

Commercial Agriculture and Resilient Livelihoods Enhancement Programme

Stories of Change

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Bulb Onion: A New Cash Crop of Ngarupongtang Village, Thangrong Gewog

Chungku¹ and Sonam Chophel²



Ngarupongtang village is one of the isolated villages under Thangrong Gewog in Mongar. It is located 6 km away from Gewog center. The village comprises 50 households with a total population of 2946 (Annual census, 2023). The village lies between 900 masl -1600 masl and farmers practice mixed farming. As per the lagthrams, the total command of land coverage area is about 137.2 acres. Maize and legumes are the major crops grown while mango and citrus were major cash crops in the past. In recent years, most of the farmers are engaging in onion cultivation as it has massive potential in generating income for the farmers.

With the seed support from Dzongkhag Agriculture Sector, Mongar and Commercial Agriculture Resilient and Livelihoods Enhancement Programme (CARLEP) Office, farmers Ngarupongtang of began cultivating bulb onions called Pune red in 2020. They are trained on agronomic and management practices of the

CARLEP-IFAD



by Gewog Agriculture crop Supervisor. Extension The sowing season for bulb onions Ngarupongtang falls in at the month of late October and November. It is an easy crop to grow that requires management practices less compared to other Cole crops in the entire growing season.

They are also more resilient

just about 1.3 acres in the whole of Ngarupongtang village cultivated by around nine households.

The following year, many farmers were interested in cultivating onions after noticing the success of crops for their neighbors in the village. By 2023, almost all the farmers of Ngarupongtang



to heat, pests and diseases. Farmers cultivate bulb onions in their dry land after harvesting maize. In the initial vear. just farmers were arowing onions in their kitchen garden self-consumption, for and nobody generated income from selling this crop. In that year in 2020, the total area under the bulb onion cultivation was

village have ventured into cultivating this new cash crop.

Farmers of Ngarupongtang buving onion are now cultivating seeds and are commercial for purposes. The average production is around 1200 kg per acre at Ngarupongtang village as per the crop cut. In 2020, the



area coverage was less and production was just enough for local market consumption. However, farmers were able to sell some quantity of bulb onion and have earned some income for the family. In 2021, they were able to supply to Thangrong Primary school, gewog staff and local shops and have generated about Nu 96,000.

In 2022, farmers were able to sell around four tons of bulb onion at Mongar and Nganglam at the rate of Ngultrum 40 per kg when taken in bulk. Income generation from selling this crop has further increased in 2023. Farmers have earned around Nu 200000 and main markets are Mongar, Nganglam and Bumthang.

For the farmers of Ngarupongtang, onion cultivation in the village has proven to be a successful farming. Major households of the village are interested onion cultivation. Within in a few years, the coverage area of onion cultivation area has increased by lots and the income generated from this crop has really benefited the farmers in supporting the daily livelihoods of farmers.

Way forward

Farmers of Ngarupongtang are optimistic in cultivating bulb



onions. They are procuring seeds at their own expense and the cultivation area keeps on increasing. In the near future, when the coverage of onion cultivation becomes large, there will be an increase in production of onion. When there is huge production, there will be problems in marketing the produce which will lead to loss in the interest of farmers to cultivate. Therefore, before any issues arise, we felt the need in exploring markets to sell the product of the farmers. Moreover. infrastructures training and support are also required for the farmers in order to have a better management of the crops and to prevent future setbacks.

Ngarupongtang Farmers of have cultivated bulb onions successfully. It is their new cash crop that has generated income for the family to procure daily households' essential items and to do school expenditure for their children. Therefore, in order to sustain the cultivation of this crop at Ngarupongtang, it is important for all the relevant stakeholders to motivate farmers by supporting them with seeds (even if it is in cost sharing mechanism), exploring markets and infrastructures.





Transforming Horticulture in Eastern Bhutan: The Role of CARLEP-IFAD in Boosting Private Nurseries and Fruit Cultivation

Tshering Pem¹, Tshering Yangchen² and Lungki³

The Fruit Intensification Program in the eastern region, complemented by the Million-Fruit Tree Program, has become a remarkable success story for Private Nursery Operators (PNOs). Launched to leverage the commercial potential of fruit cultivation, this initiative has thrived with the backing of additional financing from the CARLEP-IFAD (Commercial Agriculture and Resilient Livelihoods Enhancement Programme-InternationalFund for Agricultural Development), which spans five years from FY 2021-2022 to 2025-2026.

This strategic effort has not only benefited farmers, the National Seed Centre (NSC), and Bhutan Agro Industries Limited (BAIL) but has also significantly uplifted the PNOs.



By focusing on sustainable and resilient agricultural practices, the project aims to enhance food security, increase income for rural households, and boost overall economic growth in the region.

A testament to this success is the purchase of 157,119 fruit seedlings from seven private nurseries amounting to Nu. 6.169 million by the Agriculture Dzongkhag Sectors of eastern the region and ARDC Wengkhar the fruit for intensification program and MFTP (Table).

Furthermore, the program's impact extends beyond mere financial benefits. It has enabled a collaborative environment knowledge where transfer and technical assistance are readily available. PNOs received training on modern horticultural techniques, pest management, and postharvest handling, ensuring that they can produce healthy, robust seedlings that thrive in the local environment. This knowledge exchange has led to a noticeable improvement in the quality and quantity of fruit production in the region. The success of this program highlights flourishing the partnership between the CARLEP project and private driving nurseries. forward the region's commercial fruit cultivation endeavors. The collaborative efforts have not only stimulated local economies but also encouraged a sense of community and shared purpose amongallstakeholdersinvolved. By creating a sustainable model of agricultural development, the

Fruit IntensificationProgram is paving the way for a prosperous future for the eastern region, with private nurseries playing a pivotal role in this transformative journey.

In addition to the direct benefits to the nurseries, the program has also had positive ripple effects on the broader community. The program intensification fruit will lead to the establishment of new markets and supply chains, providing farmers with more opportunities to sell their produce at competitive prices. This, in turn, will contribute to higher household incomes improved and livelihoods. Hence, the Fruit Intensification Program stands as a shining

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example of how targeted agricultural initiatives, supported by strategic partnerships and financial investment, can lead to substantial and lasting positive impacts on rural communities. The success of the PNOs within this framework underscores the importance of nurturing local entrepreneurship and innovation in achieving sustainable agricultural development goals.

SI.No.	Nursery	Income gener- ated (NU.)
1	Druk Shindrey Natshok	822863
2	Goedoedh Kuenjuung Ling Horti- culture Nursery	832367
3	Gyelpo Horticulture Nursery	479235
4	Khemsar Horticulture Nursery	1200000
5	Paksam Horticulture Nursery	948000
6	Samten Horticulture Nursery	990910
7	Tshendu Namgyal Nursery Planta- tion	895579

1 & 2. Agriculture Officer, ARDC, Wengkhar 3. Sr. Agriculture Supervisor, ARDC, Wengkhar Seed of Success: The First Hybrid Malze Seed Production at Udzorong Achieves Success

Kinzang Thinley¹, Tshering Pem², Namgay Wangdi³ and Kinley Sithup⁴



High-guality seed is а fundamental agricultural input for enhancing crop yields and productivity on limited land areas. However, like other developing countries, Bhutan alsofacesasignificantchallenge in ensuring that farmers have access to quality seed that is both affordable and available. especially when it comes to preferred crop varieties.

Maize is Bhutan's second

most important cereal after rice, but the land dedicated to its cultivation has been steadily several declinina due to factors, including rural-urban migration, the expansion of urban spaces, and the impacts of climate change. From 2016 to 2021, the land area used for growing maize in Bhutan saw a reduction of 64 % as reported by FAOSTAT in 2022. This dramatic decrease in cereal



cultivation, paired with relatively productivity, has made low Bhutan increasingly dependent on imports to fulfill the demand for staple food crops like maize. The Bhutanese government is committed to strengthening agricultural domestic working production and towards self-reliance in key crops, while also discouraging the import of seeds, particularly hybrid maize varieties.

In response to the need for improved maize productivity, the National Maize Program under ARDC Wengkhar has been focusing on developing and distributing hybrid maize varieties that can potentially double the yield compared to traditional varieties. In 2020. Bhutan launched its first hybrid maize variety, Wengkhar Hybrid Maize-1 (WHM-1), which was sourced from the International Maize and Wheat Improvement Center (CIMMYT).

WHM-1 hybrid has been previously evaluated in farmers' fields, achieving a yield of 5.8 t ha-1, which is significantly higher than the national average of 3.7 t ha-1. This hybrid is characterized by its medium height, tolerance to heat and drought, and resistance to both stem and root lodging. Furthermore, it retains its green foliage even after the cobs have matured, making it an excellent option for livestock feed. Due strong performance to its and wide adaptability, there is sustained interest among farmers in cultivating WHMhybrids, contingent 1 on the availability of seeds.

Moreover, other hybrid maize varieties from CIMMYT, including those resistant to fall armyworm—a major pest affecting maize in Bhutan are currently being evaluated and are expected to be released in the near future.

Although these hybrid maize varieties have been tested and approved, the production of high-quality seed necessary to maximize their benefits for Bhutanese farmers has yet to be established. Bhutan's seed sector is predominantly informal, with most farmers relying on seeds saved from previous harvests, which are often of poor quality. The lack of a formal seed system, along insufficient skills with and

technical know-how across the seed production and distribution chain, presents substantial obstacles to the development of a dynamic and competitive industry in seed Bhutan.

To enhance Bhutan's maize hybridization program and reinforce its seed systems, ARDC in collaboration with CIMMYT under the CGIAR Seed Equal Initiative carried out an international training workshop on quality seed production and distribution with a main focus on hybrid maize from November 13th to 15th, 2023 at ARDC Wengkhar, Mongar. The threeworkshop day involved 30 participants

organizations, including the National Seed College Centre, of Natural Resources. geog extensions from the region, eastern Bhutan Drug Authority, Food and Agriculture Research and **Development** and Centers.

Dr. AbduRahman Beshir. a senior scientist and seed systems specialist for Asia at CIMMYT, based in Kathmandu, Nepal led the training sessions. Moreover, a maize breeder from CIMMYT-India. Maize pathologist from CIMMYT-Kenva and the Director for the Global Maize Program, CIMMYT also addressed the training on developing and maintaining inbred and breeders seed production, identification of major maize disease in Bhutan and fall armvworm management.

The comprehensive curriculum included courses on system seed components, basic maize breeding concepts, hvbrid seed production principles, seed production and marketing roadmap development, hybrid seed pricing, seed quality and certification. control. field visit along with a practical exercise at ARDSC Lingmethang enriched

Α

from diverse



the learning experience.

Following the conclusion of the training, the National Maize Program, in partnership with the Gewog Agriculture Sector in Udzorong, initiated community-based hybrid maize seed production of Wengkhar Hybrid Maize-1 (WHM-1) at Lamzang, covering 0.33 acres in February 2024, benefitting 41 households. This collaboration was aimed to enhance the maize hybridization program improve and domestic systems, seed thereby increasing maize production.

Given that this initiative is unprecedented in the country, capacity-building of farmers relevant stakeholders and conducted through were practical demonstrations and These hands-on training. demonstrations focused on essential agronomic practices such as land preparation, field layout, strategic planting of male and female parental lines, detasseling. emasculating, pollination. and bulk

Later around mid-July, a field day on hybrid maize seed production was held,

which identifying included physiological maturity, harvesting techniques, and post-harvest handling. A total of 320 kg of F1 hybrid seeds was produced. Participants noted that the WHM-1 hybrid features good cob size, medium height, and dark green stalks at maturity, and expressed interest in continuing seed production if parental lines were made available. Additionally. suitable areas for productivity assessment will be identified

Pema Tenzin, one of the beneficiaries said, "The WHM-1 hybrid has good cob size with medium height." He expressed his interest in continuing seed production, given the availability of parental lines.

Other farmers observed that the hybrid's parental lines were shorter and had darker green leaves, setting them apart from other maize varieties cultivated under similar conditions.

"Unlike previous years, the seed production sites are now fenced with chain-link fencing, which will support year-round production of high-value crops. We plan to continue producing hybrid maize seed, given its higher yield compared to openpollinated varieties," said the Agriculture Extension Officer.

Building on this success, the National Maize Program plans to expand seed production in January 2025, providing farmers with essential inputs and technical guidance on agronomicpractices. Supported by the CARLEP-IFAD, this field day represents a significant step towards improving maize productivity and achieving self-sufficiency in the country.

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Access to Credit Facilities Enabled Zambala Dairy Cooperative in Dairy Intensification

Leki Wangchuk¹, Norbu² and Nima Dorji³

Introduction

Dairy Cooperative has played a vital role in bringing significant impact to the community Norbugang Gewogun of Nganglam Dungkhag under since 2019. One such cooperative, the Zambalha Dairy Cooperative (ZDC) has emerged as a sustainable rural group enterprise comprising of three Chiwogs (Norbugang, Nyingshingborang & Tshaelshingzor), inspiring the community to engage in commercial dairy production

and voluntary economic participation. Established with the mission of commercializing the dairy value chain, achieving self-reliance in dairy production, and enhancing the livelihood of the rural community. ZDC was registered under Department of Agriculture and Marketing Cooperative as a dairy farmers' cooperative in 2018. Comprising members. including 65 33 the cooperative women. initiated its dairy value chain in early 2019, with products being sold within local markets.

Bank Institution	Households	Loan Amount (Million)
CSI	25	2.86
BDBL	17	4
PSL	3	0.60
RICBL	3	0.7
Self-Cash	22	2.03
Total	70	10.18

Credit and Investment for establishment of ZDC

Access to credit facilities is of paramount importance to the farmers in uplifting their livelihoods. provided the the amount borrowed from Bank is gainfully invested. ZDC invested over 10 million in seed capital in 2018 through lending scheme from various including Bhutan sources Development Bank Limited. Rural Enterprise Development Corporation Limited (later renamed Cottage and Small Industry Bank), Priority Sector Lending Scheme, Bank of Bhutan, and Royal Insurance Corporation of Bhutan Limited, as well as through equity in ZDC. This capital was primarily establishing allocated for and introducing pastureland high-guality dairy COWS. Additionally, the IFAD project served as а collaborative

Year	Milk (MT)	Butter (MT)	Cottage Cheese (MT)	Butter Milk (MT)
2019	218.8	11.7	22.6	0.8
2020	213.0	11.3	21.3	2.5
2021	226.6	11.8	21.6	3.3
2022	197.8	10.0	20.6	2.1
2023	185.5	7.7	16.8	2.3
Total	1041.6	52.5	102.8	10.9





financial stakeholder in the acquisition of improved dairy cows, development of infrastructure such as cattle sheds and milk processing plants, the installation of cold chain facilities, and the capacity building of cooperative members.Additionally, the IFAD project served as a collaborative



financial stakeholder in the acquisition of improved dairy development COWS, the of infrastructure such as cattle sheds and milk processing installation the plants, of cold chain facilities. and the capacity building of cooperative members.

Each year, ZDC has bolstered production capacity its by introducing high-yielding exotic breeds of dairy cows, improving pasture carrying capacity, expanding markets with quality products, and enhancing the skills of cooperative members in sound animal husbandry practices.

The outbreak of lumpy skin disease in 2023 and movement restrictions due to Covid-19 have disrupted production trends and markets.

Nonetheless, despite these challenges, the cooperative achieved its highest dairv production in 2021. Moreover, the increase of milk price within the same year, from Nu.33/to Nu.38/- per liter, motivated cooperative members to production. increase milk

However, milk production declined significantly, reaching its lowest point in 2023 due to the outbreak of lumpy skin disease. This disease outbreak has also affected product markets, leading to the closure of MPU for two months.

Economic Impact to Members and Community

Improvements in both production and milk prices have economically benefited both the cooperative members and the community. Despite a decline in production since 2022, the revenue generated everv member for has remained consistent, mirroring production the decrease in the same year. Through enhancements in product quality and market expansion, ZDC has accumulated a gross income exceeding 58 million over five years. Of this total, 67.72% has been disbursed as cash payments to cooperative members for milk production over the same period, resulting in a five-year profit margin of 6.18 million. However, this profit margin is decreasing due to the production decrease, as milk



prices are annually adjusted to acknowledge the efforts of members; the milk price for 2023 stands at Nu.40/- per liter. Additionally, Milk Processing Unit (MPU) is managed by three office bearers and three permanent employees, with monthly salaries ranging from Nu. 12,000/- to 20,000/-.

At the end of 2023, ZDC had savings of Nu.2.8 million. In 2021, it purchased 17,250 shares of RICBL valued at

1.3 million, acquired two milk vans without credit, and had outstanding cash exceeding 3 million. Consequently, the cooperative's total assets 7.7 million. amount to Additionally, during the dismissal of 20 community members, ZDC contributed a total of Nu. 0.311 million from its common savings, providing Nu. 10,000/to 15,000/- per dismissed family member of cooperative members broader community and the five-year over а period.



Cooperative's voluntary contribution to the Government's COVID relief fund



Moreover, in 2020, a voluntary contribution of 0.1 million Ngultrum was made to the government's COVID-19 fund. Furthermore, ZDC has funded the plantation of 1000 Agar trees at a monastery and has participated in two charitable events aimed at engaging youth.

Rural enterprise in dairy cooperative has played a vital role in socio-economic development of Norbugang community. This cooperative has not only enhanced the livelihood of community but has also demonstrated that enterprise dairv is highly sustainable in rural areas. It achieves through development relation of cohesive within communities. fulfillina social mandates, voluntarily economic participation without gender bias, and promoting commercialization in farming value chain. and dairv

 Sr. Livestock Supervisor, Norbugang
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Ficus Trees as an Important Fodder Resource in Winter for Chaling Dairy Farmers: Towards Cultivating Green Wealth

Tshundu Zangpo¹ and Norbu²



Established in 2008. Pemachen Dairy Group in Shongphu Gewog, Trashigang, began with 22 members focused on collecting milk and marketing processed products such as butter, cheese, and buttermilk. Initially, the group collected 70 to 100 liters of milk daily for processing and sale. Today, the group has expanded to 31 members, now collecting between 200 and 300 liters of milk daily. The group currently milk to Koufuko supplies International Ltd.'s dairv Plant at Chenari, Trashigang.

role in income generation for rural agricultural communities. The sale of Ficus fodder demonstrates economic its viability, offering farmers a dependable income source and supporting local economies. To maximize productivity and income, training and extension services on Ficus fodder cultivation, management, and value addition are crucial. Establishing market linkages and developing the value chain will ensure fair prices for Ficus fodder products, motivating farmers to invest in cultivation.

Ficus fodder trees play a pivotal

With dairy intensification

program at Chaling, the demand of fodder for their cattle has increased by manifold. Because of the climatical suitability in growing Ficus trees which is known for higher biomass production besides protein content, the

size of the tree canopy". He said, he earned Nu. 9000.00 last year by selling his Ficus trees to 2 dairy farmers of Chaling Dairy group and he plans to plant more fodder trees bordering his agricultural land and fallowed land. "I buy fodder

"J sell fodder from 3-5 Ficns trees every year and each tree fetches me an income of Nn.1,500.00-2,000.00 depending on the size of the tree canopy".

Dawa Norbn, Chaling

Ficus has become one of the major fodder resources in the area, especially during lean (winter). Currently, season majority of the households in that area owns fodder trees ranging from 3-20 trees per household irrespective of cattle holding. While the farmers who rear cattle uses their own Ficus trees to feed their cattle, the farmers who do not rear cattle sell fodder to livestock rearing farmers of the Chaling Dairy Group. Mr. Dawa Norbu of Chaling said: "I sell fodder from 3-5 Ficus trees every year and each tree fetches me an income of Nu. 1,500.00-2,000.00 depending on the

from 10-15 Ficus trees annually from Shongphu and Chaling spending about Nu. 15,000.00-20,000.00 on an average," said Sangay Tshering, a member of the Chaling Dairy Group.

As per the record maintained by the Gewog Livestock Office, Shongphu, dairy farmers of Chaling Dairy Group buys fodder from 22 households in both Chaling and Shongphu by spending Nu. 2,20,000.00 on an average every year. Fodder business in Shongphu gewog has been on the rise every year, earning an incredible income by the fodder sellers and in fact, a good and easy source of



income for them. This kind of fodder trade has created a win-win situation for both dairy farmers and non-dairy farmers (but fodder growers), meaning dairy farmers could expenditure minimize the in buying commercial cattle concentrate while the fodder sellers could earn good income contributing towards enhancing local economy.

Crop residues, forest grazing, natural meadows and winter oats are important fodder resources besides abundant Ficus trees and wild fodder trees, making the place ideal for dairy farming and hence, contributing to the success of the Chaling dairy groups.

CARLEP project has been instrumental in supporting the group in terms of providing subsidy for dairy COW constructing procurement, hygienic dairy sheds, training of farmers, supply of fodder seeds and seedlings and setting up of milk collection sheds and Milk Collection Centers. "CARLEP-IFAD support to developing a resilient dairy value chain has been invaluable to our marginal farmers and supporting the livelihoods our farmers of and providing us with an opportunity to enhance our income is a living testimony of CARLEP-IFAD Project in the east." remarked Tashi Wangdi of Chaling Dairy Group.

Investing in research and innovation to improve Ficus propagation varieties. techniques, and processing methods can enhance productivity, quality, and market competitiveness. Advocating for supportive policies and agroforestry, incentives for sustainable land management, and rural development will foster environment an conducive Ficus fodder cultivation to generation. and income

1. Sr. Extension Supervisor, Shongphu Gewog 2. Norbu, CARLEP

Overcoming Seasonal Challenges: The Role of Modified Protected Structure Greenhouses in Year-Round Vegetable Farming

Thinley Wangdi¹ , Kinga Wangchuk², Karma Yangzom³, Tshering Pem⁴ and Kelzang Lhadon⁵



The adoption of vegetable a controlled environment that cultivation under protected optimizes light distribution, shields structures is rapidly plants from adverse weather conditions. increasing, with farmers protects many and opting against pests to and diseases. install However. some available greenhouse greenhouses designs individually of low are or in groups, height, leading excessively either through to cost-sharing hot conditions mechanisms selfduring which or summer, funding. Greenhouses offer hampers plant growth.



In response to this challenge, ARDC Wengkhar, with support from CARLEP-IFAD and in collaboration with the Dzongkhag Agriculture Sectors of eastern Dzongkhags, developed а modified areenhouse model. The installation of these enhanced greenhouses began in 2021-2022 in Tashigang and Dzongkhags, Trashiyangtse and expanded to four additional Dzongkhags in 2022-2023. modified greenhouses The measure 30 meters in length and 5 meters in width, with an increased height of 3.5-4 meters achieved using MS tubular rods.

This design helps minimize disease incidence by improving humidity control and facilitating

The easier management. structures are equipped with exhaust fans, ceiling fans, and wide insect-proof nets for optimal both sides on air circulation. crucial for controlling temperature and humidity. Additionally, SMART irrigation systems and trellising materials such as MS tubular rods and GI wire were provided to greenhouse owners cost-sharing basis. on а

With the modified greenhouses fully operational, the focus shifted to encouraging tomato and chili production, especially during the lean season. In the fiscal year 2023-2024, tomato cultivation was initiated in these greenhouses with technical support from the center. Tomatoes, identified



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as а key crop by the Agriculture, Department of now be grown yearcan round thanks to the protective environment provided bv the modified greenhouses. Initially, tomato seeds were provided to farmers to promote continuous cultivation. **Beneficiaries** received training in tomato pruning, trellising, and other necessary techniques. cultivation

Although all beneficiaries of modified greenhouses the received support, only three Dzongkhags; Trashiyangtse, Pemagatshel, and Tashigang were able to commence tomato production. These three greenhouses collectively produced 454 kg of tomatoes, which were marketed at Nu. 70-100 per kg in local markets and nearby schools. The three farmers from these Dzongkhags have earned a total of Nu. 75,825 from their tomato sales.

Looking ahead, the beneficiaries are set to continue tomato and chili production in the coming seasons. The modified greenhouse structures have proveninstrumentalinproducing high-quality tomatoes and significantly chilies. boosting incomes. farmers' Ongoing monitoring by the Dzongkhag Agriculture sector and ARDC will support the continued success of these greenhouses, with future plans for additional on-farm demonstrations to further enhance production.

Site	Gewog	Production (kg)	Income generated (Nu.)
Trashiyangtse	Yangtse	450	34,050
Shali	Shumar	300	30,000
Shongphu	Shongphu	154	11,775
	Total	454	75,825

1. Officer Incharge, RDC Sub-Center, Lingmethang

2 & 3. Agriculture Officer, ARDC, Wengkhar

3. Sr. Agriculture Supervisor, ARDC, Wengkhar

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SMART Irrigation: Simplifying Orchard Irrigation in Eastern Bhutan

Kinga Wangchuk¹, Tshering Pem², Pema Yangdon³, Tshering Yangchen⁴, Dr. Tshering Penjor⁵, Domang⁶ and Dema Yangzom⁷



Agriculture today faces the significant challenge of addressing arowina water scarcity while meeting increasing demands for food production. Various initiatives have been implemented to the efficiency enhance of agricultural irrigation systems. With the advent of the Internet of Things (IoT) and Information and Communication Technology (ICT), it is now possible to monitor and control irrigation

and water management processes in real-time. SMART irrigation systems utilize watersaving technologies, such as micro-irrigation (drip) systems, combined with IoT-based automation technologies.

Drip irrigation, in particular, promotes efficient water use by delivering water directly to plant roots, thereby minimizing losses through evaporation and runoff. This method is highly effective in conserving water, reducing waste by up to 70% compared to traditional irrigation techniques. Consequently, this targeted approach not only conserves water resources but also supports sustainable agriculture and maximizes crop productivity. The integration of IoT in drip irrigation

and its use in the fruit orchard is initiated by Dr. Tshering Penjor and a team from A R D C

Wengkhar.

The mango orchard at Rashingbee, once

struggling with water scarcity and a shortage of labor, serves as a prime example of the benefits of SMART irrigation. The orchard grower's father, a devoted man well over 70 years old, previously spent long hours manually watering the trees despite his declining energy. The introduction of the SMART irrigation system brought immense relief, allowing him to rest assured that the orchard receives the necessary water, even in his absence.

The success of SMART irrigation at Rashingbee, Lhuentse Dzongkhag, has spurred interest among farmers

> in eastern Bhutan. Installed in 2022 with funding from the CARLEP-I F A D project a n d

technical s u p p o r t from ARDC Wengkhar, this system was the first of its kind in

the region, covering five acres of mango orchard at a material cost of Nu. 0.116 million. The system's success has inspired other farmers to adopt the technology through cost-sharing initiatives. In the same year, Mr. Sangay Yeshi, a lead farmer residing at Tsegpa, Jurmey under Mongar Dzongkhag also



installed SMART irrigation in his one acre of mixed fruit orchard (avocado, mango and citrus).

In 2023, with continued support from the CARLEP-IFAD project, three more orchards benefited from SMART irrigation. A total of 5.5 acres of orchards, including citrus and kiwi fruit trees, were transformed using this technology, at a material cost of Nu. 0.320 million on a 70:30 cost-sharing basis. These orchards now successfully support 240 citrus trees and 325 kiwi trees under the SMART irrigation system. All the beneficiaries were provided hands-on training on the drip irrigation system design, installation techniques, automation, and maintenance installation. during the

SI. No	Name	Gender	Village	Area (Acres)	Orchard type
1	Sonam Dorji	М	Demungla	1.5	Citrus
2	Yangdon	F	Yadhi	1.5	Citrus
3	Kinzang	М	Tongthrang	2.5	Kiwifruit



- 1, 2, 4 & 4. Agriculture Officer, ARDC, Wengkhar
- 5. Specialist, ARDC, Wengkhar
- 6. Program Director, ARDC, Wengkhar
- 7. Sr. Technician, ARDC, Wengkhar

A seed replacement initiative: The success of upland paddy in Gangla-Khaema, Khoma

Passang Wangmo[!], Kinzang Thinley², Kinley Sithup³, Tshering Choden⁴ and Tashi Wangdi⁵



More than two decades ago, in 2002, the introduction of the upland paddy variety Khangma in Gangla-Khaema Maap (2400-2600 masl) Chiwog under Khoma geog, Lhuentse by RNR-RC Khangma (then) marked a significant turning point in the gewogs agricultural landscape. Prior to this introduction, the farmers in Gangla-Khaema primarily relied on crops like millet and maize, which were the cornerstone of their diet. The adoption of Khangma Maap upland paddy brought about a profound shift, gradually reducing the cultivation of millet and maize and altering the community's food consumption patterns.

The cultivation of upland paddy became a staple agricultural practice in Gangla-Khaema, leading to increased food security and self-sufficiency. According to the chiwog's

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Tshogpa, this transition has had a remarkable impact on the community: none of the households within the chiwog have had to purchase imported rice since thev began cultivating upland paddy. This shift not only ensured а reliable food source but also fostered а sense of pride resilience and among the farmers.

Despite widespread the adoption and acceptance of upland paddy cultivation bv community. production the and productivity have declined over the years which could have been attributed due to the prolonged use of the same variety. In March, 2023, ARDC Wengkhar, collaboration in with the Dzongkhag agriculture sector and with financial support from IFAD-CARLEP, carried out a seed replacement initiative. As part of this program, a total of 1.38 MT of Khangma Maap seed was supplied to the farmers. This effort covered 6 9

> acres o f farmland a n d benefited 69 households in the

chiwog. The seed replacement initiative aimed to address the declining yields that had been observed due to the prolonged use of the same variety without replacement. As the community had hoped, the harvest saw an increased yields, with the highest yield exceeding 2 t ac-1 and an average yield of 1.6 t ac-1. Overall, the community harvested a total production of around 110.4 MT. The seed replacement initiative not only restored the hope of the farmers but also helped in enhancing the productivity and production of the crop.

The journey of Khangma Maap upland paddy in Gangla-Khaema Chiwog stands as a testament to the positive impact of targeted agricultural Through interventions. the introduction of high-quality seeds. the initiative has

revitalized the local agricultural sector, improved food security, and strengthened community resilience. As the farmers prepare for another bountiful harvest next season, their story serves as an inspiring example of how strategic support and innovation can transform traditional farming communities, paving the way for a prosperous sustainable and future.

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Impact of Community Artificial Insemination Technician in Dairy Intensification at Gongthung.

Jigme Cheda¹ and Norbu²



ommunity Artificial insemination technician has played a crucial role in advancing dairy genetics and increasing the productivity of the dairy herd within the dairy community of Gongthung under Yangnyer gewog, Trashigang Dzongkhag. Enthusiastic farmers from Shokang, Levphu and Durung chiwog has been encouraged immenselv to farming dairy venture into because of continuous support provided by the CARLEP-IFAD project in terms of cattle subsidy, hygienic dairy shed construction, feed and fodder development and farmers capacity enhancement besides institutionalization of communitybased AI Technicians and the adoption of sex-sorted semen.

Gongsor Gonor Detshen, now Druk Chigthuen known as Namlay Tshodey. reaped the first benefits of CAIT in 2018, through coordination by the Regional Livestock Development Centre with financial support from the Commercial Agriculture and Livelihood Enhancement Program (CARLEP), aimed at enhancing desirable/highvielding breeds. However, it wasn't until 2020 that CAIT services were fully functional, fulfilling the wishes of the farmers Goungthung. of

Currently, only four CAITs have been trained, with two



inseminators actively providing services to the community. With an increasing number of cattle-rearing farmers, the demand for CAIT services has drastically increased, resulting in an average of 3-4 artificial inseminations being performed every week.

Before the introduction of artificial insemination (AI), farmers were using insignificant breeds of bulls, resulting in In 2020, the group nominated another dairy farmer to undergo training organized Regional Livestock by the Development Centre, funded continuity by CARLEP. His services unwavering and encouraged farmers to engage in dairy farming. The number of services provided by the CAIT and the progeny born is shown in the graph below.

The concept of CAIT has not only

"J suplly 25-37 liters of milk to Konfuko Dairy Plant every day earning a monthly average gross income of Nu. 38,000.00,"

Karma Dema, Gongthung Dairy cooperative

unproductive progeny and undermining farmers' hopes for the dairy business. Initially, dairy group members nominated an unemployed youth to undergo CAIT training with the hope of substituting undesirable bulls in the community. Unfortunately, after a few months of service. the trained youth left for better opportunities, leading to a break in artificial insemination services and causing a loss of hope for the dairy business. helped dairy groups address drudgery reduction of having to manage breeding bull but also encouraged farmers to produce high-yield cows from their own herds. As shown in Figure 2, both HF and Jersey Cross breeds have seen an increase among group members over 6 years. The incorporation of community AI technicians has encouraged non-group also members to join groups for business.Through dairy the



support of this project, dairy farmers have experienced convenience and ease due to improved services. The CAIT personnel are well-trained and provided with better facilities, including portable equipment, Cooperative. Similarly, Mr. Kinley is a pioneering dairy farmer operating at a semicommercial level. "I earn a gross income of Nu. 50-60,000.00 every month by selling fresh milk to Koufuko and as long as

Mr. Kinley of Gongthung Dairy Cooperative said: "J earn a gross income of Nu. 50-60,000.00 every month by selling fresh milk to Konfuko and as long as you work hard, dairy farming is rewarding,"

enabling the initiation of mobile AI services in the community. Before the establishment of CAIT, many farmers were interested in sourcing cattle from nearby Dzongkhags and India. However, due to the services of the CAIT, cattle sourcing from other areas has significantly decreased.

With the increasing numbers of improved breeds in the group, milk production has immensely increased, strengthening both Koufuko and individual farmers' incomes. "I suplly 25-37 liters of milk to Koufuko Dairy Plant every day earning a monthly average gross income of Nu. 38,000.00," said Karma Dema of Gongthung Dairy you work hard, dairy farming is rewarding," said Mr. Kinley.

With the increased numbers of improved animals on the farm due to the intensification of artificial insemination, the milk supply trend to the Chenary Dairy Processing plant, managed by the extension office of the geog and group, observed maior has а increase in milk production, as displayed in the graph below.

The availability of community Artificial Insemination technicians(CAIT) within the group has not only ensured timely services but also achieved high success rates of progenies through AI. It is one of the integral components in upholding dairy farming by promoting improved breeds. The number of improved breeds in the community has risen compared to the initial establishment. Consequently, with an increase in improved breeds in the locality, milk prodution has also increased, leading to enhanced income generation.

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Chain link Fence: Crop Security & Enhanced Crop Production

IFAD

Pema Wangchen, Agriculture Supervisor, Radhi Gewog

Human Wildlife Conflict (HWC) is a significant issue where wildlife and human populations share limited resources. Farmers across the nation suffer economic losses due to crop damage caused by wild animals, despite various interventions. Measures such as solar/electric fencing and scarecrows have been implemented but are often ineffective. Chain link fencing has proven to be a better safeguarding solution for wild animals. from crops

Nashoen Sanam In 2020. Phanglem Detshen at Zor under Radhi Gewog Trashigang installed 0.66 KM of chain link fencing with funding support from the Commercial Agriculture and Resilient Livelihood Enhancement Program (CARLEP). This fencing helped revive more than 4 acres of wetland that had been fallowed for over two decades. The youth arowing group focused on



high-demand vegetables and high-value crops, protected from animal infestation.

Nashoen Sanam Detshen produced over 4,000 kilograms of mixed vegetables, generating more than Nu. 215,000 in income. The table below shows the types and quantities of vegetables produced, along with the income generated:

The primary challenge with chain link fencing is the high of materials. making cost unaffordable for lowit households. This income could exacerbate income disparities among farmers.

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Given the significant impact of HWC on farmers' livelihoods, it is crucial for the government and donors to prioritize funding for chain link fencing. This measure could provide a more sustainable and effective solution for crop protection compared to other methods.

Farmers spend many nights guarding their crops from animal infestations. Although the region's climate is suitable for various crops, wild animals pose a major challenge in agriculture farming. Electric fencing has had limited success due to the degradation of wooden poles and high management costs. Chain link fencing offers a more durable

and effective solution, reducing the need for farmers to leave their fields fallow and increasing their agricultural productivity.





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SI No	Name of vegetable	Qty produce/sold (KG)	Income generated (Nu.)
1	Indian Chili (SHB4884)	914	91400
2	Tomato (PS 61)	27	1080
3	Dalle chili	91	18200
4	Garlic Leaves (Bundles)	114	1140
5	Cabbage (Green coronet)	636	12720
6	Pumpkin	50	500
7	Rajma Beans	314	20410
8	Coriander (Bundle)	56	560
9	Potato	751	20277
10	Cauliflower	269	13450
11	Broccoli	212	10600
12	Onion	225	15750
13	Mustard green	150	3750
14	Radish	115	2300
15	Beans	40	1600
16	Carrot	50	2000
	Total	4014	215737



Enhancing Agriculture Production Through Rain Water Harvesting Ponds in Yangnyer Gewog

Tashi Wangmo, Agriculture Extension Supervisor, Yangnyer Gewog



Introduction

In the eastern part of Bhutan, the impact of climate change is severe on the agriculture activities disrupting the natural water cycle. The rainfall fluctuation and variability are often one of the shocking weather phenomena and the shortage of irrigation water is one of the greatest challenges faced by the farmers. The farmers in the Leyphu village Yangnyer Gewog under actively engaged are into agriculture farming due to suitable agro-climatic zone for diverse crops. However, over the past decade years, they have been one of the victims of the climate change pattern. Leyphu farmers have been facing water shortages for years as the settlement had no sufficient water to meet for the intended purposes. The rainfall they received in the monsoon season are short duration and high intensity where as in the winter are of low intensity and During erratic distribution.

winter, their water supply becomes unpredictable due to sources drying up and while in heavy summer monsoon, rains frequently wash away the existing pipes leading to water shortages affecting their crops.

CARLEP intervention on Rain water harvesting pond technology

with the support from CARLEP, the implementation of rain water harvest pond initiated in 2022 has immensely benefitted those farmers in mitigating climate change impact and making irrigation water available for kitchen gardening.

Atrench measuring 36 m2 with a depth of 1 meter was dug by the beneficiaries to store rain water. A blue tarpaulin sheet is laid inside to prevent rain water from seeping in the ground, its kept open to collect and store rainwater during the rainy season. The implementation of this in-situ rain water harvest (RWH) pond can hold 17 to 40 cubic liter of water which will promote off-season vegetable cultivation ensuring sustainable agricultural practices. The farmers could move from subsistence level of farming to commercialization. It not only mitigated the adverse effects of droughts and water shortages but also brought the positive impacts in terms of production, generation, income area intensification and supported diverse farming activities. As a result, farmers could cultivate wider variety of crops at extended growing seasons increase and their overall agricultural output. By reserving rain water during the sporadic rainfall events has helped them in sustaining their crops and livestock throughout the season.

Identification of target beneficiaries and other benefits of RWH

The target beneficiaries were identified by the Dzongkhag Agriculture Sectort and Gewog Agriculture Extension in consultation with the chiwog Tshogpa based on the priority on low water availability under the normal condition (aridity) and those who are more engaged into farming. A total of 10 (6 Male, 4 Female) farmers were provided the materials support of tarpaulin plastic sheet in the fiscal year 2022-2023, while the



beneficiaries contribute labor.

Rain water harvesting not irrgating only served in agricultural crops but also serves as important water source for livestock drinking. Additionally, the construction and maintenance of these ponds often involve community participation, fostering а sense of ownership and cooperation among farmers.

Initial Cost analysis for the establishment of RWH

The beneficiaries reported that the initial establishment of pond was labor-intensive requiring nine workers each day. Each labor was paid Nu: 350 per day, and it took two days to complete the pit digging and pond construction. The total cost amounted to Nu: 11,700 which included food and other refreshments. Moreover, the pond was fenced to prevent accidental fall of children and livestock.

Comparison of Production and the Income status of the farmers before and after RWH

The farmers benefitted through

this approach grow a mixture of vegetables such as beans, round chillis. Indian chillis. asparagus, brinjal, Cole crops and wide variety of fruits such as citrus, avocado, mango, lemon and banana. In 2023-2024, the total production was 15.63 MT in 5.03 acre of land, from whic a total 12.08 MT marketed and total income generated was threefold with Nu: 2,07,945.00 from the vegetables excluding fruit crops in this season. The table on the top right shows how rainwater harvesting pond has contributed to agricultural sustainability, increasesed crop vields and income of the farmers.

Fiscal year	2022- 2023	2023- 2024
Household (Nos.)	10	10
Area (Acre)	3.06	5.03
Total production (MT)	5.84	15.63
Total marketed (MT)	3.48	12.08
Total income (Nu:)	62,195	2,07,945

Future intervention, assessment and supports

The beneficiaries reported that the requirement of good quality plastic sheet is significant for the future sustainability as it is one of the simplest ways to adopt to climate smart agriculture to improve their livelihood.

The judicious use of water resources is essential for sustainabiltv of agriculture farming. In the future, the amount of water utilization for various purposes such as irrigation, drinking, household and livestock farming use can be conducted for future documentation. Furthermore. the scientific assessment on the amount of rainfall volume collected over the specific period of time can be focused. The provision of HDPE pipe, sprinkler and automatic drip irrigstion sets would additionally enhancing benefit them in their agriculture productivity.

In summary, rainwater harvesting pond technology represents a vital innovation in the farmer's livelihood for the successful growth of agriculture and livestock farming. It offers practical and sustainable solution to water scarcity

providing issues numerous benefits in domestic and agriculture sectors. Although the initial setup cost can be little higher and laborious but the long-term water security and payback justify the investment. The leveraging of future research and development on rain water harvesting can play a critical role in achieving water accessiblity and sustainability. simple approach has This proved to be a worthwhile endeavor for the individual as well as in the community. Providing a dependable water supply and other advanced agricultural technology would enhance their livelihood and build more resilienence to agricultural systems.





Empowering Out-of-School Youth through Mushroom Entrepreneurship: A Strategy for Socioeconomic Support at Lhuentse

Tashi Wangdi¹ and Sonam Chophel²

Karma Wangdi, a 24-year-old from Berpa village in Khoma Gewoa under Lhuentse Dzongkhag, decided to stay back in his village after completing 12th drade in 2018 to care for his mother. Two years later, he explored various entrepreneurial ideas and decided to pursue oyster farming. With mushroom quidance from the Gewog agriculture extension office, he attended a week mushroom farming entrepreneurship conducted training bv Agriculture Research and Development Center ARDC Khangma (RDC) funded at CARLEP-IFAD. bv Before venturing into mushroom farming, faced Karma numerous challenges, including stigma, limited social land access, and a lack of technical knowledge. These issues highlighted a gap in accessible resources and support for young farmers in his region.

The objective of Karma's venture

was to establish a sustainable and profitable oyster mushroom farming business. The scope of this project included the cultivation of both ovster and shiitake mushrooms. Limitations included initial financial constraints. lack of reliable customers. and price competition from local imported mushrooms, and transportation and issues. inadequate infrastructure for maintaining optimal growing conditions.

Karma initiated his farming venture by inoculating 400 bags of oyster mushrooms. This process involved the of introduction mushroom sterilized bags spawn into containing a substrate suitable for mushroom growth. The bags were then sealed and incubated under controlled conditions to facilitate mycelium colonization.

Following his training, Karma received material support from the CARLEP project. This



support included essential infrastructure and equipment such as a 20x5m net house, a chaff cutter, smart irrigation facilities, spawn, and plastics. The CARLEP project funded these items on a cost-sharing basis, with Karma contributing 20% of the costs and CARLEP covering the remaining 80%.

The farming techniques employed by Karma included the use of smart irrigation facilities to ensure optimal moisture levels for mushroom growth.

Additionally, maintaining proper environmental conditions within the net house, such as temperature and humidity, was crucial for successful cultivation. Regular monitoring and adjustments were made to create an ideal growing environment for the mushrooms.

strategic diversification This allowed him to explore different market opportunities and maximize his yield potential. cultivating By multiple varieties. Karma mushroom aimed to sustainable income farming from his venture.

In the first year of the project, Karma could not make any profit and towards second year 2023 he up scaled inoculating 700 bags of oyster mushroom earning Nu. 40,000. Before starting his farm his annual income was only up to Nu. 20,000-30,000. By 2024, Karma had scaled up his operations, inoculating over 1012 bags of mushrooms. This expansion led to earnings surpassing Nu.100, 000/-. demonstrating substantial а growth in income potential.

		his succe	SS	
	Oyster cultivated/ bags	Shitake/log	Income generated/ annum in Nu.]
2022	90	500	NA]
2023	700	NA	40,000]
2024	1012	120	100,000 (On-going)]

Results/Findings

Karma Wangdi's project focused on cultivating both oyster and shiitake mushrooms in 2022. Karma faced unexpected challenges during the project implementation. These challenges included unreliable



customer bases, price competition, transportation issues, and the lack of a permanent mushroom shed. adversely These factors affected temperature control production efficiency, and highlighting the importance of addressing infrastructure market and access barriers for sustainable farming practices.

experience Karma's underscores the critical role of continuous support and training for young farmers. Similar ventures in different regions have shown that sustained assistance and exposure to successful farming practices significantly improve outcomes for novice farmers. This emphasizes the need for ongoing support programs and knowledge-sharing initiatives to foster innovation and success in agricultural entrepreneurship.

Limitation

Competition from cheaper

Indian mushroom products ability limited Karma's to establish his local mushroom brand. With a sparse local faced consumer base. he demand difficulty generating for his produce, impacting sales and profitability. The absence of an access road to Karma's farm

site hindered transportation of his mushroom products, increasing logistical challenges limiting scalability and

market reach also technical resources and equipment tools

Recommendation

and

challenges To address the faced in establishing his local mushroom brand. Karma Wangdi should focus on differentiation and branding strategies. emphasizing the superior quality and nutritional benefits of locally produced compared mushrooms to import one. Expanding market partnerships through reach with local businesses, online platforms, developing by



products like drying, pickling, and agricultural cooperatives can help overcome the sparse local consumer base, while advocating for infrastructure development for enhanced transportation will facilitate efficient product distribution and market scalability. Additionally, investing in essential technical and resources equipment tools, along with continuous and knowledge training optimize enhancement. will mushroom cultivation efficiency and productivity. Collaborating with other farmers and industry stakeholders for mutual support and networking opportunities will further contribute to the and long-term success sustainability of Karma's mushroom farming venture. Also, enhancing quality control monitoring, and accessing road to the project base can also help promoting his business.

Karma Wangdi's journey into oyster mushroom farming challenges showcases the and successes of rural entrepreneurship. Overcoming hurdles like initial social stigma and limited resources, Karma diversified his farming

to include oyster and shiitake significantly mushrooms. increasing his income. While support from the Gewog agriculture office and CARLEP project was instrumental. Karma faced obstacles such as competition from imported mushrooms and transportation issues due to the lack of access roads. To sustain and expand his venture, Karma must focus differentiation strategies. on development, infrastructure and continuous training. By leveraging partnerships and innovation, Karma can enhance the profitability and sustainability of his farming while contributing to local economic arowth.



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From Unemployed Graduate to Successful Nursery Owner: CARLEP's Matching Grant Fuels Success in Bhutan

Tshering Pem¹ and Tshering Yangchen²



Mr. Tshering Dorji, a 33-yearold Bachelors of Commerce graduate from Rangjung Trashigang, Bhutan, has "I was a young man with a

"I was a young man with a degree, yet I couldn't contribute to the household income. It was a difficult period," recalls Tshering.

experienced the challenges of unemployment first-hand. After brief stints in the private sector and participating in an "earn and learn" program in Japan, Tshering found degree, yet I couldn't contribute to the household income," he recalls. "It was a difficult period."

However, Tshering's journey took a positive turn when he learned about the CARLEP matching grant program through ARDC-Wengkhar. His long-held passion for agriculture was reignited. With the guidance of ARDC, he developed a proposal, leading to the establishment of Paksam Horticulture Nursery in 2021.

CARLEP Facilitates Tshering's Growth

The CARLEP program was

A Thriving Enterprise

Today, Tshering's nursery is thriving. He cultivates a wide variety of fruit tree seedlings, ranging from popular avocados and peaches to exotic kiwis and dragon fruits. The guaranteed market is a significant advantage, with local entities such as the district agriculture office, ARDC Wengkhar, the National Seed Centre, and

Year	Fruit tree	Rate	Quantity	Amount
2022	Avocado	150	958	143700
2023	Avocado	150	3842	576300
2024	Avocado	150	1520	228000
2024	Kiwifruit	150	200	30000
2024	Pear	100	70	7000
2024	Peach	100	30	3000
2024	Citrus	200	30	6000
	Total		6650	994000

Tshering, transformative for of initial covering half his investment through the Matching Grant Scheme, which enabled him to acquire essential equipment nurserv and materials. This crucial support, along with technical assistance from ARDC, empowered him to start his nursery successfully.

farmers across the eastern region eagerly purchasing his high-quality seedlings.

Until now, Tshering's income from the sales of the fruit seedlings has been remarkable: he has sold a total of 6,650 seedlings of avocado, kiwifruit, pear, peach and citruses worth Nu. 0.994 million. It was made possible from his collaboration Stories of Change



with CARLEP's Fruit Intensification Program and the Million Fruit Tree Project.

Embracing Modern T e c h n i q u e s

Tshering is not solely focused on profits; he is a strong advocate for modern farming practices. "The days of arduous labor are behind us," he says enthusiastically. "Protected drip agriculture, irrigation, sprinkler irrigationand advancements make these farming more manageable and efficient, especially for young entrepreneurs myself." like

A Vision of Opportunity

A lifelong learner, Tshering continuously seeks knowledge advance his to nurserv. transforming He envisions Paksam Horticulture Nursery into a "mega project," creating employment opportunities for other young people similar challenges. facing

Tshering's story highlights the impact of the CARLEP program. By supporting young agricultural entrepreneurs, CARLEP is not only nurturing a love for the land but also fostering a brighter future for Bhutan, one seedling and one empowered youth at a time.



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Samsara Mushroom Farm's Success: The Power of IoT-based Automation

Thinley Gyeltshen¹, Yeshi Lhadon², Tshering Pem³, Sonam Yangdon⁴, Dr. Tshering Penjor⁵, Dema Yangzom⁶, Tshering Dorji⁷, SONAM CHOPHEL⁸

Background

support With funding from Commercial Agriculture the Resilient Livelihood Program Enhancement (CARLEP), Mushroom the Program of Agriculture the Research and **Development** (ARDSC) Sub-Center Khangma, under the Agriculture **Research Development Center** (ARDC), is actively promoting youth engagement through enterprise development. This initiative is in partnership with Dzongkhag Agriculture Offices in the region. One notable beneficiary of the program is Mr. Sonam Gyeltshen, the owner of Samsara Mushroom Farm, located in Kalapang, Saling Geog, under Mongar Dzongkhag. After graduating from Higher Secondary School, he ventured into mushroom farming in 2017 using his funds. He is supported by his spouse and father-in-law.

With assistance from ARDC-Wengkhar, his farm has gradually strengthened bv exploring financial support from financial institutions, Non-Government Organizations CARLEP. (NGOs), and In additiontomushroomproduction support, he has also received equipment for mushroom spawn production to meet the demand from Mongar, Lhuntse, and Bumthang. He has further extended his spawn business to other dzongkhags (Figure 1). From the Mushroom Spawn

Particular	Before	After	Difference (%)
Quantity produced (Kg)	650	2980	358.5
Quantity sold (Kg)	600	2900	383.3
Income (Nu)	204000	986000	383.3
Net Profit (Nu)	149000	836000	461.1

Website: www.carlep.gov.bt





Unit, Mr. Sonam Gyeltshen has generated an income of Nu 0.52 million from supplying 6,470 bottles of spawn. Each bottle of spawn sells for Nu 80. He has generated the highest income from Lhuntse (Nu. 240.000). followed Mongar Samdrup and by Jongkhar Dzongkhags.

Integration of IoT-based

Automation in Mushroom Farm

Despite being well-trained in production and management practices for both mushroom spawn and production. Mr. Sonam Gyeltshen faced significant challenges in maintaining year-round mushroom production. These challenges were primarily due

Dzongkhag	Place	Participant (No)
Samdrup Jongkhar	Orong	6
Pemagatshel	Yurung Central School	36
Pemagatshel	Shumar	13
Trashigang	Draksho Vocational Training Institute	13
Mongar	Dzongkhag's ESPs and GSPs	42
	Total	110

to the intensive labor required for his regular farming activities and the lack of temperature and relative humidity regulation technologies during peak summer (May to July) and winter (Decemberto February) months. The absence of such facilities hindered his ability to meet local market demand effectively.

To address these issues, in 2023. the center supported him by integrating IoT-based automation into his farm on a cost-sharing basis. CARLEP covered 70% of the total cost. while the proponent contributed the remaining 30%. With the system, IoT-based he can remotely automate the optimum room temperature and relative humidity using an open-source third-party application called eWeLink. These facilities significantly have helped achieving year-round in production mushroom and improving the success rate.

The results have been impressive, with both production and net profit from the farm increasing drastically by 358.5% and 461.1%, respectively (Table 1). The market value of his product is Nu 340/kg.

automating Additionally, the farm has not only reduced the labor demands associated with his regular farming activities but also enabled him to assist the Mushroom Program of ARDSC-Khangma. He provides training on mushroom production and management practices to groups, schools, and institutions mushroom enhance to production in the region. So far, he has trained 110 participants organizations. from various Details of his technical support are provided in the Table.



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Advancing Walnut Propagation with Hot Callusing Technology: A promising Enterprise

Pema Yangdon¹, Tshewang Dorji², Tshering Pem³, Dr. Tshering Penjor⁴, Lungki⁵, Mandira Acharya⁶, Dema Yangzom⁷



Walnut is one of the highvalue commodities in Bhutan. nationwide promoted under Project Million Fruit Trees (MFTP). In 2024 alone, 33,819 seedlings walnut were distributed across the country as part of the MFTP's

third phase. Remarkably, 91% of these seedlings were imported from neighboring countries, highlighting a strong domestic demand for walnut seedlings. With the MFTP project expected to continue for another two years, there is

CARLEP-IFAD

considerable potential for local walnut seedling production. However, nursery growers face a significant challenge: the low success rate of walnut grafting.

Unlike other fruits, walnuts require precise conditions, an optimum temperature of 27°C

and relative humidity of 80-90% at the graft union for successful grafting. Maintaining these conditions during the grafting season in February March and challenging is open fields. in

Hot callusing technology offers an innovative solution to this problem by heating the graft union area to speed up callus formation while leaving the rest of the plant In 2023. ARDC unheated. Wengkhar initiated a trial using this technology with locally available materials. funded by the Global Environment Facility (GEF). Conducted within a 4 x 4.5 m structure, the trial achieved an impressive 80 % graft success rate

Building on this success, the first model hot callusing walnut nursery was established at Sangay Thinley's farm, a private nursery operator in Bumpazor village, Drepong Gewog, M o n g a r

Dzongkhag, in 2024. Supported b V CARLEP funding, this initiative involved setting up a 5 x 10 m greenhouse capable of

accommodating 1,170 walnut seedlings, with materials costing Nu 0.214 million. CARLEP covered 80% of the cost, while Sangay Thinley contributed the remaining 20%. In February, walnut seedlings were grafted and placed in PVC pipes with multiple openings to heat the graft union and accelerate callus formation.



The utilizes system automated temperature and humidity sensors to maintain optimal conditions at the graft union for four weeks. monitoring with remote capabilities through IoT. reducing labor and time requirements. This innovative approach led to a 76% graft success rate, with 889 out of 1,170 seedlings successfully grafted at Drepong. Currently, the farm gate price of walnut seedlings is Nu. 175 per seedling, while the market price stands at Nu. 205 per seedling. With a 76% graft success rate, Sangay Thinley is projected to earn Nu 0.156 million from the sale of walnut seedlings in the coming year.

This technology marks а significant breakthrough in walnut cultivation, addressing historically the low graft success rates and meeting the high demand for seedlings. Plans are underway to extend technology to this more nursery growers supported by CARLEP in the previous year, aiming to meet the walnut seedling demand not only in the region but also nationwide.

This success story exemplifies how innovation and strategic investment can overcome challenges and create new opportunities in agriculture.



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Irrigation Renovation Brings Relief to Paddy Farmers in Lem Village under Phongmey

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Farmers in Phongmey rely on agriculture for their sustenance, cultivating a variety of crops such as cereals, vegetables, and fruits. The main focus is on growing rice for personal consumption, with surplus crops being sold at local markets. The community practices traditional farming methods, utilizing tools like spades and locally sourced equipment for cultivation. while oxen commonly are used for plowing the fields.

Lem Chiwog is situated between the untamed Yuderi and Dungjuri streams, which have caused significant landslides along the edges of Lem and Gazari valley, leading to disruptions in the earthen irrigation channel line that was established by the community in the 1990s. Adjacent to the renowned "rice bowl of the east," the residents of Lem, Karmagonpa, and Gazari collectively have 85 households and 135 acres of paddy fields. The farmers in this area practice diversified agriculture, cultivating various cereals, fruit crops, vegetables, and engaging in livestock farming to sustain their livelihoods. Despite their involvement in various agricultural activities, paddy remains the primary crop grown for home consumption, a tradition passed down through generations. Recognizing the challenges posed by irrigation water. limited the Agriculture Commercial



and Resilient Livelihoods Enhancement Programme (CARLEP) provided support to the farming community in the fiscal year 2020-2021 by renovating the irrigation channel from Tselamtse to Shontsham in Lem Chiwog.

Identification of beneficiaries and target

CARLEP's intervention in renovating the "Tselamtse to Shontsham" irrigation channel, which spans 1.2 Km, has brought about significant changes in the cultivation practices of the local farmers. Previously, they only cultivated in 80 acres of paddy field. However, due to various challenges such as shortage of irrigation water, human-wildlife conflict, and labor shortage, 30% of the paddy field remained fallow. The farming community consists of 85 households. female-headed with 35 households and 50 maleheaded households benefiting from the intervention. In the absence of adequate irrigation water, those who grew paddy had to rely on rainwater to supplement the water supply in their fields. Unfortunately, when rainfall was insufficient. farmers faced extreme shortages of irrigation water, resulting in poor paddy yields. The intervention by CARLEP has addressed these challenges and provided a solution to the irrigation water scarcity issue, thereby improving the overall productivity of the paddy fields.

During the fiscal year 2020-2021, CARLEP provided financial assistance amounting to Nu. 3.141 million for the renovation of 1.2 kilometers of the Tselamtse to Shontsham irrigation channel.

Cultivation and production before and after intervention

Following the renovation of the irrigation channel, there was a noticeable shift in the agricultural landscape. Initially, farmers had left 30% of the paddy fields fallow due to various reasons, with irrigation shortages being a primary factor. However, intervention after from CARLEP, 85 households were able to cultivate 115 acres of paddy fields, an increase of 35 acres compared to 2021. The remaining fallow land post-renovation can be attributed to other factors such

as human-wildlife conflicts shortages. The and labor refurbishment of the Tselamtse to Shontsham irrigation channel only improved paddy not cultivation and production in Lem Chiwog, but it also encouraged farmers to engage in winter cropping and cultivate cash crops such as cardamom

In 2021, prior to the renovation irrigation of the channel supported by the Commercial Agriculture and Resilient Livelihoods Enhancement Programme (CARLEP-IFAD), paddy production per acre stood at 1777.60 MT (Crop-cut 2021-2022). The total paddy production in Lem Chiwog



for income generation. Some farmers even began cultivating in the paddy wheat fields effectively during winter. utilizing the otherwise unused renovation land. This also advantageous for proved irrigating cardamom, leading to an increase in the number of farmers planting cardamom in the fallow (drv) land.

was 142.2 MT from 80 acres of paddy field. Subsequently, following the introduction of adequate irrigation

water in the area. paddy production per acre increased MT (Crop-cut 1802.21 to 2022-2023), resulting in а production total paddy of 207.25 MT from 115 acres of paddy field in Lem Chiwog.

Income generation

Farmers were able to sell a specific amount of rice as the

Year	Сгор Туре	Quantity (Kg)	Rate/Kg	Amount (Nu.)
2019	Paddy	2205	75	165375
2020	Paddy	2120	80	169600
2021	Paddy	2350	80	188000
2022	Paddy	4770	100	477000

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production increased through the expansion of cultivated areas on fallow land and the availability of sufficient irrigation water. They transported the rice to both the local market and district market in Trashigang. In the previous year, farmers used to sell rice in small quantities, but with the introduction of adequate irrigation water. they were able to sell more than 50% compared to the previous year. Yearly income generated from sale of rice is shown in the table below.

In the Chiwog, various other crops experienced cash significant improvement due to the availability of ample irrigation water. Cardamom. particular, stood in out prominent а produce. as yielding higher quantities as cultivation expanded and sufficient water was made accessible irrigation. for

The farmers in Lem, Gazari, and Karmagonpa were experiencing a significant lack of irrigation water for their seasonal paddy cultivation. As a result, a majority of the paddy fields were left uncultivated due to insufficient access to irrigation water. These farmers had to rely on rainfall for their paddy cultivation, further exacerbating irrigation shortage the of water. Additionally, they faced challenges such as conflicts with wildlife and a shortage of labor, which led to 30% of the paddy fields being left fallow. However, the main reason for the fallow land and poor paddy yield was the inadequate supply of irrigation water.

CARLEP's involvement in the restoration of the "Tselamtse to Shontsham" irrigation channel. which covers а distance of 1.2 kilometers, has had a profound impact on the agricultural community in the area. This initiative has resulted in the expansion of the paddy cultivation area by reclaiming unused land for cultivation purposes. Additionally, there has been a notable increase in the yield of paddy per acre, leading to a significant boost in income generation through the sale of rice and other profitable crops.

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Enhancing Dairy Production through Breed Intensification Program

Regional Livestock Development Center, Kanglung



Introduction

Regional Livestock The Development Centre (RLDC) Kanglung has in been instrumental in advancing one of the Department of Livestock's goals of breed intensification aiming to enhance the dairy production and improve the livelihoods of dairy farmers in the eastern Bhutan. This has been achieved with substantial support from Commercial Resilient Agriculture and Livelihoods Enhancement Programme (CARLEP). A major achievement has been the establishment of a state-of-theart Liquid Nitrogen (LN2) plant in addition to the existing one and with larger capacity of more than 10 liters of LN2 production in an hour. This plays a critical role in ensuring a reliable supply of LN2 to AI centers across the region, enabling the successful implementation of AI services, which are central to breed intensification efforts.

Additionally, CARLEP project has also supported in procurement of high-quality sex-sorted Jersey semen which significantly increased the

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number of female calves born. directly contributing to higher dairy productivity. Furthermore, RLDC with the support from CARLEP has been proactive in building local capacity by training Community Artificial Insemination **Technicians** (CAIT). These technicians. with specialized equipped pivotal skills. have been effective AI delivering in services to the communities

Establishment of the Liquid Nitrogen Plant

One of the most significant achievements is the installation of a new and larger capacity Liquid Nitrogen (LN2) plant in Eastern Bhutan. The plant, capable of producing more than 10 liters of LN2 per hour, was established at a cost of Nu 11.71 million. This facility plays a critical role in the storage and transportation of bovine semen used for artificial insemination (AI), a key component of the



breed intensification program. Since inception in 2023, the



LN2 plant produced and distributed a total of 18,672 liters of liquid nitrogen across six Dzongkhags in Eastern Bhutan.

In addition to serving the Dzongkhags, the National Dairy Development Centre (NDDC) in Yusipang in Thimphu also received 1,315 liters of LN2. The availability of LN2 has ensured that AI centers in the region are well-equipped to perform their functions, thereby improving the success rates of AI and contributing to the overall goal of breed intensification.

Procurement and Distribution of Sex-Sorted Semen

Another critical intervention is the support for the sex-sorted Jersey semen, which has been instrumental in ensurina а higher yield of female calves. Since its inception, CARLEP has allocated Nu 12.82 million and procured 8151 doses of the specialized semen, which is then distributed to AI centers across the region. The availability of sex-sorted semen has significantly benefited farmers, as female calves are more desirable for dairy production. The strategic distribution of sexsorted semen has enhanced the breed intensification program, leading to an increase in the number of high-quality female calves, which are crucial for expanding sustaining and dairy production in the region.





Community Artificial Insemination Technicians

In addition to providing the necessary infrastructure and resources. CARLEP also supported on capacity development through the training of Community Artificial Technicians Insemination (CAIT). These technicians play a vital role in the successful implementation of the Al program by providing services directly to farmers. A total of 4 batches of CAIT training has been conducted and 78 number of individuals has been trained of which 43 is still functional and providing active services. Furthermore, the CAIT program provided employment has opportunities for community members, with each technician earning between Nu 300 and Nu 500 per service, translating to a monthly income of Nu 13000 to Nu 15.000. This not only supports the technicians' livelihoods but also contributes to the sustainability of the Al program by incentivizing quality service delivery.

Impact on Dairy Production and Breed Intensification

The efforts in establishing the LN2 plant, distributing sexsorted semen, and training CAITs have significantly intensified dairy production in the region. The program has enabled farmers to access highquality semen and AI services, leading to the birth of genetically superior cattle that are more productive in terms of milk yield. Additionally, the success of the CAIT program has ensured effective AI services expanding the reach and impact of the breed intensification program.

The CARLEP project has played a crucial role in enhancing dairy production in Eastern Bhutan through its focus on breed intensification. By establishing the LN2 plant, procuring and distributing sex-sorted semen, and training CAITs, CARLEP has created a robust infrastructure that supports sustainable dairy farming practices. The project's efforts have not only improved the quality of livestock in the region but have also provided economic opportunities for community members involved in the AI program.

Office of the Programme Management

Commercial Agriculture & Resilient Livelihoods Enhancement Programme (CARLEP)

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