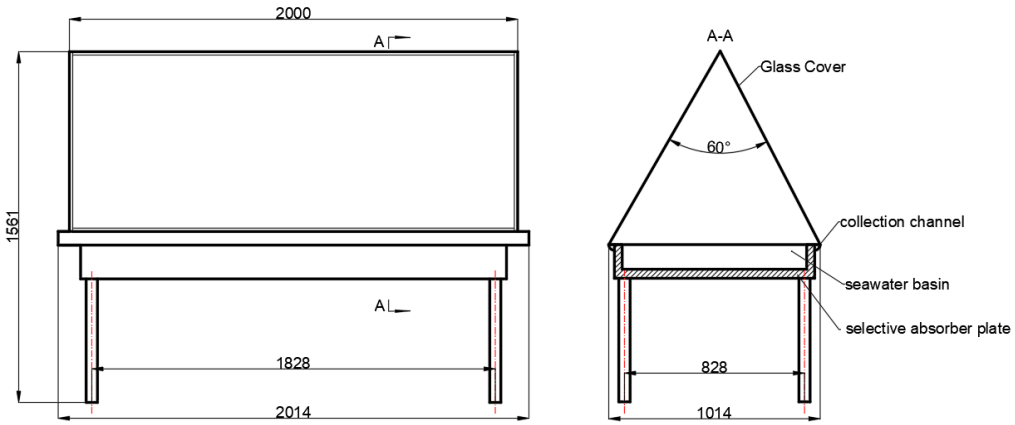


**Figure 1.** Schematic diagram of solar still

A double slope solar still was designed in this experiment, which was made of rectangular metal basin covered with a 4 mm thick glass panel with a slope of 60°. At the bottom of the basin, a selective absorption plate was installed to absorb the maximum solar radiation, the basin area was 2000 mm × 866 mm. The condensate gets collected through the inclined channel incorporated in the lower side of the glass and collected in the bottle and was measured hourly (**Figure 1**).

In this work, the temperature of the seawater ($T_{sw}$), the temperature of vapor temperature in the tank ($T_{ea}$), and the ambient temperature were measured with thermocouples, the solar irradiance was measured using a pyranometer type WXL20-LVRZC-12. The data of all parameters were recorded every 1 min by a data acquisition instrument (Agilent 4970A).

The experiments were carried out from April to November 2020. The experiments typically start from 8:00 to 18:00 or till 8:00 of the next day, and the water produced was tested hourly.

## 3. Results and discussion

**Figure 2** to **Figure 6** shows the seawater, vapor and ambient temperatures, solar irradiation intensity and the accumulated water production in four different days.

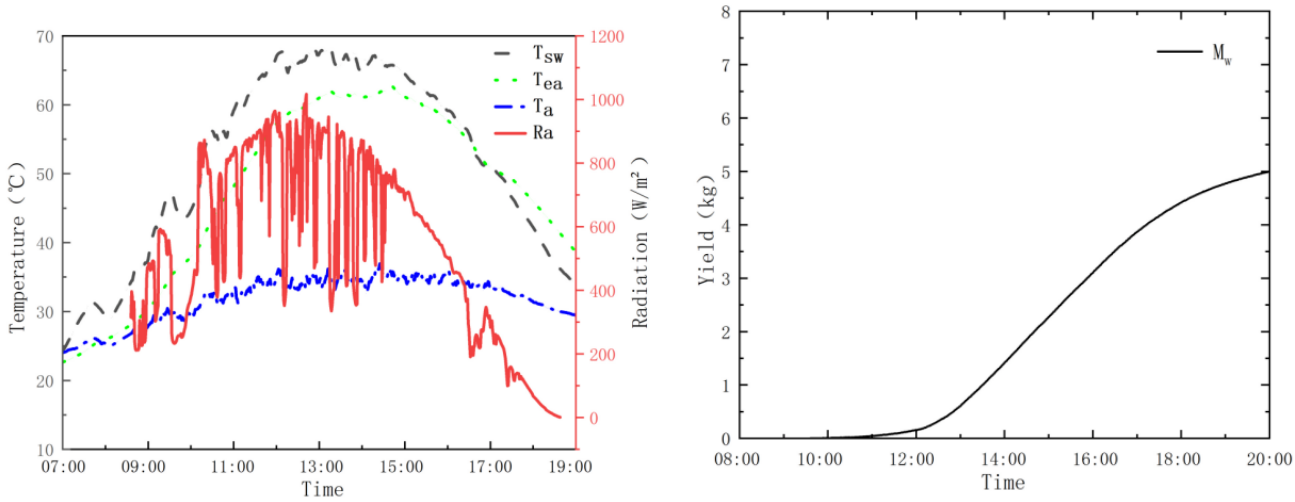


**Figure 2.** The change in seawater, vapor, and ambient temperatures, and solar irradiation intensity, and the accumulated water produced on April 13, 2020

As shown in **Figure 2**, the average solar irradiation intensity is 534 W/m$^2$, with the highest irradiation being 900W/m$^2$, and the average ambient temperature is 28.7℃. Because of the relatively stable solar irradiation, the highest seawater temperature reached 69℃ at 13:00, and the fresh water production increased sharply from 11:00 to 6:00 pm, because of the larger temperature difference between the seawater and the ambient, and the daily accumulated water production reached 6.27kg, which equates to 3.62 kg/(m$^2$·d).

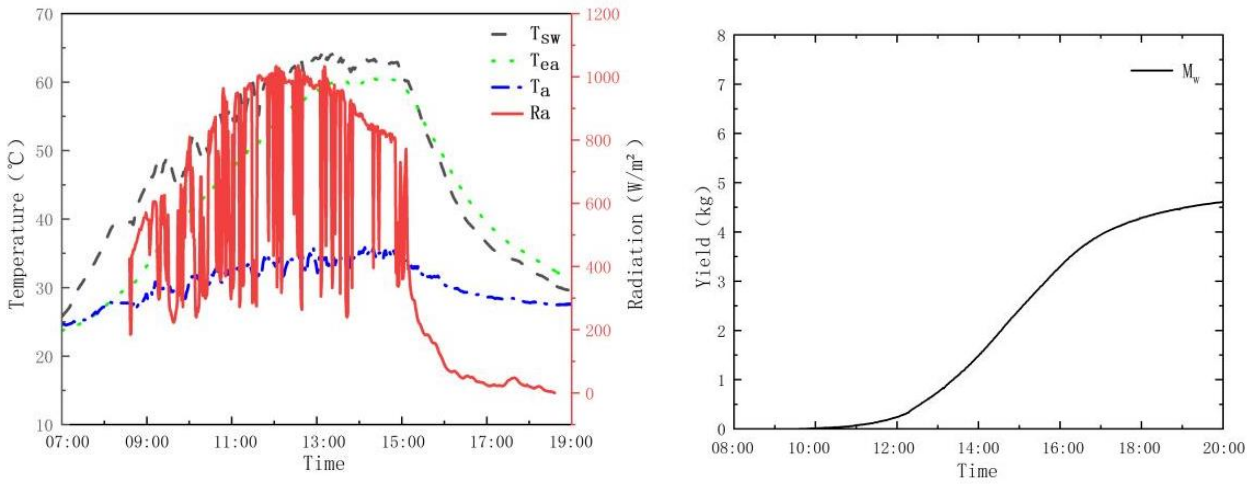


**Figure 3.** The change in seawater, vapor, and ambient temperatures, and solar irradiation intensity, and the accumulated water produced on April 14, 2020

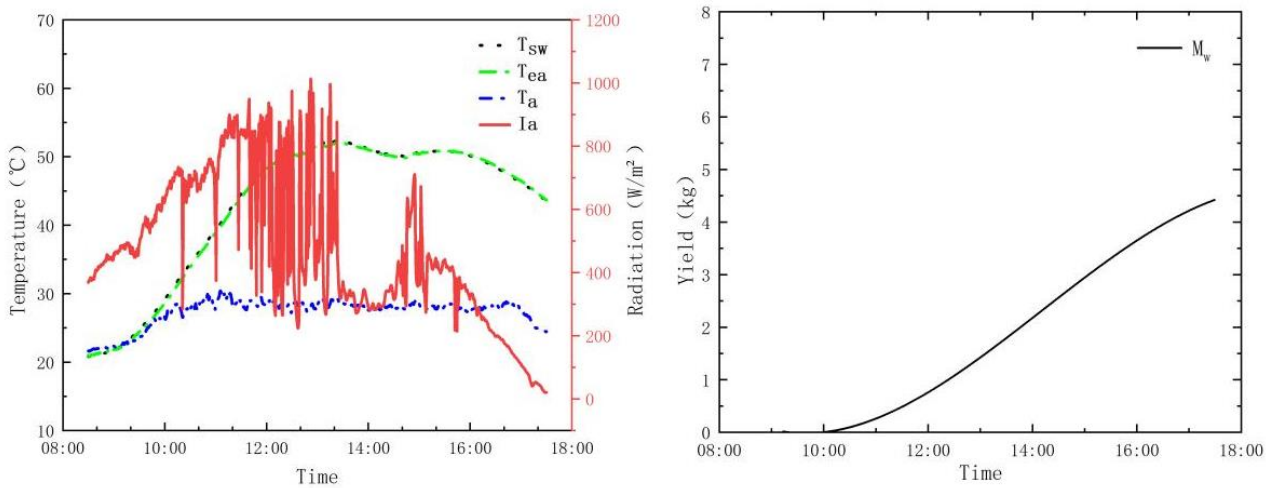


**Figure 4.** The change in seawater, vapor, and ambient temperatures, and solar irradiation intensity, and the accumulated water produced on October 21, 2020

**Figures 3** and **4** showed the test results of April 14 and October 21, the average solar irradiation is 478 W/m$^2$ and 455 W/m$^2$, respectively, and the average ambient temperature of these two days is about 27℃; the daily accumulated water production is 5.66 kg and 4.62 kg, respectively; because the solar irradiation decreased sharply in from 13:00 onwards, and the highest seawater temperature was just 50℃, but the highest seawater temperature was up to 63℃.

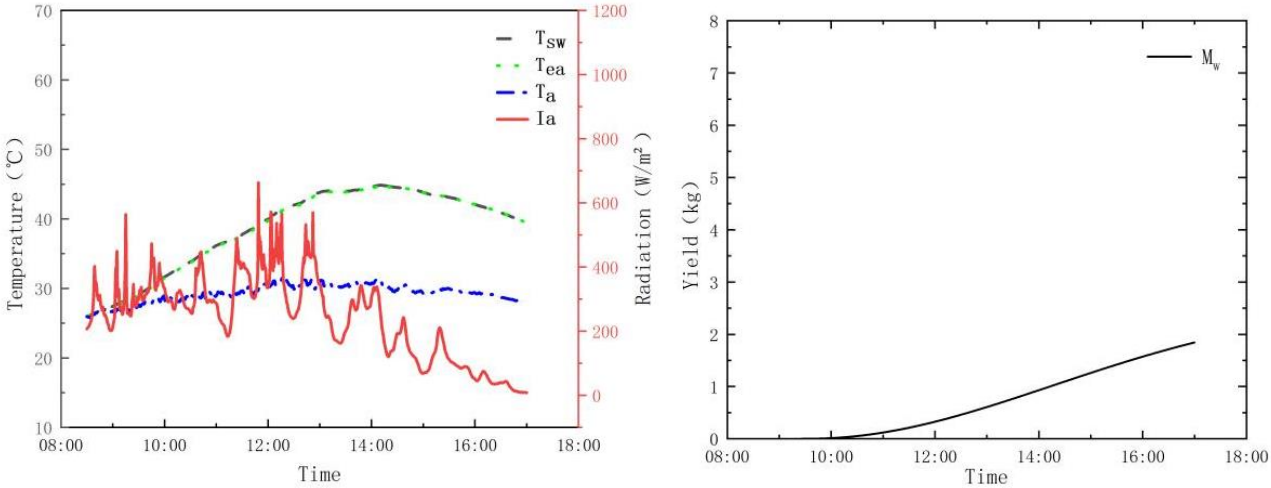


**Figure 5.** The change in seawater, vapor and ambient temperatures, and solar irradiation intensity, and the accumulated water produced on October 28, 2020

**Figure 5** shows the operation of the solar distiller on October 28. It was a cloudy day, the average solar irradiation intensity was 236 W/m$^2$, the highest seawater temperature was only 45 ℃, and the daily accumulated water production is decreased to 1.9 kg. This indicates that solar irradiation intensity has a great influence on the water production.

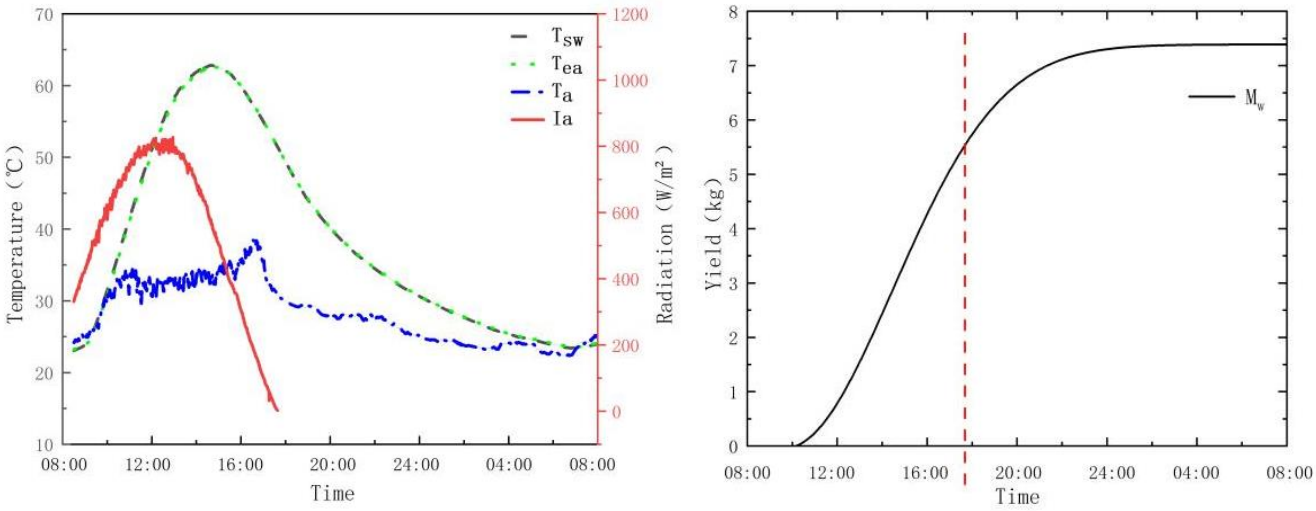


**Figure 6.** The change in seawater, vapor and ambient temperatures, solar irradiation intensity and the accumulated water produced on Oct 26–27, 2020

As shown in **Figure 6**, the seawater temperature is still as high as 35 ℃ at 18:00, and the temperature difference between seawater and the ambient, the water production after 18:00 pm is test continually on October 26–27, and the result show that the water production was still increasing before 24:00, up to 7.55 kg, which equates to 4.56 kg/(m$^2$·d ).

## 4. Conclusion

A solar still was built and tested between April 2020 to November 2020, and the test results show that the fresh water production is affected by the solar radiation intensity, the average production of the unit is 6.27 kg/day, the water production is decreases to 1.9 kg/day when the daily average solar radiation decreased to 236 W/m$^2$. At the same time, the test result show that the solar still could produce water at night, and the

daily production could increase to 7.55 kg/day when the average solar radiation per day is 533 W/m$^2$. The water production could be further improved by the thermal insulation of still basin and the selective absorption material used in the inner wall of the still basin, which will improve solar thermal performance and reduce heat loss. The relative results show that the solar still is an effective method for producing fresh water in coastal areas of low-income countries, where modern desalination techniques are not suitable due to high investment and maintenance cost.

**Disclosure statement**

The authors declare no conflict of interest.

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# Analysis on the Common Quality Problems and Production Methods of Jeans Belt Loop Knot

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**Abstract:** The belt loop is an important part of a standard five-pocket jeans, integrating functionality and aesthetics. Because of common problems such as skewed belt loop, unequal lengths, improper slackness, double lines at the front pocket of the belt loop cover, exposed bottom of the belt loop, asymmetry, too low or too high position of the belt loop, and no light in the back, we tracked the sewing of the belt loop in the jeans production line, analyzed the causes of the problems, and came out with targeted solutions. We analyzed the operation steps of knotting jeans belt loops and then develop daily maintenance measures for knotting machines, provide technical guidance for seamstresses/seamsters and team leaders to enhance the maintenance ability to knot machines, enhance the ability of knotting machines to run well, ensure the stability of jeans belt loops quality, and provide technical reference for quality control of belt loops in the same type of jeans production lines.

**Keywords:** Belt loops; Jeans; Knotting machine; Routine maintenance

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## 1. Introduction

The jeans production industry is currently in a crucial period of transformation and upgrading. In the face of the new pattern of industry development, continuous improvement of the knot method of the belt loop, the improvement is the quality of jeans is imperative. Lv and Zhang concluded that the most classic denim clothing is workwear jeans, which have continuously evolved into various trouser types, such as suspender jeans, flared jeans, and hot pants [1]. Liang et al. pointed out that the production of denim clothing presents a development pattern of multiple types in small batches [2]. Liu and Zhu concluded that China is both a significant consumer and producer of denim garments [3]. Ge pointed out that the latest report from the China Business Industry Research Institute states that the global market size of ready-made denim garments is expected to exceed the threshold of 2 billion pieces by 2023 [4]. Belt loops are small loops that hold the belt on jeans and are sewn into 1.2 cm wide, 4 cm long strips of cloth, also known as trouser lugs, tabs, trouser noses, or belt tabs, which play the role of fixing and decorating the belt. The belt loop knotting is an essential part of the finished jeans and is also prone to quality problems. The equipment used in the knotting process is the knotting machine, which is the most widely used machine in the jeans production line. The knotting machine is one of the most commonly used special equipment in garment production, which is used for stitch reinforcement and decoration. Ding and Chang found that exploring the common quality problems and process operation points when knotting waistband loops in jeans can help improve quality control and efficiency of the production line [5].

## 2. Literature review

Zhang and Wang found that the main differences in the waist style of jeans are mainly in the workmanship and design, which can directly affect consumers' overall impression of jeans [6]. Liang et al. pointed out that the main reason workers fail to follow the standard procedure in the making of mass-produced jeans was that there is no systematic training, hence their technical knowledge is lacking [7]. He concluded that the overlock machine is special sewing equipment, which is usually used at the pocket, trouser toss, back strap, and other tensioned parts, which not only reinforces the tensioned parts but also act as a decoration [8]. Feng pointed out that the overlocking machine is mainly used for reinforcing particular parts of garments and decorative sewing stitches, which makes it an indispensable machine in garment production [9]. Wang pointed out that quality control is fundamental to achieving high-quality enterprise management, and quality management is the key to the stable development of the enterprise, thus strict quality control and quality management needs to be practiced [10]. Cheng pointed out that quality management is the root of the enterprise's foundation. A sound quality management system allows the enterprise run more smoothly and improve its core competitiveness [11]. Shen pointed out that quality is an enterprise's lifeline and determines its survival and development [12]. Pan pointed out that the appearance of high-quality finished jeans must have a flat surface with symmetrical and firm pockets. However, due to factors such as operating skills and proficiency, various quality problems occur during the sewing process [13]. Wang pointed out that most of the quality problems in the manufacturing process are caused by human errors and that analysis and research on human factors, and development and implementation of effective measures can reduce quality problems caused by human error [14]. Zhou pointed out that for a company to have good quality products, frontline employees should have professional operational skills and strict quality awareness [15]. Yuan pointed out that the process of taking apart and re-sewing should be avoided. This is because with more sewing, the frequency of machine needles piercing the fabric also increases, which can easily cause needle holes [16]. Liu pointed out that the employees' work quality and the optimization of quality management is essential for a company [17]. Cheng pointed out that quality management and control should not only include the product itself but also the manufacturing process, gradually improve the stability of the process in order to ensure the consistency of the products' quality [18]. Jin pointed out that ex-ante management is conducted to predict possible quality problems and provide reliable solutions based on analysis and diagnosis, thus improving product quality [19]. Wang pointed out that strict standards, requirements, and assessment should be applied in quality management, and the efficiency and professional skills of employees should be continuously improved to control the quality, and only in this way can the market competitiveness of enterprise products be continuously improved [20]. Chang pointed out that equipment management is needed to maintain equipment in the best state of reliability and improve equipment productivity through scientific and practical means [21].

## 3. Research methodology

This paper adopts site investigation and analysis as the research method. We visited the production lines of different jeans enterprises, summarized the methods of belt loop knotting and common quality problems in the production process, conducted field data collection and analysis. A famous jeans enterprise was visited, hence this paper explains the belt loop sewing process, pre-production preparation, and production quality control of this jeans manufacturing enterprise. On-site production analysis was conducted to understand the existing belt loop problems and to communicate with the seamster/seamstresses.

## 4. Research findings

### 4.1. Common quality problems of jeans belt loops

#### 4.1.1. Belt loop skew, length difference, and slackness

(1) Skewed belt loop

If the knot of the belt loop is not tied according the positioning line, there will be a skew. This can be caused unclear positioning line or a sewing speed that is too high. As a result, there is no accurate alignment when piecing the semi-finished products together, causing a skew. When the skew amount exceeds 0.3 cm, it is a severe defect and needs to be reworked.

(1) Belt loop length

In standard five-pocket jeans of the same size, the belt loop length is usually the same, if the ironing is not following the amount of sewing ironing, or when the belt loop is not cut according to the required length, it will cause an asymmetry between the belt loops. When the difference between the length of the belt loops in the same jeans is 0.5 cm and above, it is considered a severe defect; when the difference in length is between 0.3 and 0.5, it is considered a minor defect and can be reworked before the next process.

(2) Belt loop slackness

The slackness of the belt loop is set to meet the capacity of the belt, so the slackness should be executed according to the order standard. When the sewing workers do not leave the slackness according to the standard, or do not sew according to the alignment point, or trim the belt ring inaccurately, the slackness will change. When the difference between the slackness of the belt loop and the required slackness exceeds 0.3 cm, it will be classified as a severe defect and needs to be reworked.

The solutions to a crooked belt loop include clear powder marks, reasonable reduction of sewing speed, prioritizing quality over quantity, and precise alignment when placing the presser foot. As shown in **Table 1**, the solution to the belt loop length problem requires ironing with the help of a template during ironing to ensure the accuracy of the sewn portion. After the belt loop is turned and sewn in the cutting phase, the sewing worker can choose to draw a positioning line on the cutting table as a standard to ensure the accuracy of the cutting length. As for the problem of belt loop slackness, sewing should be done strictly following the alignment point, and the belt loop length should not be trimmed randomly.

**Table 1.** Belt loop skew, length, and slackness problems and countermeasures

| Quality problem points | Cause analysis | Solution |
|---|---|---|
| Skewed belt loops | The positioning line is not clear, causing inaccurate positioning | The sweeping powder should be clear |
| | Overly fast sewing speed | Reduce the speed of sewing, prioritizing quality over quantity. |
| | The needle is not aligned with the stop | Timely adjustment of alignment when placed under the presser foot |
| Belt loop length | Sewing and ironing errors | Iron in place according to the template slip edge |
| | The front channel belt loop is incorrectly cut | Sewing workers should check the length of the belt loops that have been cut |
| Belt loop slackness | Amount of slack is not according to the standard | The amount of slack should be consistent and performed according to the standard. |
| | Not sewn according to the alignment point | Sew strictly according to the alignment point |
| | Belt loop secondary trimming | Do not trim belt loops randomly |

#### 4.1.2. Belt loop covers the front pocket double line, exposed bottom, and asymmetry

(1) Belt loops cover the two decorative lines of the front pocket

The belt loop at the curved front pocket is close to the crescent pocket, and if the alignment point is not sewn, it will easily cause the problem of double lines at the front pocket of the belt loop cover. However, if there is a double line problem in the front pocket of the belt loop cover, it is a severe defect and needs to be removed and reworked.

(2) Exposed insides of belt loop bottoms

The problem of exposed bottom occurs when sewing workers do not iron the belt loops properly or randomly adjust their sewing gesture. When the length of exposed bottom is more than 0.3 cm, it will be considered as a serious defect; if the length of exposed bottom is 0.2 cm to 0.3 cm, it will be considered as a minor defect, which can be reworked timely.

(3) Asymmetry of belt loops

If the side seams are not sewn properly, or there is misalignment between the seams, or if the sewer did not pay attention to the symmetry of the seams, it will cause the problem of asymmetry of the belt loops. When the difference between the position of the belt loops is 1 cm or more, it is considered a severe defect. When the misalignment of the belt loops is between 0.5 cm and 0.9 cm, it is considered a slight defect and can be reworked in time before the next stage.

The solution to the double line at the front pocket of the belt loop cover is to sew according to the alignment points, adjust the machine needle positioning in time when placing the semi-finished product under the presser foot, and reasonably adjust the sewing speed. As shown in **Table 2,** when sewing the belt loops, the workers ensure that no quality problems occur in the process they are responsible for, and products with quality problems at any stage shall be rejected in time.

**Table 2.** Belt loops conceal the two decorative lines on the front pocket, exposed bottom, asymmetry problems, and countermeasures.

| Quality problem | Cause analysis | Solution |
|---|---|---|
| Belt loops conceal the two decorative lines on the front pocket | Not sewn according to the alignment point | Stitching in strict accordance with alignment point positioning |
| | The needle is not aligned with the top edge. | Timely adjustment of needle positioning when placed under the presser foot. |
| | Overly fast sewing speed | Moderate reduction of sewing speed |
| The inside of the belt loop bottom exposed | Belt loop ironing is not in place | Ironing after aligning strictly with the edges of the template |
| | Sewing gesture problem | Do not adjust the gesture at will to ensure consistency of the gesture. |
| Belt loop symmetry | Not sewn following the side seam allowance | Precise sewing according to the reserved seam allowance |
| | Not sewn according to the alignment point on the waistband of the pants | Stitching in strict accordance to the alignment points |
| | No sense of symmetry in sewing workers | Cultivate self-inspection awareness among sewers |

#### 4.1.3. Improper height of the belt loop on the waistline

(1) Incorrect belt loop position

When the waistline of the pants is knotted with the belt loop, if the sewing gesture is adjusted frequently, the belt loop is not knotted according to the alignment mark, or if the sewing speed is too fast when the belt loop is placed, or the machine needle and the stop edge are misaligned, it will result in the position of the belt loop being too high or too low and not aligned with the waistline of the jeans. If the misalignment is severe, rework needs to be done and causes losses.

(2) The belt loop is not aligned with the stitching at the back of the pants

The alignment of the middle belt loop at the back of the waistline is an integral part of the quality inspection. If the spacing between the two parallel stitching lines of the belt loop is uneven and the upper end of the belt ring is misaligned, directly tying the set knot without accurate alignment in the back center will directly lead to the misalignment of the two parallel stitching lines in the back center and affect the beauty of the garment.

To avoid the problem of low or high belt loops, the turners and sewing workers operate with consistency and stability of hand gestures as shown in **Table 3**, operate in strict accordance with the alignment points, control the speed of the machine while maintaining the quality, and determine the precise positioning before tying the set knot after the belt loops are placed under the presser foot. As for the problem of not shining the line in back middle belt loop, when turning and sewing the belt loop, the unevenly spaced belt ring cannot flow into the production line. the upper end of the belt ring should be accurately aligned before inserting the needle, and when placing the belt loop, the two parallel stitching lines in the back middle should be accurately aligned, which can effectively avoid the problem of misalignment of the two parallel decorative lines in the back middle.

**Table 3.** The problem of the improper height of belt loops and the problem of not illuminating the line in the back and countermeasures.

| Quality problem points | Cause analysis | Solution |
|---|---|---|
| The belt ring is too low/too high | Sewing hand gesture error | Maintain consistency and stability of hand gestures |
| | Knotted belt loops are not aligned | Knotting belt loops in strict accordance with the position of the alignment points |
| | Overly fast sewing speed | The speed of the machine should be controlled |
| | Misalignment of the machine needle and stop edge when placing the belt loop | After putting the belt loop under the presser foot, determine the precise positioning and tie the knot. |
| The belt ring after the center does not illuminate the line | Belt loop two parallel stitching line spacing is uneven | When sewing belt loops, unevenly spaced belt loops shall be rejected before proceeding to the next production stage |
| | Misalignment of the upper end of the belt loop | The upper end of the belt loop should be accurately aligned. |
| | No alignment in the back center, directly tying the set knot | When placing the belt loops, the rear and middle double stitching lines should be precisely aligned |

### 4.2. Routine maintenance of nesting machines

In order to ensure the smooth operation of the production line, the daily maintenance of the knotting machine should be implemented, as shown in **Table 4**. The aspects needing maintenance include the working table, the thread frame, the surface of the machine head, the thread clamp, the oil window, the

working light, the frame, the computer central processing unit (CPU), the bobbin, the bobbin bed, the dynamic and static knives, the presser foot paper, the stitches. The sewers and sewing machine operators will perform daily maintenance on the knotting machine according to the requirements.

**Table 4.** Schedule of routine maintenance of the casing machine

| Spot-check serial number | Spot check parts | Spot check requirements | Use of tools | Remarks |
|---|---|---|---|---|
| 1 | Workbench board, wireframe | The body is cleaned, and no objects are placed in a mess | Towel | Three times/day |
| 2 | Head surface, strainer, oil window, work light | Clean and dust-free | Towel | Three times/day |
| 3 | Rack, computer CPU | Clean surface | Towel | One time/day |
| 4 | Pendulum shuttle | No dust accumulation | Small brushes, small tweezers | In the evening, before work |
| 5 | Shuttle bed, dynamic and static knife | No dust accumulation | Small brushes, small tweezers | |
| 6 | Pad with presser foot paper | Machine pin inserted | / | |
| 7 | Take out the presser foot paper | No oil leakage | / | In the morning, before work |
| 8 | Power-on spot check | Standard oil supply to the equipment<br>The machine is running correctly. | / | |
| 9 | Pinning | Normal stitching | Clothes piece | All day |

The sewer cleans the workbench and thread frame three times a day to prevent all kinds of debris on the table, and cleans the surface of the machine head, the thread clamp, the oil window, and the work light with a towel to keep them dust-free. The sewing workers need to use a small brush and small tweezers to clean the accumulated dust on the swing shuttle, bobbin bed, and dynamic and static knives before they leave work every night, and lift the presser foot, pad it with presser foot paper and insert the machine needle down to avoid the presser foot paper falling off. When working, make sure the stitching is standard.

### 4.3. Procedure of belt loop knot

In the first step, smooth out the fabric surface where the belt loops are knotted. Align the pressure foot with the alignment point at the semi-finished belt loops, press the jeans with the left hand and take the belt loops with the right hand.

The second step is precise alignment, before tying the knot, the machine needle is usually on the left side, and the machine needle and the left stop of the belt ring are aligned to tie the knot; the knot will be equal to the belt loop, the middle seam of the presser foot is aligned with the width of the belt ring, and the knot is tied in the middle; usually the knot will be in the middle of the belt loop.

In the third step, the belt loop ironing upper stop needs to be aligned with the trouser waist stop position and cannot be skewed. In contrast, the upper and lower belt ring stop need to be aligned. If the upper stop is skewed, no adjustment will be tied to the set of knots, and it will cause the entire belt ring to be skewed.

The lower stop is difficult to correct, easy to appear belt ring length, and inconsistent problems.

In the fourth step, the left hand is placed 2 cm from the lower stop of the belt loop, the hand is then moved to the back of the presser foot. Next the presser foot is pressed against the belt loop, and the cutting piece is held with the right hand to prevent the jeans from being skewed and finish the process of tying the knot of the belt loop.

## 5. Conclusions

In this paper, we analyzed the most common problems in sewing jeans belt loops and formulated corresponding measures to solve the problems. We also summarized the operation steps of belt loop knotting from the front line of jeans production and points of maintenance of the knotting machine to ensure proper operation of the knotting machine. Besides, we have also provided theoretical support for sewers and security workers to troubleshoot and maintain the equipment quickly, help shorten maintenance time, improve work efficiency, and ensure the quality consistency of the belt loop link in jeans.

## Disclosure statement

The author declares no conflict of interest.

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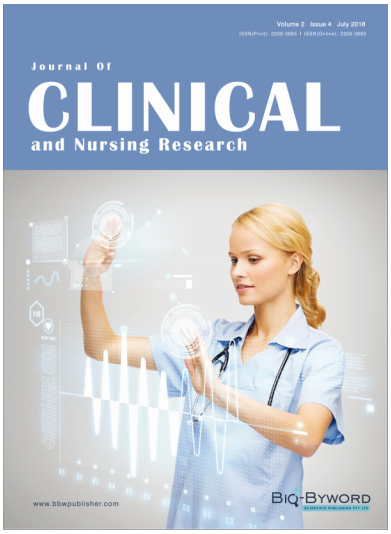


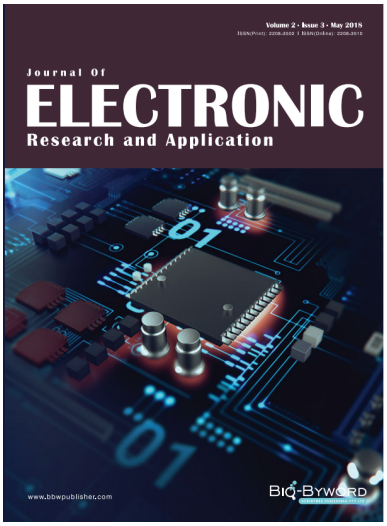


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