



Food and Agriculture Organization
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SUPPORT TO SUSTAINABLE USE AND MANAGEMENT OF SUGAR CROP RESIDUES FOR SUSTAINABLE PRODUCTION AND NATURAL RESOURCES CONSERVATION

June 2024

SDGs:



Country: The People's Republic of China

Project Code: TCP/CPR/3804

FAO Contribution: USD 200 000

Duration: 1 April 2021–31 December 2023

Contact Info: FAO Representation in China
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Implementing Partner

Ministry of Agriculture and Rural Affairs (MARA).

Beneficiaries

Local sugar producers in pilot sites.

Country Programming Framework (CPF) Outputs

CPF 2022 – 2025

Priority 1: Supporting people and prosperity and better production and better nutrition through rural revitalization.



BACKGROUND

China is the world's largest sugar importer, third-largest sugar consumer and fourth largest sugar crop producer. Key regions for sugarcane and sugar beet production are Guangxi Zhuang Autonomous Region and Inner Mongolia Autonomous Region, respectively. Sugarcane covers one million hectares in Guangxi, 60 percent of China's total, while Inner Mongolia hosts 80 000 hectares of sugar beet, 36 percent of the national total. The sugar industry is crucial for local economies and farmer incomes in these areas.

Despite China's advantages in sugar crop cultivation, sugarcane planting areas decreased from 1.7 million hectares in 2013 to 1.37 million hectares in 2017, a trend assessed as likely to continue due to rising production costs, particularly for chemical fertilizers, and shrinking profit margins. Overuse of chemical fertilizers led to soil degradation, reducing the production potential of sugar crops and causing environmental issues like water pollution and erosion.

In addition, sugar processing generates significant waste, including bagasse, pulp and molasses. These by products, rich in organic matter and nutrients, are underutilized, contributing to pollution and greenhouse gas emissions. Using these wastes as organic fertilizers could reduce chemical fertilizer use, lower production costs and improve soil fertility.

Against this background, this Food and Agriculture Organization of the United Nations (FAO) project was designed to implement circular agriculture by returning sugar production waste to fields as organic fertilizer, addressing both input and output challenges. Identifying two pilot sites, Chifeng City of Inner Mongolia and Hechi City of Guangxi, the project aimed at providing technologies for waste processing, nutrient-based fertilization and soil health management, to be further extended and replicated in a participatory manner to local producers of sugarcane and sugar beets.

IMPACT

The promotion of ecological and sustainable sugar crop production systems in the two pilot sites through a circular use of wasted plant nutrient resources contributed to enhancing economic profitability, ecological sustainability and livelihood improvement, offering opportunities for nationwide replication. Approaches such as soil health and nutrient management significantly influenced the ecologically safe planting and sustainable development of sugarcane and sugar beet. Introducing practices that increase productivity, maintain ecosystems, strengthen capacity for adaptation to climate change and extreme weather events, and progressively improve land and soil quality, the project contributed to SDG Target 2.4.

ACHIEVEMENT OF RESULTS

The project, whose daily implementation was led by the project implementation unit at the Institute of Agriculture Resources and Regional Planning of the Chinese Academy of Agricultural Sciences, and supported by relevant departments and expert groups from Guangxi and Inner Mongolia, successfully achieved its outcome by promoting ecological and sustainable sugar crop production systems the two pilot sites.

Ranging from field research and experiments to the demonstration of sugarcane and sugar beet ecological safe planting, and then to Training of Trainers (ToT) and Farmer Field Schools (FFS) training for improved capacities of local practitioners, the project design provided a logical framework to support eco-safe cultivation of sugar crops based on integrated agricultural technologies, focusing on agronomic interventions, water management, pest and disease control and scientific fertilization.

By integrating interventions on soil health, nutrient management and waste resource utilization, the technical package introduced under the project improved the yield and sugar content of sugar crops, increased income for growers and sugar factories and enabled technical service personnel and growers to establish the concept of ecologically safe planting and master ecologically safe planting technologies through training. Based on findings from literature reviews, field research summaries and demonstration results, the Technical Guide on Sugarcane Ecological Production and the Technical Guide on Sugar Beet Ecological Production were developed under the project and tested during the ToT and FFS processes.

More in detail, under Output 1, technical models for ecological and sustainable sugarcane and sugar beet cultivation were established, emphasizing waste recycling and reasonable fertilization.

Under Output 2, the proposed technical models for sugar cane and sugar beet cultivation were tested in approximately 134 hectares of sugar beet planting area in Chifeng City, Inner Mongolia, and in about 112 hectares of sugarcane planting area in Yizhou District, Hechi City, Guangxi. The demonstration witnessed improved growth of sugarcane and sugar beet plants, with taller plants and thicker, greener leaves. Increases were observed in terms of effective stems, per-hectare yield, output-to-input ratio and sugar content.

Under Output 3, a total of 62 local technical personnel and cooperative representatives in Chifeng, Inner Mongolia, and Hechi, Guangxi, including 21 women, graduated from season-long ToT sessions. Additionally, 424 farmers graduated from 13 FFS, with 170 women participants included.

IMPLEMENTATION OF WORK PLAN AND BUDGET

A rephrasing, aligning the actual commencement of the project to the first financial transaction, and a no-cost extension, aimed at mitigating delays caused by the COVID-19 pandemic and related restrictions, were requested and approved, eventually bringing the project's end date to December 2023. This allowed for the implementation of project activities within the planned budget.

FOLLOW-UP FOR GOVERNMENT ATTENTION

It is recommended that the technical codes and guidelines developed for the ecological production of sugar beets and sugarcane be extended, in a participatory manner, to the major sugar production areas in the country.

SUSTAINABILITY

1. Capacity development

Given the current level of attention and support from the national and provincial governments for the development of the sugarcane and sugar beet industries, the results of this project are expected to continue to be popularized and applied in the two regions. Governments at all levels provided in-kind contributions in support of project implementation. Earmarked funding for sugarcane and sugar beet development will be allocated by provincial/regional governments through existing institutional arrangements.

The policy support from state and local governments for the development of the sugar industry (especially sugarcane) promoted, to a certain extent, the sustainability of the ecologically safe planting technology of sugar crops in this project. In the National Plan for Crop Production during the 14th Five-Year Period (2021–2025), issued by the MARA, efficient, high-quality and resilient sugar crop production was highlighted. The Provincial Plan for Sugar Industry Development during the 14th Five-Year Period issued by the Guangxi regional/provincial government set explicit goals for sugar production and emphasized the importance of industrial structuring, sustainable production, value chain development and digital development.

The Institute of Agriculture Resources and Regional Planning of the Chinese Academy of Agricultural Sciences will maintain communication and collaboration with the field implementers of this project, including local governments, research institutes, sugar factories and ToT trainees, to extend the project results. The technical guides developed under the project will continue to be used by the project beneficiaries and further disseminated to sugar crop practitioners in other parts of the country. The FFS methodologies will continue to be the main means for participatory training, ensuring the long term impact of the project results.

The project significantly strengthened the relationship between the government, sugar mills, growers, technical service companies and other stakeholders, fostering sustainable cooperation. At the grassroots level, the project helped strengthen networks among cooperatives and farming communities through the organization of ToT and FFS trainings.

Through the implementation of the project, eco-safe sugar crop cultivation technologies were introduced and demonstrated.



The project results were reviewed and commended at the expert consultation forum held at the end of the project implementation. The wider and stronger partnerships created under the project will continue to function and strengthen cooperation in the long run.

2. Gender equality

Gender equality was highly emphasized throughout the project cycle, particularly in the selection of training participants. Women participants accounted for 33 percent and 40 percent of the participants in the ToT and FFS sessions, respectively.

3. Environmental sustainability

The project laid the foundation for the safe recycling of waste in the future by training trainers in recycling waste generated by the sugar crop industry. The implementation of nutrient synergistic combination technology ensures soil health and sustainable use, having a far-reaching impact on the long-term benefits of the soil environment and living conditions.

The project documented the results of FFS training and the demonstration of ecologically safe planting technology for sugar crops through work briefs and highlights. These records were distributed to project authorities, local governments, technology extension departments, sugar mills, technical service companies, growers and experts.

4. Human Rights-based Approach (HRBA) – in particular Right to Food and Decent Work

The project contributed positively to the human rights-based approach through the dimensions mentioned above.



5. Technological sustainability

The ecological safe planting technology of sugar crops adopted in the project is based on years of practice and site-specific field observations and demonstrations. It is carried out in combination with local fertilization and management, making it highly appropriate, flexible and implementable.

Through the development, implementation and dissemination of the Technical Guide on Sugarcane Ecological Production and the Technical Guide on Sugar Beet Ecological Production, the project promoted the integration of local agricultural waste resources with ecological planting technology, as well as soil health and sustainable use. It also improved fertilizer utilization efficiency, yield and quality.

Through season-long ToT and FFS, the awareness and capacities of local agricultural technology extension staff and farmers were greatly enhanced in extending and applying the introduced sugar crop cultivation technologies and practices. Test results and questionnaires indicated a significant increase in the knowledge, attitude and performance of the beneficiaries. Stakeholders and beneficiaries were equipped with the necessary technical capacity to continue project activities.

6. Economic sustainability

The MARA, along with its provincial and prefectural subordinates in Inner Mongolia and Guangxi, provided in kind contributions to the implementation of the project activities. After the project's completion, local governments in Guangxi and Inner Mongolia will continue allocating earmarked resources to extend the technologies developed by the project.

The project provided cost effective products and services for beneficiaries and stakeholders, with a production investment ratio of approximately 8 to 10.

ACHIEVEMENT OF RESULTS - LOGICAL FRAMEWORK

| | | | |
|------------------------|--|---|-----------------|
| Expected Impact | Enhanced economic profitability, ecological sustainability, and livelihoods improvement through circular use of wasted plant nutrient resources for ecological and sustainable sugar crop production | | |
| Outcome | Ecological and sustainable sugar crop production systems promoted in Guangxi and Inner Mongolia | | |
| | Indicator | The technical package for safe, ecological and sustainable planting of sugar crops based on recycling and reuse of sugar production residuals. | |
| | Baseline | 0 | |
| | End Target | 1 | |
| | Comments and follow-up action to be taken | Under the project, a Technical Guide on sugarcane ecological production and a Technical guide on sugar beet ecological production were developed. | |
| | | | |
| Output 1 | Establishment of a technical model for ecological and sustainable sugar crop cultivation, based on the waste recycling and reasonable fertilization | | |
| | Indicators | Target | Achieved |
| | A report of technical model for sustainable sugar crop cultivation. | 1 | Yes |
| Baseline | 0 | | |
| Comments | The technical models for ecological and sustainable sugarcane and sugar beet cultivation were established based on waste recycling and reasonable fertilization. | | |
| Activity 1.1 | Conduct field research on plant cultivation, processing, and waste utilization in the selected main sugar crop production bases in Chifeng, Inner Mongolia and Hechi, Guangxi | | |
| | Achieved | Yes | |
| | Comments | Field researches were conducted in December 2021 and January 2022 by the national consultants and project management officers. Field observations and discussions were held with local farmers, cooperatives, enterprises and agricultural extension services on plant cultivation, processing and waste utilization in the selected main sugar crop production bases in Chifeng, Inner Mongolia and Hechi, Guangxi. | |
| Activity 1.2 | Conduct literature review to summarize the advanced theories, practices, technologies and techniques on sugar crop cultivation and waste utilization in and outside China | | |
| | Achieved | Yes | |
| | Comments | The national consultant, together with the technical experts in Inner Mongolia and Guangxi, conducted a literature review on sugar crop cultivation and waste utilization. While the majority of the consulted articles and books originated from China, the review encompassed relevant literature from various regions. The findings resulting from this comprehensive analysis were presented during the project inception workshop that took place in May 2022. | |
| Activity 1.3 | Conduct field experiments on the circular utilization of sugar residuals, molasses and the residuals of yeast | | |
| | Achieved | Yes | |
| | Comments | Twelve field experiments on the circular utilization of sugar residuals, molasses and the residuals of yeast for both sugar beets and sugarcanes were conducted in 2022 and 2023 | |
| Activity 1.4 | Formulate the best model for sugar crop sustainable and eco-safe cultivation based on the soil characteristics for sugar cane and sugar beet cultivation, combining the agriculture machinery condition, nutrition requirement, etc. | | |
| | Achieved | Yes | |
| | Comments | Based on the findings of Activities 1.1, 1.2 and 1.3, two specific technical models for sugar crops eco-safe cultivation were established based on integrated water management and fertilization strategies. | |

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| Output 2 | Pilot demonstration on the recycling and reuse of wasted plant nutrient resources for ecological and sustainable sugar crop production | | |
| | Indicators | Target | Achieved |
| | A tested model on the recycling and reuse of wasted plant nutrient resources. | 1 | Yes |
| Baseline | 0 | | |
| Comments | The proposed technical models on sugar cane and sugar beet cultivation were tested in about 134 hectares of sugar beet planting area in Chifeng City, Inner Mongolia, and in about 112 hectares of sugarcane planting area in Yizhou District, Hechi City, Guangxi. The demonstration witnessed better growth of sugarcane and sugar beet plants with higher plants and thicker and greener leaves. An increase was also seen in terms of effective stems, per-hectare yield, output-to-input ratio, as well as sugar content. | | |
| Activity 2.1 | Identify 20 hectares of sugar beet farm and 20 hectares of sugarcane farm in Chifeng of Inner Mongolia and Hechi of Guangxi respectively for demonstration | | |
| | Achieved | Yes | |
| | Comments | In Guangxi, about 107 hectares of sugarcane farm in Shuangtang, Meidong, Huaidao Villages of Beishan Township and Shibie District of Shibie Township were identified for demonstration of the introduced technical package in 2022, and another five hectares of sugarcane farm in Shuangtang Village of Beishan Township and Qingyuan Township joined the demonstration in 2023. In Inner Mongolia, 67 hectares of sugar beet farm in Wufendi Town, Guangdegong Township, Wudan Township in Ongniud Banner, Shiertu Township in Linxi County and Tianshan Xinmin Township in Ar Khorchin Banner were selected for demonstration in 2022, and an additional 67 hectares in Wudan Township of Ongniud Banner were added in 2023. | |
| Activity 2.2 | Pilot the selected technologies and cultivation models for demonstration | | |
| | Achieved | Yes | |
| | Comments | From 2022 to 2023, ecological safe cultivation demonstration trials were conducted in about 134 hectares of sugar beet planting area in Chifeng City, Inner Mongolia, and in about 112 hectares of sugarcane planting area in Yizhou District, Hechi City, Guangxi. | |
| Activity 2.3 | Assess the demonstration results in terms of farmland ecology, resource utilization and crop quality and efficiency improvement | | |
| | Achieved | Yes | |
| | Comments | The demonstration witnessed better growth of sugarcane and sugar beet plants with higher plants and thicker and greener leaves. An increase was also seen in terms of effective stems, per-hectare yield, output-to-input ratio, as well as sugar content. In Hechi City of Guangxi, over 70 percent of the treated sugarcanes showed an increase in yield, with 57 percent showing an increase in sugar content. In Chifeng City of Inner Mongolia, the experiment results showed average sugar beet yields of 15 percent to 25 percent increase compared to the controls, and average sugar content of 0.5 percent to 0.8 percent increase compared to the controls. | |

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| Output 3 | Improved capacity of local agricultural practitioners on circular sugar crop production through trainings and extension | | |
| | Indicators | Target | Achieved |
| | Number of local stakeholders with improved capacities in ecological development of sugar crops through training programmes. | 40-60 trainers and 300 farmers trained | Yes |
| Baseline | 0 | | |
| Comments | 62 local technical personnel and cooperative representatives in Chifeng of Inner Mongolia and Hechi of Guangxi, including 21 women, graduated from season-long ToT sessions. Additionally, 424 farmers graduated from 13 FFS, including 170 women participants. | | |
| Activity 3.1 | Organize Training of Trainers (TOT) sessions to 40-60 local technical personnel and cooperative representatives in Chifeng of Inner Mongolia and Hechi of Guangxi | | |
| | Achieved | Yes | |
| | Comments | Three ToT sessions for 15 days were held in Hechi City, Guangxi, and Chifeng City, Inner Mongolia respectively, training a total of 62 participants. Women accounted for 33 percent of the trainees in total. The training covered the following main topics: (i) Soil Health, including soil characteristics of sugarcane in Guangxi and sugar beet in Inner Mongolia, soil barrier characteristics and improvement measures, the importance of soil health, methods of analysis of the agricultural ecosystem; (ii) Nutrient Management, covering water and fertilizer demand characteristics and management techniques of sugar crops, ecological optimization planting techniques; (iii) Variety Selection and Cultivation Techniques, focusing on the selection of excellent varieties of sugarcane/sugar beet and key points of cultivation techniques; (iv) Green Control of Diseases and Pests, including common disease and pest characteristics of sugarcane/sugar beet, control measures and biological control techniques; Residue Resource Recycling, covering the nutrient resource status of sugarcane residues in Guangxi and sugar beet residues in Inner Mongolia, risk control of returning to the field and safe field return techniques of residues; (v) Benefit Analysis, including analysis of factors affecting the efficiency of sugarcane/sugar beet planting, nutrient management under the goal of optimal benefit, and benefit analysis of ecological planting techniques; (vi) Skill Training about the FFS facilitation skills and team building. | |
| Activity 3.2 | Organize 10-20 Farmer Field Schools (FFS) for 300 local farmers to spread the technical introduced by the project. | | |
| | Achieved | Yes | |
| | Comments | Thirteen FFS were established in Yizhou District and Luocheng County of Hechi City and in Ongniud Banner, Linxi County, Ar Khorchin Banner, Aohan Banner, and Bairin Right Banner of Chifeng City. A total of 424 farmers graduated from the FFS, including 170 women participants. Training themes included characteristics and methods of FFS training, sugar beet ecological safety planting demonstrations and effects, sugar beet paper cylinder seedling and cultivation management, sugarcane ecological safe cultivation demonstration bases, demonstration effect display, sugarcane seedling surveys, ecological safe planting fertilization techniques, high-yield and high-sugar cultivation management techniques, water and fertilizer management, and control techniques for sugarcane diseases, pests, and weeds. | |
| Activity 3.3 | Finalize a model/scheme for the introduction, application and extension of the technical package introduced by the project for future extension. | | |
| | Achieved | Yes | |
| | Comments | Based on literature review findings, field research summaries and demonstration results, the ToT and FFS Technical guides were finalized and tested during the ToT and FFS process. | |

Partnerships and Outreach

For more information, please contact: Reporting@fao.org

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