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SANAM DRUPDREY

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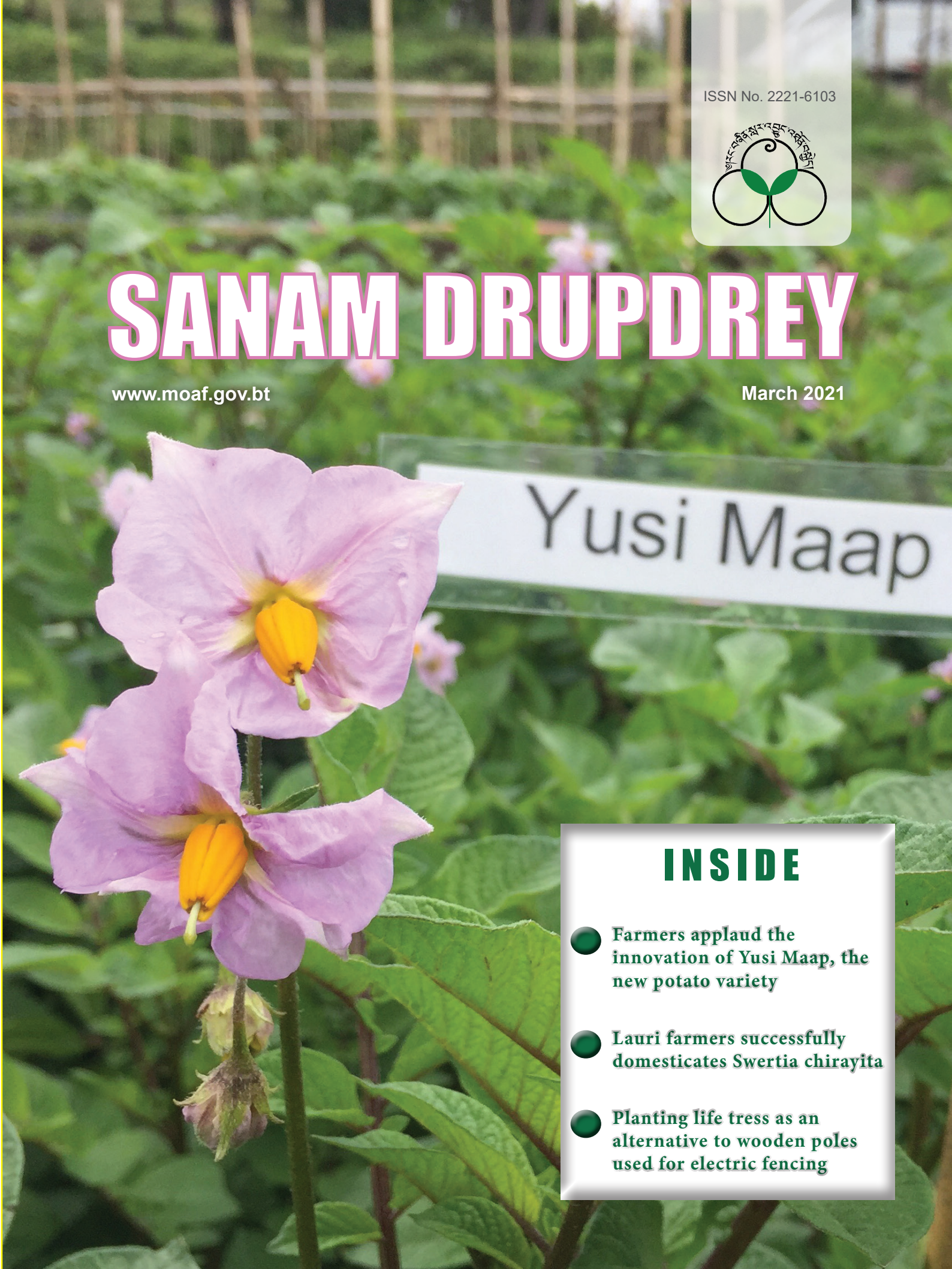

INSIDE

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FOREWORD

Dear colleagues,

I am delighted to present you the 11th edition of Sanam Drupdrey or the RNR Magazine that reaches out to people from all walks of life sharing some inspiring glimpses from the Renewable Natural Resources (RNR) sector.

The magazine features a wide range of success stories related to the RNR technology, diversification, value chain, integrated approach and alternative option that will help farmers to have better opportunities in farming.

Some of the promising stories include the release of hybrid maize and potato varieties and the technologies for curing onion, tomatoes, heifer production and reviving drying springs.

The other interesting stories are about the first organic farm, Lauri farmers, integrated farm, urban dwellers and livelihoods. Some new flora and fauna species were also discovered last year and they are worth reading in this exciting issue.

With hard work and dedication, our colleagues have been able to innovate several technologies over the years from electric fencing to smart irrigation to new crop varieties. This has today, empowered our farmers to grow a diversified food basket significantly contributing to achieving the national goal of food self-sufficiency and import substitution as well as to their livelihood enhancement.

As I look back at the year 2020, I see the past year has been challenging for the country due to the COVID19 pandemic situation. The Ministry of Agriculture and Forests faced more challenges in managing the food supply chain with all the movement restrictions.

Good side is, with the closure of border gates with India and interruption in the import of food items, the pandemic pushed the RNR sector to focus more on agriculture production and move a step closer to achieving food self-sufficiency in the country.

When the first national lockdown was announced in August 2020, many people were forced to reconsider their priorities for livelihoods.

The pandemic encouraged many of them including educated youths to take up farming as a viable source of income. On the other hand, farmers took this situation as an opportunity to boost their agriculture production and help the country in reducing imports.

Besides the measures such as reviving the fallow lands for cultivation and others, the Ministry kick-started the urban farming program particularly to support those laid-off workers in producing their own food as well as meet their regular expenditures from the surplus production.

Although challenging, the pandemic came as a 'Blessing

in Disguise' for the RNR sector triggering increased agricultural activities with larger opportunities and motivating farmers to do their best. The COVID19 reminded us that we need to be 'Self-sufficient' for survival particularly in difficult times. With pandemic, the Ministry was able to make good achievements in the agriculture, livestock and forestry areas.

While shifting the overall agriculture development from subsistence to growth-oriented farming in the 12th five-year plan, the Ministry is concentrated to change towards maximising the growth in domestic production and increase marketing opportunities with agricultural value chain enterprises.

The latest statistics show that the RNR sector contributed 17.37% of GDP of the country (Nu.28,591.14 M) which is accounted by crops, livestock and forestry and logging sectors as 10.64, 4.92 and 2.44% respectively. The RNR sector growth rate stands at 3.39% and is expected to be increased in the coming years. With agriculture farming picking up in the country, the production has also steadily increased substituting the imports to a huge extent. We are now focusing on diversifying the products through value addition so that there is a wider market for Bhutanese products.

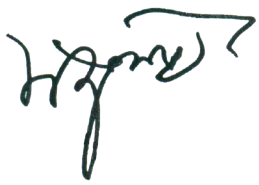
Our youths are showing keen interest in the value addition enterprises and they are being educated on the advantage of farming and the new technologies in the sector. The launch of the e-RNR Crop Advisory, a mobile app that disseminates information on growing crops is further expected to play an important role in helping our youths take up farming for their livelihoods.

With this, let me take this opportunity to offer my sincere appreciation to all the colleagues for your valuable contributions in making the sector a most promising sector during the pandemic situation.

I also would like to congratulate all the contributors for bringing up these success stories and sharing them with our audience. I hope this Sanam Drupdrey continues to inspire our people to understand that farming can offer attractive livelihood opportunities as well as health benefits.

I wish you all a very happy and prosperous **Female Iron Ox Year** ahead.

Tashi Delek!



Yeshey Penjor
Minister
Ministry of Agriculture and Forests

EDITORIAL ICTD

Information and Communication Division (ICTD) is pleased to bring yet another exciting issue of Sanam Drupdrey, the 11th edition this year. Over the years, the magazine has been successful in creating awareness and disseminating the new development taking place in the RNR sector to a wider audience.

The Ministry of Agriculture and Forests' in the 12th five-year plan focuses on increasing food self-sufficiency, developing commercialisation and enterprises and maintaining environmental sustainability. In line to the objectives, the magazine shares various success stories including the RNR technologies innovated to enhance livelihoods of our rural communities.

This issue shares with you all a new eco-friendly technology for onions which is designed by the National Post-Harvest Centre. The post-harvest challenge is a major concern for farmers. This onion technology is expected to help our farmers in reducing the post-harvest losses by storing onions up to six months. The rain-shelter technology is another promising and affordable innovation from the National Centre for Organic Agriculture for growing quality tomatoes. There is a story how Lauri farmers are benefited by domesticating the Swertia Chirayita, the popular medicinal herb native to Lauri in Bhutan. Sixty-eight farmers are cultivating the herb today earning a good income.

The magazine also tells you how the first organic certified farm in Paro with three organic-certified products: asparagus, rice and apple has been successful despite many challenges in the owner's journey.

The initiatives put in place to revive the drying springs in the country is another informative story the magazine features. The record shows that more than 147 water sources in Bhutan have dried up and it is crucial to explore the measures for revival and save our water sources.

Another initiative of planting life trees as an alternative to wooden poles used for electric fencing is a strategic approach to help reduce forest degradation in the long run.

We also bring you an inspiring story of a farmer living his dream of farming and gradually planning to uplift his subsistence farm into a model farm stay. The successful stories on livelihoods through integrated approach, commericialisation, dairy value chain, community forestry and poultry are also featured which makes us believe that farming is challenging but worth taking up for livelihoods.

Some of the new flora and fauna discoveries that Bhutan achieved in 2020 are the highlights of the magazine. All these and more you can read in depth in this edition of Sanam Drupdrey.

ICTD hopes that these articles would inspire and motivate our readers in taking up farming and contribute to the national goal of achieving food self-sufficiency in their own little way.

With this, ICTD would like to extend our sincere acknowledgement to all the authors without whose contributions this publication would not have come through.

We wish you all a **Happy Reading.**

Contents

Rain Shelter

A low-cost technology to produce high-quality tomatoes

Tashi Lhamo, Tashi Gyalmo and Thinley Pem, NCOA-Yusipang

Many people believed that good quality tomatoes can only be produced in a conventional plastic greenhouse. The National Centre for Organic Agriculture (NCOA) in Yusipang has adapted and demonstrated that a very simple rain shelter can also be used to produce high-quality tomatoes.

In 2019, the vegetable researchers at the centre designed and evaluated two types of simple low-cost rain shelters with dome-shaped and sloped roofs using bamboo and polythene sheets for successful tomato production at Yusipang located at an altitude of 2600 masl.

Three critical factors that hamper the production of high-quality tomatoes are heavy rainfall, warm temperature and high incidence of tomato blight disease particularly in summer. The heavy rainfall and warm temperature make it conducive for the incidence of late blight disease which causes the rotting of leaves and fruits. It is therefore very important to avoid the direct exposure of tomato plants to rain. The simple rain shelters of different shapes have been proven to be very effective to reduce the incidence of late blight allowing the production of high-quality tomatoes.

The rain shelter generally consists of a frame covered with polyethylene plastic on

the top with sides and ends open for air circulation and the entrance of light which are critical for photosynthesis. The most commonly used materials to make the rain shelter frames are ordinary wood and bamboo.

The rain shelter with the dome-shaped roof was 16 m long and 1.5 m wide with a growing area of 24 m^2 with an expenditure of Nu.2305. Before covering the roof with plastic, 16 x 1.5 m planting raised bed was prepared and covered with black mulching plastic. It accommodated 64 plants which were planted at a plant to plant and row to row distance of 0.50 m. Under this shelter, the open-pollinated tomato lines received from the Asian Food and Agriculture Cooperation Initiative were planted. A total of six harvests were done with a total yield of 72.53 kg at an estimation of 12224 kg/acre.

The size of the shelter with the sloped roof was slightly bigger with an expenditure of Nu.3555. The support in the front side was 2 m tall while the back support was 1.5 m tall to create the slope for the rainwater. It was 26 m long and 1.5 m wide with a planting area of 39 m^2. Before the installation of the plastic roof, the planting raised bed was prepared and covered with black mulching plastic. It accommodated 153

plants which were planted at a plant to plant and row to row distance of 0.50 m. A total of 13 harvests were done with a total yield of 198.62 kgs at an estimation of 20371 kg/acre. The tomato variety planted in this case was a cosmic hybrid from Japan. The higher production in the sloped roof type rain shelter is attributed to the variety and larger planting area.

It is apparent that very high-quality tomatoes can be produced using simple rain protective structures. These structures were found to be very effective to protect the plants against rain and temperature which are the key factors that induce tomato blight.

This technology has proven to be efficient, beneficial and cheap which can be easily adopted by farmers. It does not require any special technical expertise and can be prepared with locally available materials. Further, as the production environment can be easily controlled and managed, it is very suitable for organic production.

In order to create awareness about the technology, the centre demonstrated it in five gewogs in Chukha for winter tomato production. In September 2020, two rain shelters each in Bongo, Darla, Dungna, Logchina and Phuentsholing were constructed. During the demonstration, a total of 80 farmers were trained on the construction of rain shelter and management practices of tomato production. The centre also supported the farmers with plastic sheets, mulching plastics and tomato seedlings.

The technology will also be promoted in Paro, Thimphu and Haa for the rainy season. Besides training on the various aspects of growing tomatoes under the rain shelters, the centre will support interested farmers with seeds and plastic sheets.

Lauri farmers successfully domesticates Swertia chirayita

About 68 farmers cultivate chirayita earning a good income

Jimba Rabgyal and Karma Pelden, NCOA-Yusipang

Swertia chirayita, a popular medicinal herb is a native species in Bhutan to Lauri gewog in Samdrup Jongkhar. It has been one of the main income sources of livelihood for Lauri community where the farming system also includes cereals and some vegetables as a source of food and nutritional security.

Chirayita was found to be growing abundantly in open ground and slashed and burned forests. However, the availability of chirayita was seen declining over the years due to unsustainable collection such as uprooting the entire plant before seed set and climate change. This has imposed a great threat not only to the community's livelihood but also to the critically endangered species. Considering the issue, the National Centre for Organic Agriculture (NCOA) in Yusipang, Agriculture Research and Development Centre in Wengkhar and the National Biodiversity Centre (NBC) in Serbithang initiated a project to domesticate chirayita in 2015 with funds from Chanel Parfums Beaute, a French pharmaceutical company.

The project was implemented after a feasibility study and several rounds of consultations with the Lauri community, government officials and the local government. At first, the people of Lauri were not convinced about the possibility of domesticating chirayita. Today, the concerted efforts by the research team not only successfully domesticated chirayita but also proved it as a profitable agriculture business and livelihood option for Lauri people. The team also published the package of practices for chirayita in 2019 as a reference for farmers and interested entrepreneurs. Farmers are advised not to mix the cultivated chirayita and other chirayita species harvested from the wild.

Today, about 68 farmers of Lauri cultivates chirayita earning an average annual income of Nu.22,256.67.



In 2019, the community produced a total of 2428 kgs of chirayita earning an income of Nu.1.3 M.

The dry yield of chirayita ranges from 269.80 to 377.72 kgs/acre depending on the management practices. The total production cost and the net benefit from one acre of land come to Nu.11,0752.80 and Nu.64,697.20 per acre with the total production cost of Nu.202.81/kg.

Chirayita takes three years to reach maturity and the harvesting stages. The seeds are sown in February and March and transplanted in July-August. For the next two years, the crop remains in the rosette stage.

It is only in the third year where the shoots come out, flowers and reach maturity. The proper care must be taken such as regular weeding, manuring and watering throughout the growing period for productive and healthy crops.

The Bhutanese chirayita is exported to France facilitated by NBC as per the memorandum of understanding between the importing French company and the Ministry of Agriculture and Forests.

The company pays Nu.550/ kg to the farmers. Since the project initiation, the group has exported around 3261.25 kgs of Swertia chirayita to France between 2016-2019. In the past, farmers used to sell them at the auction yard at Samdrup Jongkhar where the offered auction price used to be less with just a few bidders.

Although the chirayita is used in many traditional medicine systems globally, there are no potential market opportunities in the country except for few kgs in the Menjong Sorig Pharmaceutical Corporation Limited.

According to group members, the marketing issue is one of the major concerns for them. The annual demand for chirayita from the French company is only about 2000 kgs but the production surpasses the demand. They produced almost 3 tonnes in 2020 and if the Chanel Parfums Beaute takes only 2000 kg, there will be no market for the surplus production.

Other challenges include the lack of drying shades, warehouses and post-harvest technologies. The management of tiny seeds during the initial stage and damages by natural disasters and animals without proper fencing are other pertinent issues in chirayita cultivation.

The members feel that the government's support in these areas would be crucial in solving the issues. If such supports are provided, farmers are confident to continue the cultivation of chirayita for diversification. They are also planning to form an association and lease public land to start a model community chirayita farm.

Nevertheless, the group shared that the domestication of chirayita has immensely benefited Lauri farmers enhancing their financial strength to meet the households and educational expenses.

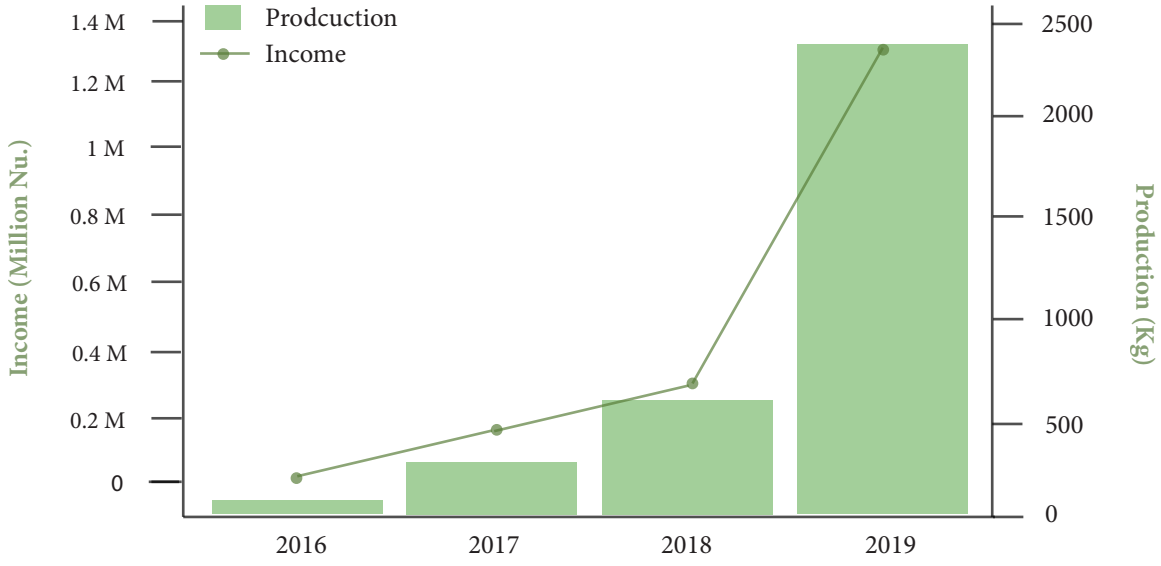
Some farmers even bought jersey cows from their hard work. With the COVID19 pandemic situation, farmers are worried whether the export will be possible, if not they are likely to face issues with no post-harvest facilities in place.

Chirayita is valued for amarogentin, the most bitter compound extracted to date. The whole plant or its extracts are used in both traditional and modern medicines to treat a wide range of ailments including chronic fever, malaria, asthma, liver disorders, hepatitis, gastritis, constipation, skin diseases, worms, epilepsy, ulcers, hypertension, blood purification and diabetes.

The plant is also being considered a potential species for the development of skincare products. According to the International Union for Conservation of Nature, chirayita is categorised as the critically endangered tri-annual medicinal plant, native to the temperate Himalayan region.

It is usually found to be growing at an altitude range of 1900 to 3000 masl. There are more than 100 species of the plant genus Swertia. Other species can be found in between 1200-3000 masl in the country. In Bhutan, chirayita is known as Jatig in sowa rigpa and Khalu in tshangla.

Production and income trend of cultivated chirayita in Lauri gewog



First Organic Certified Farm in Paro

The farm has three organic-certified products

Dawa Dem, NCOA-Yusipang

Kinley Wangmo of Chimakha village in Luni gewog, Paro is a proud farmer as she is the first farmer to have an organic certified farm in the Dzongkhag. Her seven acres family farm including both wetland and dryland was certified by the National Centre for Organic Agriculture (NCOA) in Yusipang.

The farm was certified under the local organic assurance system, an organic certification system for the domestic market based on the Bhutan Organic Guarantee System. With the certification in hand, she proudly uses the Bhutan Organic Mark on her products to market them as certified organic products. Her three organic certified products are asparagus, rice and apple.

Kinley's farm is located about 3 km away from the Bondey town and is situated on a pristine hilltop overlooking the beautiful Paro valley. She ventured into organic farming way back in 2005. "My parents practiced natural farming where they would not use any weedicides or other pesticide for pest management," recalls Kinley who is in her late forties. With the advent of modern farming technologies, the use of weedicides and pesticides to control weeds, insects and diseases in crops like rice and apple became common.

After attending training and awareness on organic farming organised by the National Organic Program (NOP), her mindset on conventional farming changed. Being a Buddhist with her strong belief to live in harmony with nature and care for all sentient beings, Kinley convinced her family to shift towards organic farming in 2005. "My initial endeavour in organic farming was challenging as

the crop productivity reduced drastically, farm labour requirement increased and it was difficult to manage pests and diseases," says Kinley. "My family members would compare our production with that of our neighbours and curse my decision to embrace organic farming."

However, the initial low yield did not deter Kinley and she wriggled her way forward with organic farming. She consulted NOP and got better advice and support for making compost, pest and other organic management practices such as crop rotation, intercropping and trap cropping. It is now almost 15 years that she has been practicing organic farming. She has completely stopped using chemical fertilisers and pesticides on her farm. She is convinced that the production on her farm has stabilised. She said that on the advice of NOP, she registered as an organic farmer with NCOA in 2019 and got the certification. Besides the three organic commodities, she grows many different temperate fruits, vegetables and cereal crops which are integrated with cattle and backyard poultry.

Surrounding her farmhouse, she has different fruit trees like apple, pear, peach, persimmon and walnut. She cultivates cabbage, cauliflower and tomato inside the greenhouse whereas asparagus, brinjal, chilli, coriander, potato, zucchini, pumpkin, radish, peas and carrot are grown in the open field.

She says managing soil fertility is one of the key components for successful organic farming. She manages soil fertility by applying leaf mould collected from the forest, farmyard and poultry manures produced in her farm. She owns nine cows and eight chickens which gives enough manure to fertilise her farm.

She also cultivates paddy in one acre of land which is enough to meet her family's needs and even sells the surplus as organic rice. She manages weeds through improved inter-cultural operations like mulching, pests and diseases by following crop rotation and through the physical removal of infected and infested plant parts which she finds quite effective. "Diversity is one of the strong components in organic farming" believes Kinley and her message to an organic farmer are to have a diverse and integrated organic farm.

The produce from her farm is sold at the Centenary Farmers' Market in Thimphu and sometimes some buyers also visit her farm to buy. She earns about Nu.100000 annually. Kinley is looking forward to certifying more products in the future. Her message to Bhutanese farmers is, "Have patience and practice organic farming which is a sustainable practice and caring for all sentient beings."

New technology for onion curing and storage in place

It can reduce post-harvest losses and store onions for 5-6 months

Pema Chophel, National Post Harvest Sub-Centre, Dagapela
Sonam Lhundub, Manoj Sanyasi and Kelzang Dorji
National Post Harvest Sub-Centre, Shumar

Onion cultivation is picking up in the country with a rise in demand. With the COVID19 pandemic situation restricting the onion import, the price is skyrocketing and it is becoming dearer for consumers. Many farmers considered this as a good opportunity and have started taking up onion cultivation, some are going for commercial production. Farmers need to cure and store the onions properly for a longer period to ensure the regular supply in the market.

The post-harvest process has been a major challenge for many vegetable farmers due to the lack of storage facilities. But not anymore, particularly for the onion growers. The National Post Harvest Centre in Paro has designed a curing and storage structure for onions to help store them properly for a longer duration. It is a cost-efficient technology, environment friendly and easy to construct that can help farmers store onions for five to six months. It was introduced in 2016.

After harvesting onion, farmers are challenged with post-harvest losses such as infection of onion bulbs by Aspergillus niger, sprouting and other infections. These issues have led to a reduction in the shelf-life of onion to a large extent destroying the hard work put in by farmers.

To determine the efficiency of the new technology, a trial was conducted in Dagana at two sites including Khagochen in Kana gewog and lower Gangzur in Tsendagang gewog. The sites were chosen as there was good onion production in the identified villages. The storage structure was constructed in 2016 and the efficiency test was done in 2019.

To monitor and evaluate the effectiveness of the structure, the freshly harvested onions which are full of sugary juices and coated only with a light skin cover were stored with proper post-harvest handling and the data was recorded for analysis.

The parametres used to study the efficiency included a total weight loss of onion, number of damaged bulbs during storage, store temperature range, bulb hardness and the number of sprouted onions when stored for certain months. The data collection was done monthly to see the changes in the sample taken. The data showed that there was a decrease in the weight of onions due to the gradual conversion of outer skin into papery wrappers. The recorded temperature for the store ranged between 20°-30°C with proper ventilation.

The bulb hardness was found to decrease gradually when it was stored for several months. A few numbers of sprouted onions were also found increasing with storage duration and it increased exponentially after the sixth months of the storage period. Despite having minor losses like weight and sprouting, beneficiaries were satisfied with the performance of the technology as it was effective in reducing the post-harvest losses. They were able to store the onions for up to 6 months with minimal deterioration.

The trial was also conducted in Zhemgang at Berti in Trong gewog in 2016. With the success of the trial, about 43 numbers of structures were disseminated across the county to date.

In 2019, a studywas conducted at the National Post Harvest Sub-Centre in Dagapela and Shumar to determine the efficiency of the structure.

The studies also proved the advantages of technology in managing the onions smoothly for six months.

The recommended storage structure can cure 1.5 MT and store 3 MT, the size of the structure can be altered according to the requirement. It is built using locally available materials like bamboo, cane and timber. The base of the structure is lifted with a vertical post of 1 m above the ground to enhance proper aeration/air circulation from the base of the structure which is lined with cane or bamboo.

The wire mesh of 55 mm*25 mm (3 mm gauge) is used for covering the structure which will help in proper air circulation and restrict the entry of larger pests.

The structure also includes a walking space for workers to work with ease while the onions are being cured and stored. It should be built in a windy and sun-facing area for better aeration. The cost of the structure designed by the centre is around Nu.40,000-45,000 which takes about a week to complete.

However, the cost will vary as per the size of one's requirement. Besides onion, other seasonal fruits and vegetables such as garlic and potato can also be stored.

As per the Agriculture Statistics 2019, the country produced 154.9 MT of bulb onion from 140.73 acres of land with Mongar producing the highest of 23.47 MT from 22.14 acres of land.

Agriculture farming picks up in Gashingma, a remote village under Phuntshopelri

Pushpalal Khatiwara, RNR Centre-Phuntshopelri and Tshering Doma, ICTD

A group named, Sr. Youth Group at Muktiar Bagan, Gashingma village under Phuntshopelri gewog in Samtse has ventured into fruit and vegetable production.

The group consisting of three members had tried their luck in farming in 2015 with chilli cultivation in 3 acres of land. However, they lost 95% of their hard work to wildlife discouraging them to continue farming for the next three years.

Considering the vegetable cultivation picking up across the country with better income and livelihood opportunities, the group showed their keen interest once again for farming in 2019. They planted 600 nos. of avocado and 300 nos. of lemon saplings in 4 and 2 acres of land respectively to make a model fruit farm in the future and encourage others. To sustain till the tree starts bearing fruits, the

group cultivated chilli, beans, cauliflower, lady finger, bitter gourd, ginger and turmeric as an alternative source of income. The group aims to go for 100% natural produces without using hazardous chemicals and ensure nutritional value. With six cattle around, they prepare their own bio-pesticides using cow urine and compost for a nutritional supplement to crops. They own 10.5 acres of leased land with avocado and lemon as the main crops.

Since May 2019, the group has sold more than 1000 kgs of hybrid chilli at Gedu, Thimphu and Gomtu. They have not faced any marketing issues for their vegetables except that the pandemic has made it difficult for them to bring the additional inputs particularly avocado saplings for their fruit orchard.

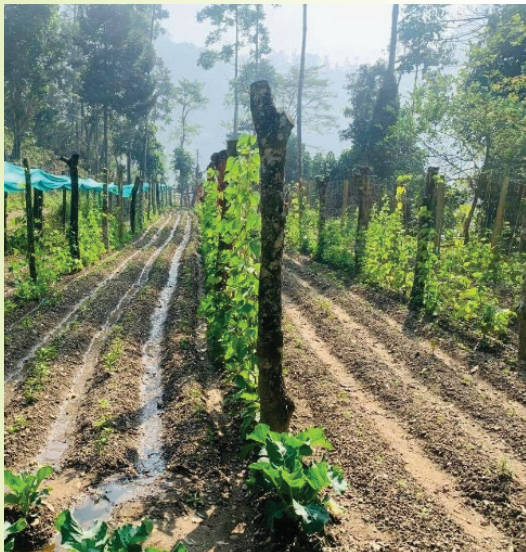
According to the group chairman, Birkha Bdr. Chhetri, their farmland is located in an isolated place. He added that wildlife such as monkey, wild pig and deer are regular issues for them as the existing barbed wires are not helpful anymore. To solve the issue, they are opting to go for electric fencing for safeguarding their crops and request has been put up to the concerned office. A lack of farm road at Muktiar Bagan is another challenge for the group. It takes around 2 hours to reach the nearest road point, the gewog centre. A proposal for the farm road has been put up to the gewog administration and they are hopeful to have a proper road access soon.

The group has invested around Nu.1 M since 2019 to enhance their agriculture farming. Today, they own a power tiller to ease bed preparation and a bolero for transporting their products to the market. The Dzongkhag Development Grant also provided them fund support of Nu.0.73 M to ensure irrigation from Khanavarti River and procure a power tiller and a greenhouse.

During peak season, the group is able to create employment opportunities for around 20 farmers. They encourage them to replicate the chilli and vegetable cultivation in their respective farms. The group has planted few banana and fodder tree saplings including hedgerows with napier to ensure land management. They also constructed two demo stone check dams. There is also one greenhouse for nursery development, two more temporary greenhouses will be developed using the local materials to run the farm smoothly. The group is further exploring getting an electric drier for post-harvest processing of ginger and turmeric products.

It is quite challenging for the centre to provide regular guidance to the group considering the location. But with hard work and dedication, the group is performing well proving that farming can be a successful venture.

The group was registered with the marketing department as Jangcholing Tshoesey Dumra Detshen in 2015 and was later renamed as Sr. Youth Group.



Poultry farming serves as a boon during the pandemic situation

Sangay Tshewang, RNR Centre-Tareythang

Poverty alleviation has been one of the national goals for a long to achieve by enhancing food self-sufficiency at a household level. Often farmers are left without development opportunities due to limited sources of income. The Dzongkhag Livestock Sector, Sarpang played an important role in boosting the family income and rescued some.

One such farmer is Karma Wangdi at Yoezergang in Tareythang gewog. He came to Yoezergang as a re-settler in 2009 and has a family of five members including his wife, son and three grandchildren.

The family's main source of income comes from livestock and agriculture farming. He owns six cattle including two milking cows, two heifer and 2 calves which provides an average of 5 litres of milk daily. He grows broccoli, cabbage, chillies, beans and radish in his 0.50 decimal of land for sale as well as for personal consumption.

For Karma, the income from his small subsistence farming wasn't enough for the family

"

Had there been no layer farm in place, our life would have been difficult in the pandemic situation with no savings for an emergency.

"

to cover the household and educational expenses. His son Jigme Dorji often had to go as a wage worker at a construction site to earn some extra income which at times is difficult to find. He shared that life is hard when you have a family to feed with a limited source of income.

In 2019, Jigme Dorji showed a keen interest in taking up a poultry farm to supplement the income and put up the proposal to the gewog livestock sector. He was supported with shed construction materials while the workforce was contributed by the family members. Jigme, spearheaded by his father customized the feeder and drinker structures with available materials for provisional time.

Considering the family's economic situation, the office also supplied them around 170 nos. of pullets to start his poultry farm of 200 bird's capacity. According to Tshering Tenzom, the Yoezergang Tshogpa, "Such necessary support is crucial to boost the household income which also offers the nutritional diet for the family."

Jigme started earning from his hard work by selling eggs to nearby gewogs, shops and the Gyalsung project area. His daily average production was around three trays of eggs.

When his business had just started to bloom, the COVID19 pandemic situation appeared making his dreams go in vain, affecting not only him but everyone from all walks of life. With the first national lockdown announced, the sale of eggs was suspended making his family's income status almost nil at the initial stage.

Due to lockdown, he could not go for construction work to support the family. The family was later able to sell their products to the nearby shop and meet the expenditure for the basic household items.

Expressing his acknowledgment for the support, Karma shared, "Had there been no layer farm in place, our life would have been difficult in the pandemic situation with no savings for an emergency."

Today, the family earns a decent monthly income of Nu.10,000-15,000 excluding the feed cost and others. Due to mortality, there are a little more than hundred birds for now. Although the family was quite new in the farming business, they have been able to run the farm smoothly.

Karma is now planning to increase the farm size in the coming years but a bit worried about how he would be able to do it and replace those spent birds.

When asked, do you regret venturing into poultry farming, Karma? He responded, "Certainly not. It has rescued me from the challenges I faced in day-to-day life. But being a Buddhist follower, the religious sentiments do get conflict."

During winter, farmers usually do not face any issues in marketing their products and getting feeds regularly unlike in summer where roads get frequently cut off making farm management difficult for them. However, there were some feed and marketing issues due to the pandemic situation which was later resolved. Karma had to feed rice to his birds for around 2 days until the feed reached the gewog.

Be it mega or backyard farms, the ultimate joy lies when the end-users are benefited the most. With scarce resources at disposal, every effort is surgically planned and executed so that farmers like Karma come forward in taking up the livestock farming for livelihood. His farm is the first of its kind with a large flock size in the area. The encouraging story of Karma and his family has served as an eye-opening case to the rest of the villagers. Since then, two enthusiastic graduates have come up with two-layer farms with a capacity of 500 nos. of birds through the cottage and industries loan scheme.

Embarking into livestock farming helps our youth and graduates to engage meaningfully apart from generating income and gaining experiences. Such stories at far-flung villages are the sole reason why we, the Extension Staff 'Walk the Extra Mile.'

Reviving drying springs

The first pilot site at Lholing

Kaka, Dorji Gyaltshen, Jigme Tenzin, Jamyang Phuntshok, Kinley Dem, Ngawang Dorji and Sigyel Delma, Watershed Management Division
Phub Thinley, Kezang Wangchuk, Nidup, Sangay, Thinley Tshering and Lhendup Tharchen Paro Forest Division

Mountain springs are the primary water source for millions of people living in the Himalayan region. Despite the key role they play, spring sources are found to be declining and drying up across the world causing unprecedented water stress to the communities (Pandey 2018). Bhutan is not an exception. According to the scoping study done by Watershed Management Division (WMD 2019), more than 147 water sources in Bhutan have dried up and 2317 are in the process of drying up indicating the urgent need to understand the basic characteristics of springs and demonstrate methods for reviving them. However, addressing the issue of drying water sources is complex and requires a comprehensive understanding of biophysical, socio-economic and institutional settings through diverse qualitative and quantitative research methods. To understand the cause of water sources drying up across the country, the Department of Forests and Park Services has initiated the process of mapping and identifying water recharge areas for protection and implementation of spring revival measures. The work started with technical support from the International Centre for Integrated Mountain Development (ICIMOD) piloting the first spring revival site at Lholing in Paro in 2018. Lholing village is situated within the dry valley zones of Bhutan Himalayas (2800-3200 masl) and receives


Before


After

relatively less rainfall. Paro Forest Division is managing the Lholing pilot site with technical backstopping from WMD. Apart from Lholing, five spring pilot sites have been identified across the country to implement the spring revival measures.

Dorji Gyeltshen, the ex-local leader from Lholing shares that the village had about 15 springs catering to about 240 individuals in 1980s. "However, these springs have gradually dried up and only one spring "Zana Omchhu" is thriving and catering to the community," he added.

Deforestation and change in land use pattern due to infrastructure development combined with the impact of climate change are believed to have caused the drying up of springs. One of the most important processes for spring revival measures is identifying the water recharge area after carefully studying the hydrogeological setting of the area based on the spring revival protocol (ICIMOD 2018). Several rounds of joint scientific investigation were carried out at Lholing to understand the hydrogeology of its springs and devise means to revive them.

After identifying the recharge areas, the interventions were planned. As most of the designated recharge areas have a good vegetation cover mostly dominated by *Pinus wallichiana* and *Populus spp*, most of the structural spring revival measures were constructed along the Dongkola roadside areas in the form of trenches, ditches, check-dams and roadside drainage. The trenches were designed and located at strategic points to capture maximum run-off and precipitation. They were specifically designed dipping gradually from one side in triangular shape to avoid unintended incidence such as animal drowning while maximising infiltration. More than 150 trenches with a maximum capacity of 30,000 litres and a minimum of 600 litres were constructed on the gentle slopes and flatlands. Small check dams along the roadside were constructed to capture roadside drainage water.

Two meteorology stations (HOBO) were set-up along the pilot site to record rainfall, temperature and relative humidity and water discharges are measured regularly along with meteorological data. The data collected will help us understand the rainfall pattern, the amount of annual rainfall and impact on spring output (discharge).

Lholing being a relatively drier site receives rainfall of less than 491 mm per year (April 2018-October 2020). Despite the scanty rainfall, the water level in the collection tank of Zana Omchhu improved from July 2020 indicating the positive result of the interventions carried out in the prime recharge zones over the three years. The improvement in water discharge was also observed in the Bara and Zamshina springs at Shaba (lower elevation) that cater to a larger community. In addition to enhancing the spring discharge, the measure implemented at several locations at Lholing has also created a drinking water source for domestic and wild animals. However, it is still early to conclude whether the positive observation mentioned above is because of the revival interventions. It is therefore crucial to carry out long term monitoring of rainfall and water discharges along with maintenance of the structures to better evaluate the impact and it is being carried out by Paro Forest Division.

While undertaking this initiative, it was observed that it is crucial to involve the public for better understanding of the site, necessary support and ensure that they take ownership of the outcome. The repeated consultations among experts and communities help in identifying the appropriate intervention measures and the use of existing structures can help minimise the cost to achieve the outcome.

From the pilot experience, the approximate budget for such activity may range between Nu.6,00,000 to over Nu.10,00,000 depending on the size, issues and intervention measures required in the recharge area identified. The revival of springs requires a minimum of 5 to 10 years depending on the nature of the underground geological setting, climatic factors and the rate at which rainwater infiltration occurs at the recharge area to re-fill the aquifers.

In the future, once there is an impact, trenches and other structures will be handed over to the communities for regular maintenance as they are the main beneficiaries. The lessons learned from Lholing will enable the implementation of appropriate interventions in other pilot sites.

However, the department alone cannot solve the water source drying issues. While the department will continue to advocate and equip technically to assist the initiative, the onus lies with the local government who should take ownership of such issues and come forward to address the same.

The department will continue to build the capacities of field offices and implement pilot sites that will showcase the best-adapted interventions for uptake by the local government and communities. The capacity development will be the key component of the spring revival initiative and will go a long way in contributing to future interventions in mapping the recharge areas and addressing the drying water sources issue in the country.

Farming: A fruitful way of living a life

Jambay Lhamo, RNR Centre-Samtenling, Sarpang

With globalisation and good opportunity in the agriculture sector, farming with dirtying hands looked upon as a job of a layman now remains a history of the past as we can witness all levels of degree holders choosing to farm for their livelihoods and businesses.

Hem Ghalley who has a master's degree in Human Resource Development is one inspiring exemplary. After running and managing his own business in Thimphu for a few years, he decided to move back to his home town to venture into farming in 2019. He chose the idea and prospects of utilising his resources at his village in Pareygaleygoan under Samtenling gewog, Sarpang. "Gradually I began researching about developing a model farm and maintaining a farmhouse. With that in mind I began working on the project," he said. He also asserts that the support rendered by the agriculture sector in terms of seeds, polyhouse and spraying machine etc. boosted his start-up confidence. Hem initially started with 1000 nos. of areca-nut and 7000 nos. of teak plantation in 4 acres of land envisioning long term investment for sustainability. He then took a baby step into growing assorted vegetables and marketing.

His experience for the first year was overwhelming so he extended the area under vegetable cultivation and dedicated full time to vegetable production from the second year. Today he grows mostly hybrid vegetables including chilli, cauliflower, cabbage, broccoli, beans, tomatoes and others.

The first-year return from his farm recorded a decent turnover of approximately Nu.3-4 lakhs from 1.5 acres of land which kindled the hope of being gainful organically. Although, the viable option for income, the challenges in farming remains with irrigation shortage and pest and diseases. He claims that agriculture is not an easy profession and has to be committed if one chooses to venture into it for good.

"

Gradually I began researching about developing a model farm and maintaining a farmhouse. With that in mind I began working on the project.

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To be more resilient with his approaches and change the perspective of the belittling profession, he invested his earnings into buying a mini power tiller which has shredded the underlying constraint of manpower shortage. His investment in power tiller has not only eased him but benefited his neighbour with the same purpose.

Having been in the village and working closely with nature, Hem believes that he has nothing to lose and he is investing for his good health and rewarding future. With determination and commitment, anybody can venture into farming for it is a kind of self-healing therapy and would feel like a strong horse with all the calories burned in the process. With support from the family members, he produces around 2 MT of vegetables annually which are sold in Gelephu and Thimphu. This season, he is looking forward to producing around 3.5 MT of vegetables. Hem envisions his embankment in agriculture farming positively and gradually plan to uplift his subsistence farm into a mega farm and work on his project dream of transforming his 3 acres of land into a model farm and a farm stay. He gathers most of his ideas and innovations from Google and YouTube to foster his plans and efforts.

As the country imports all the necessary items, he believes that we have an opportunity to contribute in our small way in graduating from being the importing to the exporting nation.

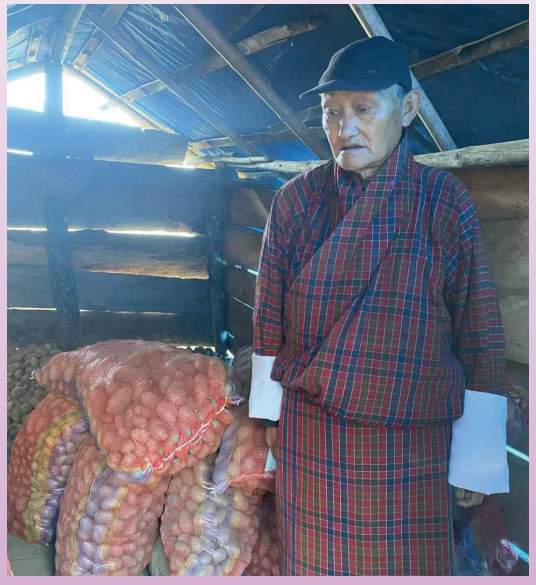
Farmers applaud the innovation of Yusi Maap, the new potato variety

Pradeep Rai, Yadunath Bajgai, Tshering Lhadon, Karma, Lobzang and Sangay

NCOA-Yusipang

Potato cultivation has picked up fast over the decades and has transformed Bhutanese agriculture from subsistence to an emerging market-oriented economy due to its wider adaptive capacities, climate suitability and research interventions. It is one of the most important sources to achieve better livelihood for farmers living at an elevation between 2000-3500 masl. Farmers from these high-altitude places like Bumthang, Chapcha, Haa, Gangtey and Phobjikha depend on potato farming to meet their essential requirements. However, degeneration in potato quality seeds, yield stagnation and the decline has been observed across the major potato growing Dzongkhags. To address this, the National Potato Program under the National Centre for Organic Agriculture (NCOA) in Yusipang released a new potato variety, Yusi Maap in 2017 as an alternative option for farmers. It is a high yielding,

Chencho Tshering



Gyeltshen

Ugyen Dorji

nutrient-dense and late blight resistant variety. Ever since the release of this new variety and dissemination began, there was an overwhelming response from the farmers.

Sanam Drupdrey 2018 has already covered a story on Yusi Maap highlighting why the new variety is better as compared to other potato varieties. This issue mainly shares some encouraging feedback from the potential potato growers across the country.

According to 66 years old, Chencho Tshering from Nagu village in Paro, "When I saw huge vegetative growth, we were a little worried at first."

"But as time passed and the crop attained maturity, we were amazed to find this variety outperforming other varieties in terms of yield particularly the existing popular variety, Desiree. I earn a sum of Nu.1,26,000 after selling 2.8 MT of Yusi Maap to the Department of Agriculture for dissemination to other villages."

"Today, my neighbours are also aware of its potential and have expressed their keen interest to grow the new variety. I have sold them 50 bags at the rate of Nu.2000/bag."

Gyeltshen, a 75 years old from Lobnekha in Chukha shared, "I am very optimistic about Yusi Maap variety after a good experience in potato farming. No other varieties could outperform Yusi Maap for now."

"It is red-skinned with a large tuber size and late blight resistant and yielding capacity of 1 to 2 times higher than Desiree. Our farmers are happy and have decided to replace the old varieties. We remain thankful to the Department of Agriculture for introducing this new variety."

Sixty years old, Ugyen Dorji from Dekiling in Bumthang said, "Potato crop is the main source of income to support livelihood and food security for my family."

"Before I used to cultivate Desiree and Khangma Kaap. I have been cultivating the Yusi Maap variety ever since I received it from the government and fetching better prices. The annual average production from my 1.3 acres of land is 10-11 tonnes with an income of Nu.2,00,000 to 2,50,000."

"This variety has substantially improved the living standard of my family. I would like to thank the centre for providing us this variety. I have been also receiving a good demand for seeds from government agencies and entrepreneurs."

"I am planning to expand my potato farming and create awareness to encourage other fellow farmers to cultivate Yusi Maap. It is a life-changing potato crop for me."

The centre has disseminated the new variety to all the 13 major potato growing Dzongkhags through various demonstration and research outreach programs. Although the Nasphel Kewa Kaap variety released earlier yields higher than the Yusi Maap, it was not well received by farmers.

During one of the participatory varietal selection exercises, the farmers shared that it was because of the white-skinned colour which fetches low price and there was less demand. It was concluded that it is not only the yield performance that farmers are considering but also the other parametres like colour, taste, shape, size and market demand. The feedback was an important point for researchers to consider for future study.

The release of Yusi Maap variety is one of the success instances for now but the larger challenge ahead could be daunting possibly due to climate change impacts.

Nonetheless, the centre will continue to strive for crop innovations and help farmers to have better livelihood opportunities.

Bhutan released its first hybrid maize variety: Wengkhar Hybrid Maize 1

Tshering Pem, Passang Wangmo and Kinzang Thinley

ARDC-Wengkhar

A new maize variety, Wengkhar Hybrid Maize 1 has been released which is a heat-tolerant, medium height and a high-yielding variety with yellow dent kernel and yield potential of 1.8 to 2 tonnes per acre.

The new variety is in line with the changing climate conditions particularly increasing temperature. With medium height, it has some tolerance to lodging. Another advantage of the variety is the green character of stalks during harvest which is effective for utilisation of crop residues.

With the release, Bhutanese farmers will now have the hybrid variety for seed production. It is expected to contribute towards commercialisation of maize, increase income and enhance maize self-sufficiency. The new variety is the result of vigorous research evaluations both on-stations and on-farms carried out by the Agriculture Research and Development Centre (ARDC)-Wengkhar and ARDCs-Samtenling, Yusipang and Bajo jointly with International Maize and Wheat Improvement Centre (CIMMYT), India for the past four years across the maize growing areas in the country.

The evaluation was supported with funds from the EU and

the government. CIMMYT has embarked on the development and testing of heat-tolerant maize hybrids through Heat Tolerant Maize for Asia (HTMA) project. Bhutan joined HTMA in 2014 to access and evaluate the germplasm under the Bhutanese conditions to prepare against any possible heat stress in maize in the future. The germplasms were received from CIMMYT in 2015.

A total of 13 trials consisting of 452 hybrids were evaluated in various locations across the country using our improved varieties as a standard check. The trials were established using Alpha lactic design with two to three replications in the first four years.

Based on the heat stress resilience during the reproductive stage, grain yield and other agronomic traits, five hybrids were selected in 2019 and put under adaptation trial across three locations using Yangtsepa as a standard check (local check). The performances of the climate-resilient maize were assessed through farmers' participatory varietal selection exercises and other cumulative traits. Based on their results, HTMA Hybrid ZH111755 was found to be potential and released as Wengkhar Hybrid Maize 1 by the Ministry's 22nd Variety Release Committee.

The result showed that the most suitable sites for the new variety stretch along the southern foothills and some parts of Mongar and Trashigang. The maintenance and seed production of parental lines of ZH111755 are on-going at the Agriculture Research and Development Sub-Centre in Lingmethang. The preparation and planning for the release and deployment are on track. As per the deployment plan, the potential producers will be identified for hands-on training on seed production and on-farm seed multiplication. The deployment of the released Wengkhar Hybrid Maize 1 will begin from 2022 and the maize hybridisation program looks forward to deploying 20-30% of the selected sites with the hybrid maize.

The Commercial Agriculture and Resilient Livelihoods Enhancement Program is supporting the intensification of hybrid maize in the eastern region to enhance livelihoods and resilience.

As per the Agriculture Statistics 2019, the country produced 46,235.35 MT of maize from 32,484.67 acres of land with Mongar producing the highest of 7,749.43 MT from 5,714.50 acres of land.

Basil

Culinary herbs cultivation: A new livelihood option for Bama Sanam Chithuen Detchen

Jimba Rabgyal and Rupmeena Biswa, NCOA-Yusipang

The culinary herbs play an important role in cooking by adding an aromatic flavour to dishes. Although these herbs have limited use in the Bhutanese diet, they are in good demand.

The major market for the culinary herbs in Bhutan includes tourist-based hotels and resorts serving foreign cuisines. Although the global pandemic affected almost all the sectors in the country, the Bama Sanam Chithuen Detchen in Geyneykha village in Thimphu is rejoicing the benefit from the cultivation and sale of culinary herbs. They cultivate celery, chives, chervil, fennel, thyme, dill, sage, parsley, basil, oregano and rosemary on 80 decimals of land. The farm was inaugurated in May 2020 and is run by a group of four members with 3 males and 1 female. They have generated a revenue of Nu.49000 in seven months. Earlier, they were into the cultivation of fruits and vegetables. The group started the cultivation of herbs with technical support from the National Centre for Organic Agriculture (NCOA) in Yusipang and funds from the National Organic Flagship Program during the financial year 2019-2020. They received 5 prefabricated greenhouses, 5 sets of drip kits irrigation, 2 rolls of Druk pipe, 1 roll of flexible pipe, 1 water syntax (2000 litres) and 2 Bolero trips of farmyard manure, seeds and

seedlings. They are the first culinary group in the country receiving such support. The project was implemented on a cost-sharing basis where the total project cost was Nu.0.87 M, out of which Nu.0.3 M was contributed in kind by the group.

Amid the COVID19 pandemic situation, the group sold about 700 bundles of assorted culinary herbs at the rate of Nu.70 each weighing about 100 gms. Besides, the group cultivated tomatoes under protected structures and earned about Nu.35000.

With hotel business shut down during the pandemic, the group has managed to get connected with the processing companies for their produce. According to the group chairman, "We are happy with our income this season, with the situation getting back to the normal, we expect to earn more." The group will increase the production of parsley, celery, chives, basil, fennel, dill and rocket salad as these herbs have a huge demand in the market. They will cultivate the herbs in all five greenhouses which could not be used last year. Considering the constant demand, they will go for year-round production through a staggered plantation. Technically, the year-round production under normal conditions may not be possible so the use of the hydroponic system and protected structures are recommended for culinary herbs production.

The group is also planning to venture into the processing of green teas and juices if production is bountiful. They are hopeful to receive regular support from the government and better market opportunities to help sustain their business.

In addition, they are exploring to receive the processing machines for tea and juice, dryer and greenhouses through government support. They aspire to become one of the model organic certified culinary production farms in the country. Bhutan imports the majority of culinary herbs in dried or frozen forms. Culinary herb cultivation is a new concept in Bhutan and the value is known to a few individuals. Although there is a limited market at the moment, it has a huge potential in the future if the processing technologies are put in place.

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We are happy with our income this season, with the situation getting back to the normal, we expect to earn more.

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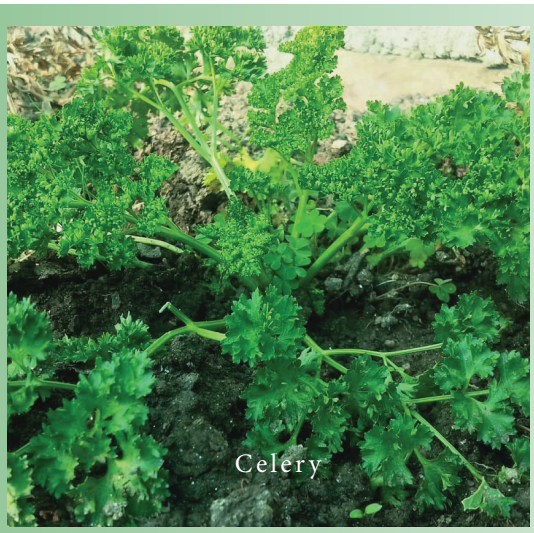
In the meantime, NCOA is planning to support a processing enterprise in the coming year and come up with value-added products. They will train farmers on culinary herbs cultivation, management and post-harvest practices. The evaluation of 12 varieties of culinary herbs is on-going at the centre.


Thyme


Celery


Sage

Crop diversification: A means to address household food self-sufficiency

Kinzang Thinley and Tshering Choden, ARDC-Wengkhar

Agriculture is the most important sector in Bhutan in terms of contribution to livelihoods and producing enough food for the growing population remains a challenge. Farming in Bhutan has been characterised by the presence of small and marginal scale farmers with small farm holdings.

Farmers in eastern Bhutan entirely depend on crop production followed by livestock rearing. The majority of them follow monoculture farming practices which are exposed to unforeseen climate change impacts that can put their households' food security at risk. The region has diverse agro-climatic conditions that enable farmers to enhance their productivity by diversifying crops.

The Agriculture Research and Development Centre (ARDC)-Wengkhar and the Dzongkhag Agriculture Sectors with funds from the Commercial Agriculture Resilient Livelihoods Enhancement Program (CARLEP) initiated the crop diversification and intensification program in the six eastern Dzongkhags to enhance resilience for climate change impacts by enhancing production and income generation opportunities.

The program was later streamlined into the annual agriculture development plans focusing on identified climate-smart villages, youth farms, land user certificates and communities affected by climate change and poverty.

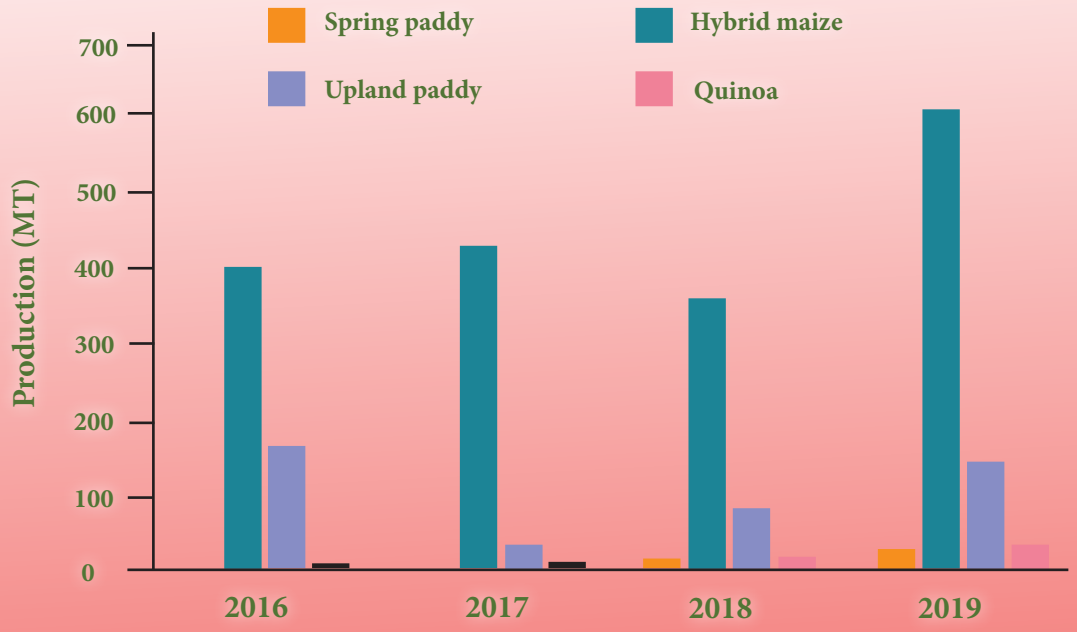
Crop diversification is a viable strategy in developing a resilient agriculture system that helps in poverty alleviation by increasing farm-level crop productivity and minimising unforeseen risk. These strategies allow farmers to improve their crop yield and offer a variety of food for consumption and generate income by marketing surplus produces.

To enhance production, low volume with high value and climate-resilient crops are being promoted including the intensification of hybrid maize, spring and upland paddy, buckwheat, quinoa and rajma bean. The program provides support in terms of startup seeds, small machines for farmers and technical assistance. Maize is predominantly cultivated in the east with limited rice production due to which farmers are importing almost 50% of rice from India to meet the domestic requirements. To address the emerging issues, the program on spring and upland paddy intensification was begun to enhance production and help achieve rice self-sufficiency.

During 2018 and 2019, the intensification of spring paddy in the eastern Dzongkhags showed an increasing trend in area and production with an annual growth rate of 41.6%. The upland paddy cultivation has gained popularity particularly in rain-fed dry areas. The trends in area and production of upland paddy fluctuated over the years, however in 2019, the total upland paddy production was 139 MT from 116 acres of land.

The production of quality seeds through the establishment of community-based seed production groups has made the upland paddy program gain its momentum in the east. Through this approach, farmers had an option to diversify the maize-based cropping system and grow paddy within their locality. This kind of strategy helped in reverting the existing fallow land to cultivation giving more varietal choice

Production through crop diversification from 2016 to 2019



and help in reducing rice imports. There is a concern about achieving maize self-sufficiency in the country due to inconsistent and low maize productivity caused by emerging heat stress. To resolve the problem, the program on spring maize intensification was implemented in rural communities where farmers practiced subsistence farming with local races and have low lands in the rice fallow system and problems of GLS diseases.

Owing to its higher productivity, farmers have shown interest in hybrid technology over the years due to which hybrid maize production has increased significantly from 404 MT in 2016 to 600 MT by 2019 with an annual growth rate of 48.5%. The program has brought immense benefits to the farmers especially in the rice-fallow cropping system.

The intensification of nutrient-dense cereals like quinoa is further expected to help reduce the challenges of food security and food shortage globally. When the Department of Agriculture introduced quinoa in 2015, the crop gained its momentum in the east as farmers were keen to take it up. Today, the demand for quinoa seeds has drastically increased.

The trend in quinoa production has revealed a significant increase from 3 MT in 2016 to 33 MT in 2019.

With the promotion of the crop diversification program, the monoculture farming pattern has diversified, nutritional security of farmers is enhanced and their self-sufficiency in food production is comparatively better from the past. The crop diversification approach provides alternative means to sustain their livelihood offering more varieties of crops to their food basket.

Integrated commercial farm performing well

Up-scaling the rural economy in Pemagsatshel

Krishna M. Adhikari and Yonten Dorji, Dzongkhag Veterinary Hospital, Pemagatshel

The commercialisation of farms has become the main pillar and stimulator for the rural economic growth in the Dzongkhags with more diversified income-generating intervention. Up-scaling the small and marginal rural farms have further become considerably important during the COVID19 pandemic situation. With this in mindset, one of the strategies identified was to promote and gear towards an intensive farming approach. Integrated fishery and piggery farm owned by a farmer, Mahindra at Yuridrang under Shumer gewog is one such successful ventures.

It is the first commercial fishery farm in Pemagatshel with a total area of 12954 M^2. It has 13 ponds with warm water aquaculture fishes. To improve fish growth and reduce the production cost, packchong Napier and Alzola were introduced to feed as protein sources.

For the commodities diversification and to ensure proper land use, the cultivation of pakchong,

banana and avocado trees were incorporated. The pond is a blessing for horticulture farming that helps to thrive fruit trees for additional income to the owner. The farm construction was started at the end of 2018 in a deserted land with limited water and poor soil. However, the commitment and hard work from the relevant agencies have contributed to the success of the farm.

With support from the National Centre for Aquaculture in Gelephu, the stocking of the first batch of fingerlings of 3500 silver and common carps were done on 31 March 2020. Eleven thousand fingerlings of grass and common carps were stocked on May 11 as a second batch.

The third batch of 15000 fingerlings stocking was done on July 31. In different batches, more than 40 thousand fingerlings were stocked in 13 ponds. The production shall be staggered to ensure a continued supply chain of fresh table fish in the Dzongkhag. The first harvest from two ponds saw almost 0.150 MT generating an income of Nu.50,000. The production could have been better if the wild predators had not been a challenge. Around 8.5 MT of table fish were harvested in 2020.

There are also 32 pigs housed in five piggery sheds for complementary income. The sheds are designed to allow wastages into the ponds for manuring and activate microgram growth. Such integrated farming can boost income by reducing the feed cost.

Around 1.5 MT of pork has been produced so far; it is expected to produce 3.5 MT of pork for the local market when the pigs reach the maturity stage. The production is assured to improve the livelihood of the owner with greater economic returns, help in pork substitution and provide nutritional security.

According to the owner, "The works was quite challenging at first but the return is getting impressive that keeps encouraging me to expand the farm." Although the Dzongkhag also has a fishery farm at Nanong, it is not enough to meet the demand in the area. Therefore, the Mahindra's farm has a good market opportunity amid the pandemic situation.

With hard work and dedication, the farm is a big success for Mahindra. It is expected to serve as a model farm that can be replicated by aspiring farmers to earn income from fish, pigs and horticulture fruits.

According to the Livestock Statistics 2019, the Dzongkhag produced 30442 kgs of pork.

Understanding the natural habitat of Takin, the national animal

Tsharijathang is the main gathering place for takins

Norbu Dorji, Laya Park Range

Laya Park Range under Jigme Dorji National Park is a prime summer habitat for Bhutan Takin (*Budorcas taxicolor whiteii*), the national animal. The office had been monitoring the takins for a long in their summer habitat at the alpine grassland of Tsharijathang where hundreds gathered for salt supplement and mating.

The foresters trek about 10 hours to reach Tsharijathang for the annual takin count and the highest counted to date is 203. They also do the monitoring visit particularly to assess their prominent migratory routes, threats, distribution and habitat.

Takins are seasonal migrating and social animals. They migrate twice a year in early spring to a higher region to avoid hot climate infested by blood-sucking leeches and insects. During autumn, they migrate back to lower valleys to avoid a cold climate and look for the green vegetation.

During the monitoring visit in the winter habitat at Kabena, the team noticed weak and inactive herds of takins. The team with help of the park management immediately deployed veterinary professionals to treat them. They collected samples from the infected takins and later it was confirmed that takins were infected with Peste des Petites Ruminants (PPR) disease. To contain the diseases and stop them from further spreading to the summer habitats, the team had to cull some of the infected

animals. Despite the measures put in place, around 14 takins were lost in the summer habitat.

As per the movement ecology study carried out by Dr. Sangay from the Ugyen Wangchuck Institute for Conservation and Environmental Research between 2012-2017, most of the herds gathering through different routes takes place in Tsharijathang. Around 20 takins were radio-collared at Tsharijathang during 2012-2013 and they were found migrating at the different park locations such as Barshong in Lingzhi, Soe in Thimphu, Kabena/ Damji and Gasa Tsachu. Since the radio-collaring was carried out only on few individuals, the result was not a complete representation of the migratory routes used by takins. In addition to the radio-collared results, the foresters documented the additional takin migration routes through camera traps and SMART patrolling. During the patrolling, the team found out that the route behind Koina is the main route frequently travelled by takin.

The takin gathering at Tsharijathang is related to the presence of natural land-based mineral lick. Besides, there are other mineral licks around the area namely, Merana mineral lick which is located downstream of Tsharijathang (Jashirawa River) and Gangphu mineral lick located upstream. All these mineral licks are easily accessible by calves, juveniles, yearlings and adults. Since the mineral licks are located on open ground, takins can easily keep a watchful eye on the approaching predators particularly the Himalayan Black Bear and Dhole.

Besides, the alpine grassland habitat has the potential to accommodate and feed hundreds of takins. The visit of takins to the licks can be

easily distinguished from colour of the mineral lick. To avoid disturbance during Takin gathering, there is a Tsharijathang Pasture land Management agreement signed between herders and park management which was handed over to the group of herders in 2019 mainly to preserve takins. As per the agreement, herders should leave Tsharijathang pastureland before arrival of takins for a period of 4 months from 1st day of 4th month to 30th day of 7th month of lunar calendar. They will be fined if their cattle and horses are found during the period.

Today, the most direct threat to takin is the resource competition in the summer habitat by yaks and horses as they also graze in Tsharijathang. The other pertinent threat is habitat loss as a result of the increased yak population. There are also human disturbances during the peak takin gathering season from mid-May-August by cordyceps collectors and trekkers as all the collection sites and trekking routes fall within their habitat. Takins, particularly the calves and the juveniles are reportedly being killed by wild and stray dogs. Some of the wild predators and herbivores which pose threat to takins directly or indirectly include snow leopard, Himalayan Serrow, Common Leopard, Asiatic Golden Cat, Musk Deer and Goral.

The most dreaded threat of all is the outbreak of a disease such as PPR and if such disease is not monitored, the entire takin population can go extinct. More than 40 takins were lost due to PPR disease in winter and summer habitats. Therefore, it is crucial to adopt and standardise the monitoring and reporting protocols for takins and other species by the concerned offices to take timely precautionary measures. Despite losing some takins to the disease, we are still fortunate to sight many healthy takins, genetically superior ones following the same circle of migration to summer and winter habitats.

The records show that the takins in the summer habitat are almost evenly distributed. To ensure quality data on takin and other wildlife, more camera traps need to be set up which will also help foresters to scan any possible disease outbreak. Nevertheless, the range office will continue to monitor takins in their habitats and ensure they are healthy.

Additional takin migration route documented by the monitoring team

Sl. No.	Route location	Sl. No.	Route location
1	Ngarithang	7	Dolaya
2	Rodhuphu/Gimchukha	8	Langdok
3	Yaktha	9	Bora
4	Taktsimakhang Top	10	Tsholuna
5	Tsachuphu	11	Sumchuna/Goenlu
6	Langothang Top	12	Gyentsa

Phuntshopelri farmers venture into watermelon farming

Pushpalal Khatiwara, RNR Centre-Phuntshopelri and Tshering Doma, ICTD

Watermelon will soon be an important cash crop for farmers in Phuntshopelri gewog, Samtse. A 'Sugar Baby' variety of watermelon was introduced in December 2019 to provide an alternative source of income and encourage farmers and youth groups. Locally raised seedlings were planted in the field of a farmer, Mon Bdr. Mongar at Chhunag covering 0.4 acres of land.

Awareness training was provided to all 21 Chhunag households covering the watermelon cultivating technology such as nursery raising, construction of low-cost polytunnel, planting, mulching, irrigation and pest and disease management practices. The program kicked off after the proposal put up by the gewog extension office was approved by the Dzongkhag Agriculture Sector. Initially, Nu.32,000 were spent for the program to cover farmers' training and procure planting materials.

More than 2000 kgs of fresh watermelon were harvested from about 0.30 acres of land in four months. All fruits were sold like hotcakes at a rate of Nu.50/kg in Gomtu.

Farmers were able to generate an income of Nu.0.5 M from their first harvest. Besides encountering some common aphid in the field which was solved using bio-pesticides, farmers did not face other serious issues during the process.

With successful cultivation, farmers cultivated watermelon in 3 acres of land during the second season involving 11 households. They were sold to the local market earning an income of Nu.80000.

This season, one small group and 10 households are growing watermelon on an average of 0.30 acres each. They were provided free seeds of around 10 kgs besides the technical backstopping. Due to the pandemic situation, farmers had a difficult time in materials procurement such as mulching plastics, plain sheet, poly pot and others.

Watermelon farming is gradually picking up across the country. Farmers in the east, Punakha and Zhemgang are potential growers earning a good income. Farmers say growing watermelons is easier than the other cash crops such as chillies and potatoes since they are less damaged by wild animals and major pests and diseases.

Urban dwellers take up organic vegetable farming

Tshering Wangchuk, NCOA-Yusipang

During the three weeks COVID19 national lockdown which was imposed on 11 August 2020, the shortage of fresh vegetables was the most important concern for the urban dwellers. But many of them who started organic farming did not face the shortage of green chillies, tomatoes and other basic vegetables as they were able to harvest from their small gardens.

Many organic enthusiasts from Thimphu Thromde had participated in an organic urban agriculture program initiated by the National Centre for Organic Agriculture (NCOA) in Yusipang.

The concept was aimed at promoting organic vegetable cultivation for meeting small household needs, enhance household nutrition through the production of fresh organic vegetables and contribute to household vegetable self-sufficiency.

The centre supported 30 interested residents in Thimphu by providing them healthy potted seedlings and seeds of chilli, tomato, cabbage, cauliflower and spring onions. The program had three categories for the clients. Ten

clients had participated in balcony or verandah farming, eleven undertook backyard kitchen garden and nine adopted the vegetable pots. While the balcony and pot farming aimed at clients with no land; backyard farming aimed at those with a small area in their backyard to cultivate vegetables.

The feedback and data provided by the client show that the program had far-reaching benefits than what was initially aimed. The initiative helped them to harvest fresh organic vegetables from their home during the COVID19 lockdown. When they were engaged in gardening, it helped them to improve their physical and mental health.

According to Meghraj Tamang, one of the beneficiaries, "The backyard organic vegetable farming is fun; it helped me and my family to meet our needs during the lockdown." He advises the centre to extend and upscale such small but effective programs to more interested urban dwellers.

Urban dwellers are largely categorised into affulent or middle-class families who can easily afford to meet their household needs. However, if analysed in detail, many face difficulties in meeting their end needs. Such a program can help the urban dwellers to produce a small percentage of their food during an emergency.

The program was successful and proved to be crucial when the inevitable natural disaster comes in.

Considering the overwhelming response from the clients and their advice to expand, the centre is looking forward to upscale the organic urban vegetable farming into a full-scale outreach program supporting more clients.

Planting life trees as an alternative to wooden poles used for electric fencing

Dr. Tshering Penjor, Geley Namgay, Pema Thinley and Sonam Dorji, ARDC-Wengkhar

The electric fencing (EF) technology was legalised in the country in 2012 to solve the long-standing issue of human-wildlife conflict. It has served the purpose for almost seven years now. Almost every beneficiary has reported a good crop harvest after installing the EF around their farms. However, setting up such a facility comes at a price. The Department of Forests and Park Services is now concerned that the extraction of timber for EF might lead to forest degradation in the long run. As per the 11th five-year plan terminal report of the Ministry of Agriculture and Forests, the country has 3492 km of EF installed protecting 39346 acres of cultivated farmland. Considering the need, the Agriculture Research and Development Centre (ARDC)-Wengkhar initiated an innovative approach to accomplish the purpose of EF while conserving nature on the other hand. The research trial activity was supported by the Bhutan

Trust Fund for Environmental Conservation grant. One of the main objectives of the grant MB171Y17 was to explore alternatives to the wooden poles used for EF. The replacement of wooden electric fence poles with 75 mm and 50 mm HDPE pipes was tried out in some selected households at Saling and Drepong gewogs in Mongar.

Since the establishment cost of HDPE pole-based EF was found to be very expensive, the idea of using life trees to serve as an electric fence pole seemed to be cheap and sustainable in the long run. The activity was carried out at Thenmung under Tsamang gewog.

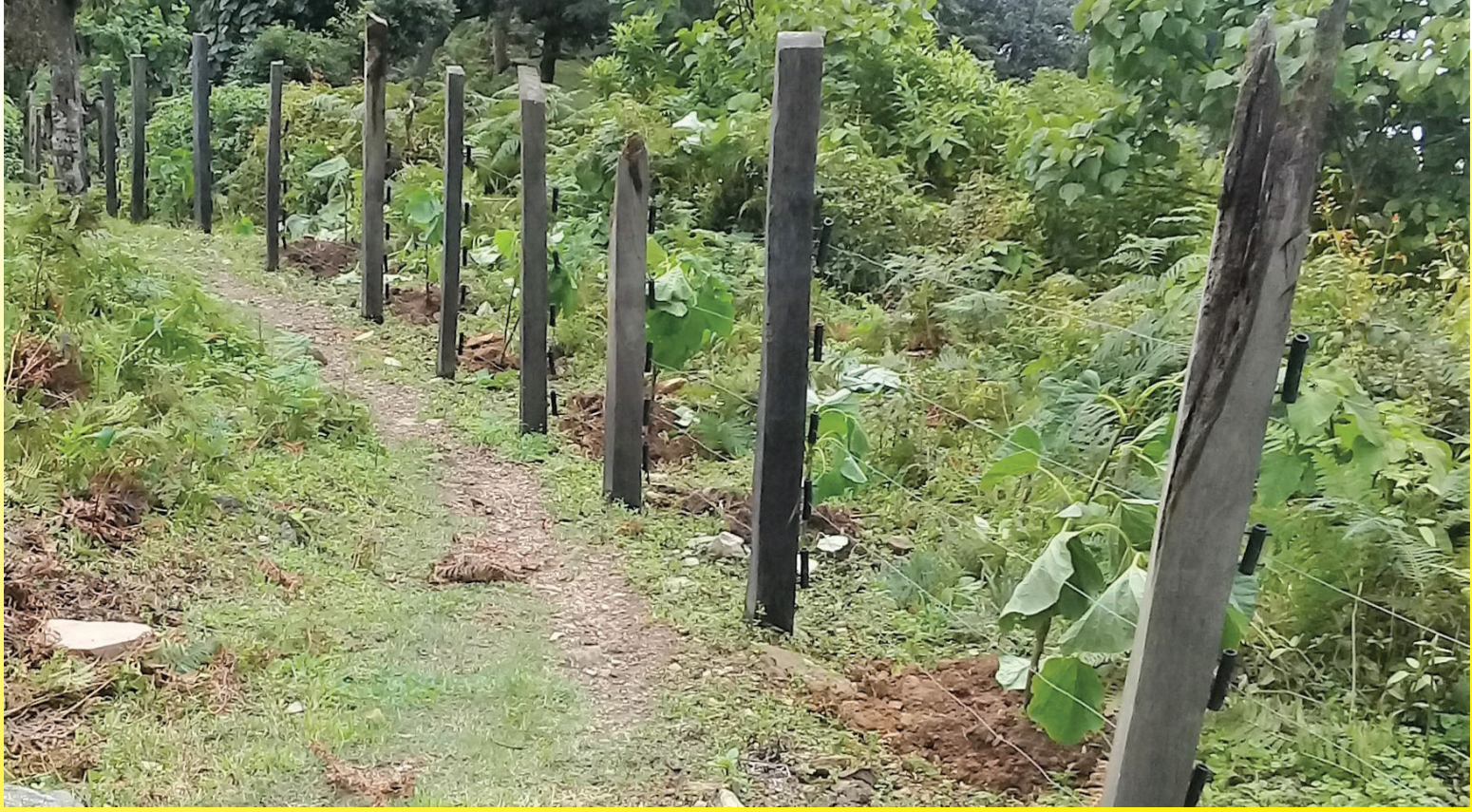
The community comprises of seven households with 1.5 km length of EF were covered during the initial phase of the project. The whole package of the approach includes installation of a greenhouse with the irrigation facility, propagation of selected tree species, public awareness program and the plantation of tree saplings.

A set of greenhouse measuring 5*10 m dimension was provided to the community. With the technical backstopping from the centre and coordination by the gewog extension officer, the greenhouse was set up at the appropriate site in the community.

To ease the nursery activities and provide better care of plantlets, the community was provided with the capacity of 2000 litres and HDPE pipes for irrigation. The effort started with the hands-on training for the community comprised of potting mixture preparation, selection of tree species, proper cutting of plantlets, potting in the poly tube plastic and irrigation schedule. Four species of trees were selected based on hardiness, fast-growing and their multipurpose applications and propagated through hard and softwood cutting methods.

The tree species were *Rhus paniculata, Toricelia tiliifolia, Ficus elastic* and *Ficus rhoxburghi*. The former two species are of hard and long-living types while the other two species are fast-growing and the tops can be fed to cattle. About 2500 numbers of cuttings comprising 4 species were planted in the greenhouse.

Three days of awareness including a day-long plantation program was conducted at the site. A total of 29 households from Tokari-Thenmung chiwog participated among others. The program included a discussion on the importance of forest, deforestation and the possible impact of climate change on agriculture.



Further, the current scenario of electric fencing record was shared to participants with its implication on our nature in a long run.

Alongside, participants were trained on the nurturing and maintenance of those plants. The key requirements of planted trees are that the lower 2 m length trunk to be maintained branch-free for fixing insulator with wire for fencing and the main trunk needs to be straightened by training the tree.

The saplings were planted adjacent to the existing wooden fencing post. The centre's technical officials provided a demonstration prior to the mass plantation. In total, 340 numbers of saplings comprising of 4 species were planted in a day-long program. When the existing fence post completes its service life, normally of 5 years and the saplings attain the pole size, the insulators holding the fencing wires will be fixed to those life trees.

Therefore, it is a kind of long-term research whereby the possible outcome will only be displayed after the saplings reach the pole size tree. The success of the activity may be subjected to proper training, care and management of tree saplings. Due to a lack of awareness and ignorance on the impact of forest degradation, rural dwellers have been practicing unhealthy harvesting of forest products. Although the forest officials and other concerned offices are putting their soul into protecting the forest, the forest cover in recent years is seen reducing. This trend indicates a need to shift to other strategic approaches that help in maintaining or enhancing the forest cover. The current program is one of the promising approaches to reduce forest degradation.

Considering that the activity yields a successful result as expected; the concern over forest degradation attributed by EF may conclude. Similar activity will be conducted in a few other areas in the coming years through the same grant. This could let the researchers confirm if any community behaviour is an attribute for the success of the program.

Dairy value chain supply rescue livelihoods in Pemagatshel

The initiative was taken during the COVID19 pandemic situation

Thinley Rabten and Leki Wangchuk, Dzongkhag Livetsock Sector, Pemagatshel

The pandemic of COVID19 has greatly impacted the regular income of rural farmers and their livelihoods including dairy farmers. One of the prominent strategies identified to help them generate income was by consolidating the milk and milk products from every household and marketing them together in a business model.

With support from the Commercial Agriculture Resilient Livelihoods Enhancement Program (CARLEP) in the east, numerous self-help groups (SHGs) were formed to ensure a sustainable dairy value chain supply and marketing opportunities. There are 12 SHGs in Pemagatshel producing milk and milk products. Among these SHGs, Zambala Dairy Cooperative has remarkably exceeded as one of the eye-catching cooperatives.

During the first national lockdown, all the milk processing units (MPUs) were shut down affecting the dairy farmers. The marketing of dairy products to other outlets was also not possible due to movement restrictions. The monthly loan repayment was a big concern for some SHGs who have procured high-yielding dairy cows for sustainability with the project loan. Zambala Dairy Cooperative formed in 2018 with a total of 74 members was performing well beyond expectation and their products including butter and cheese had already gained popularity in Thimphu. With this advantage,

the cooperative innovated the ideas of connecting other dairy groups in upper Pemagatshel to Thimphu.

To facilitate the linking, the cooperative adopted the buy-back policy for the first time in the Dzongkhag. Before assembling the products from the dairy groups, they conducted virtual training for all the MPU processers on how to make good quality products. The products from the Shali-Gamung, Ngangmalang, Tokari and Wongchilo groups were collected with transportation support from the Dzongkhag Livestock Sector. Later, the cooperative took over the full transportation cost making it much easier for smaller groups in the Dzongkhag to sustain themselves. The cooperative could collect more than 1200 kgs of butter and cheese weekly and marketed them to Thimphu at a farm gate price of Nu.330/kg for butter and Nu.250/kg for cheese. The local rate was just Nu.280/kg for butter and Nu.180/kg for cheese. Through this dairy supply chain initiative, the

groups could sustain on their own meeting the recurrent cost and salary for their workers. Today, the cooperative has two utility Bolero vans for product marketing. They were able to generate a saving of Nu.3.4 M through the sale of products over the 2 years. On a weekly basis, the group delivered around 25822.74 (S=21850), n=12 in 2018, 33489.5(S=28337.2), n=12 in 2019. The average milk production increased significantly in 2019 compared to 2018 indicating the members' contribution from outsourced dairy cows. The average annual income of each cooperative member is Nu.89000 and the highest income generation in 2020 is Nu.3,47000 while the lowest income is Nu.8500. The cooperative dispenses almost a sum of Nu.0.6 M monthly to the dairy group members.

As the linking program proved to be fruitful, these SHGs were able to generate employment for 20 youths. They also encouraged other youths to participate in the

development of small and medium enterprises. The key to the significant success of the cooperative can be attributed to the mass fodder establishment, cohesiveness of communities, supply of electric chuff cutters and access to large landholdings.

The success was also due to members' willingness to avail the loan for outsourcing the high-yielding dairy cows from India. A total of more than Nu.669 M loan was invested in dairy farming.

But these successes didn't come without challenges. The subsistence small-scale operations with primitive farming systems and hygiene pose a hindrance in a clean milk production venture. The lack of effective community supports to group for marketing and production as well as lack of awareness on the dairy business were other challenges encountered.

Further, the village level milk collection and transportation to the MPU was the greatest challenge. The erratic problems faced in the field also include the lack of cold chain facilities and milk spoilage and marketing problems due to excessive production particularly in summer. Other related problems are the soaring feed price, bookkeeping, lack of product diversification skills and packaging facilities. Despite the challenges and issues in the field, the dairy commodity is getting momentum in the Dzongkhag making a huge difference in the livelihoods of the rural community. With support from the CARLEP, the dairy value chain supply is expected to see greater developing opportunities in the future.

According to the Livestock Statistics 2019, the Dzongkhag produced 1896265 kgs of milk, 78712 kgs of butter and 141353 kgs of cheese.

Tshesay Chirup Dhetshen takes up protected cultivation

To ensure the year-round production of tomatoes

Karma Yangzom, Kinga Wangchuk and Karma Choden, ARDC-Wengkhar

Bhutan has diverse agro-climatic conditions which make it feasible for the cultivation of various vegetables but the production of warm-season crops like tomato and chilli takes place only during summer. These vegetables are imported in winter due to shortages. Therefore, the promotion of year-round production was felt crucial to reduce imports and achieve vegetable self-sufficiency which can be easily achieved by staggered cultivation of vegetables using the protected cultivation technology.

The Agriculture Research and Development Centre (ARDC)-Wengkhar with support from the Commercial Agriculture Resilient Livelihoods Enhancement Program (CARLEP) initiated on-station research for the protected vegetable cultivation to achieve year-round production of high-value vegetables including tomato and chilli. It is being promoted at eight sites including five land user certificates, one youth group at Marpheng, one farmer group at the peri-urban area and one individual commercial

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We will continue to produce tomatoes in protected cultivation to ensure a year-round production. With better management practices and experience in the technology, we hope to earn more.

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farm in four Dzongkhags. The protected vegetable cultivation refers to producing vegetables either in a highly costing sophisticated greenhouse or in a simple low costing naturally ventilated greenhouse. It is fairly a new technology in the country but it is widely practiced globally. Chilli and tomato are usually promoted under this technology as they are not affected by daylight duration.

Tshesay Chirup Dhetshen, a women farmer group comprising of seven members at Kidheykhar, Mongar took up the protected cultivation of tomatoes inside 5x20 m greenhouse. A total of 200 numbers of seedlings were transplanted in May 2020.

Greenhouse plastic, drip irrigation set, fertiliser, tomato seedlings and jute rope were supported by the centre with funds from CARLEP. They were also supported with vegetable pruner on a cost-sharing basis of 20% of the total expenses. They were given hands-on practice on the planting method, training and pruning of tomato plants inside a greenhouse. The crop performance was encouraging and they harvested around 200 kgs of tomatoes. The tomatoes were mostly sold at the local market while some quantities were sold to the nearby schools at the rate of Nu.70 and Nu.30 a kilogram respectively. At an average market price of Nu.60/kg, the income generated from this new technology in one season was Nu.11000. A cost-benefit analysis showed a benefit ratio of 0.163 which was not economically viable. But since few of the materials were supported free of cost, it resulted in a benefit ratio of 1.03, the economically viable deal.

According to Dorji Tshomo, a group member, "We will continue to produce tomatoes in protected cultivation to ensure a year-round production. With better management practices and experience in the technology, we hope to earn more."

Formed in 2017 for vegetable production and to generate income, the group also grows other vegetables including cabbage, cauliflower, broccoli, radish, carrot, potato, beans, mustard greens and coriander on their leased land of 0.5 acres. They are sold to the nearby school, Kidheykhar Central School and at the local market. While many farmers were impacted due to the pandemic situation, the group did not face any challenges in selling their vegetables. With a good harvest, they were able to contribute vegetables including radish, mustard greens, coriander and spring onion to the frontline workers at Kidheykhar, Mongar. The group's success is setting an example in society by empowering women. The experts say, growing vegetables under protected cultivation has many advantages over conventional practices. The crops can grow faster and vegetables like chilli and tomato can be produced throughout the year which will fetch attractive prices in the market particularly during the lean season. Further, this technology helps in higher yields as pests and diseases can be controlled more effectively and it ensures weed-free cultivation.

Based on the positive impacts, the agriculture officials recommend the protected cultivation to farmers as a better farming option particularly for the high value and warm seasonal crop including tomato, chilli, cucumber and beans.

Community Forestry enhances income generation and livelihoods in Tsirang

Gem Tshering, Territorial Forest Division, Tsirang

The community-based natural resource management commonly known as the Community Forestry (CF) is an institutional approach for preserving forest resources by rural people without disturbing the ecosystem for better opportunities. The concept of CF came due to a drastic reduction in forest areas near the vicinity of human settlements and over-harvesting of the forest products. Experts say that forests should be managed sustainably for the benefit of present and future generations. Bhutan's CF policy not only recognises the CF programme as a promising strategy for the protection, conservation and sustainable use of forest resources in the country but also as a contributor to poverty reduction and livelihood enhancement. Many rural people depend on the forests for their livelihoods and they need to practice sustainable forest management. To ensure the benefits of CF, a study was conducted in Tsirang with a particular emphasis on income generation opportunity The study has found the positive economic impacts of CF. The community forests management groups (CFMGs) have still not derived the maximum economic benefit from their community forests despite sound management planning and practices. For

example, the timber harvested from the Samdrup and Zomnya CFMGs was below the annual harvesting limits while less timber was harvested from other community forests due to their limited capacity for timber supply. Excess timber was sold while removing trees for the construction of farm roads and power transmission lines after allotment for domestic use by the members; the maximum income is generated through these two activities.

Income sources are also from the membership, royalty and penalty fees. Due to the enabling regulatory framework, sand and stone boulders have been targeted for future income generation purposes. Some CFMGs have also prioritised growing broom grass and bamboo considering their potential economic value.

In terms of loan distribution, when a particular CF generates income, one can allocate not more than 50% of the total fund for a loan. The CF by-laws have provisions to facilitate CF funds for the loan. Every CFMG member is allowed to avail loan from their respective CF funds. The members shall decide on the interest rate during the general meeting with a two-third majority based on the by-laws. The interest rate shall be on an annual basis. However, the interest rate shall not exceed 15% per annum as per Section 17 (1) of the Movable and Immovable Property Act of Bhutan 1999. The record shows that a majority of the members used the loan for house construction, kitchen and toilet to have a decent living place for their family.

Initially, the CF program focused the timber resources in community forest areas and the preparation of management plans. Recent attention has been given to the potential value of non-timber forest products (NTFPs) from the community forests. The importance of building capacity for CFMGs on books and record keeping, silvicultural and managerial skills has been also identified as priorities. It is expected that better use of NTFPs will provide additional economic benefits to communities particularly if the business skills and product development capabilities of the community can be improved.

It has been noticed that the CF is increasingly contributing to forests and environmental conservation through the active involvement of rural people. Silvicultural activities are improving forest conditions, degraded or barren land is being planted with a variety of species and headwaters are being protected. The willingness of CFMGs to

invest both cash and labour to improve their community forests shows that the CF is supporting the overall national forestry policy of maintaining 60% forest cover. Further, the CF is supporting Bhutan's commitment to the millennium development goals.

Zomnya CFMG formed in 2009 is one of the successful examples of CF. It has 115 members with a forest coverage area of 553.75 hectares and focuses on timber production. Although the challenge remains to manage a group of large members, they earn an income of Nu.148,2207.75 in 2019. According to a group member, 69 years old Dorji, "The community forestry is a potential resource to benefit our children and grandchildren in the future."

Another successful group is Phenthogchen CFMG which also focuses on NTFPs such as cane, bamboo, fern, mushroom, Terminalia spp, betel leaf and wild yam. The group formed in 2009 has 156 members with a forest coverage area of 358.25 hectares. They were able to earn an income of Nu.112500.28 in 2019. Dil Maya Rai, 57 years old feels that the concerned offices should train farmers on the value addition of NTFPs for better income and employment opportunities. Tsirang Territorial Division has 49 CFMGs and 2 NTFPs group. There are 2895 households of beneficiaries covering 9287.07 hectares of state reserve forest lands representing 97.67% distribution of CFMGs in the Dzongkhag. It further represents a 16.08% distribution of area managed by diverse CFMGs across 12 gewogs in the Dzongkhag.

Community forest management groups' loan and recovery (2018-19)

Sl. No.	Name of CFMGs	Loan paid	Beneficiaries (Households)	Recovery	Purpose
1	Zomnya	710,000	35	75%	Construction of house/ kitchen/toilet
2	Khorsaney	65000	9	80%	-do-
3	Phendeling	43500	11	70%	-do-
4	Tashiding	170,000	11	67%	-do-
5	Dangreybu	79706	7	85%	-do-
6	Chirphen	170,000	11	90%	-do-
7	Chuzomsa	65000	3	77%	-do-
8	Chuzomsa	30000	1	0%	Education
9	Yarkey	65000	3	77%	Construction of house/ kitchen/toilet
10	Thakorling	45000	8	100%	Education
	Total	**733,206**	**95**		

The Department of Forests and Park Services should continue to support the CF program and actively stimulate the up-scaling of cash income through potential NTFPs by the establishment of small business enterprises at the community level. The CF is contributing to the livelihoods of Bhutan's rural communities through sales of timber and NTFPs and it would further contribute significantly in the future if better opportunities are explored.

Shoot-Tip Grafting in vitro

Ways for obtaining disease-free planting materials in citrus

Dr. Tshering Penjor, Sonam Gyeltshen, Geley Namgay and Pempa Lhamo
ARDC-Wengkhar

The citrus orchard in Bhutan is facing a serious problem of decline which is mainly attributed to the prevalence of citrus diseases such as Huanglongbing (HLB) or citrus greening. The need for a healthy certified quality planting stock is recognised as a basic to revive the citrus industry in the country. The use of healthy planting material for establishing the new orchards will help in controlling the diseases and increasing productivity. The technique of shoot-tip grafting (STG) in vitro described by Navarro et al, 1975 has been proven effective in the elimination of diseases and helps in the establishment of healthy citrus orchards worldwide. It is the most reliable method to eliminate graft transmissible diseases in citrus from the infected parental source. Keeping this in view, the Agriculture Research and Development Centre (ARDC)-Wengkhar initiated research trials on STG based method to produce disease-free citrus planting materials. The STG in vitro consists of grafting a small shoot tip (meristematic apical dome) of 0.1 to 0.3 mm on to a young seedling rootstock growing in vitro under the aseptic conditions. This is based on the finding that most pathogens cells move in plant tissues through the vascular system which is absent in the meristematic tissue of the shoot tip apex. The fast rate of cell multiplication at shoot



tip apex has been considered as a limiting factor for pathogen cells to progress proportionally and reach into the shoot tip tissues. Therefore, the shoot tip is free of pathogens even though the whole plant is infected by the disease. Plants obtained by STG are similar to normal grafted plants which do not have the problems such as reversion to the juvenile state, excessive thorniness, vigorous and upright habit of growth, slowness to fruit, alternate bearing in early years and physical differences in fruit which are present in nucellar plants. The four standard steps and procedures were followed for carrying out the shoot tip grafting at the centre.

1. Rootstock preparation

Appropriate rootstock seeds were de-coated and sterilised with 0.5% sodium hypochlorite solution containing 2-5 drops of 0.1% Tween-20 for 10 minutes. The seeds were then thoroughly rinsed with sterile distilled water for 3-4 times and planted in the potting media and allowed to germinate for 2-3 weeks under the dark condition at 27° C in the seed germinator.

2. Scion preparation

Budstick of different released citrus varieties were collected from the germplasm collection block. The collected budsticks were 5-10 cm long containing at least 2-3 opened buds. The leaves of budsticks were removed and surface sterilised with 0.5% sodium hypochloride solution containing 2-5 drops of 0.1% Tween-20 for 5 minutes. It was then thoroughly rinsed with sterile distilled water for 3-4 times.

3. Grafting under a microscope

The three weeks old rootstock was decapitated about 1.5 cm from the hypocotyl. Its cotyledons and root-tips were trimmed off. An inverted T-cut is made on the rootstock using a sharp surgical knife under the dissecting microscope. Under the microscope, carefully removed the shoot-tip (apical meristem) measuring about 0.2-0.3 mm from the budstick and aseptically placed on the inverted T-cut of the rootstock. The inverted T-cut is then carefully wrapped with parafilm to prevent immediate drying of the shoot-tip. The grafted plants were planted in the potting media and kept in a germinating chamber with 16 hours light/day at 27° C temperature.

4. Double or re-grafting of STG plants to bigger rootstock

After 5-6 weeks, the successful shoot-tip plants were again re-grafted to bigger and vigorous rootstock such as Rangpur lime. The development and growth of the STG plant are accelerated when re-grafted on a vigorous rootstock. A total of 26 successful STG plants were double grafted into healthy C-35 rootstocks and raised in a protected citri-culture greenhouse.

The double grafted plants will be tested for the presence of graft transmissible diseases such as HLB and Citrus Tristeza Virus (CTV) by using biological indexing and molecular (RT-PCR) methods. The seedlings of indicator plants (Sweet orange and Mexican lime) were already raised and bio-indexing activity will be carried out in the upcoming spring season. All negatively tested STG plants will be strictly maintained in the protected greenhouse and will be utilised in the future establishment of protected primary foundation block or protected germplasm block in the country.

Sexed Semen Technology launched to enhance the Heifer production

Dr. D.B. Rai, Dr. N.B. Tamang and Abi Narayan Koirala, NDRDC-Yusipang

The Department of Livestock supported the import of over 2800 dairy animals from India and supplied them to interested farmers on a cost-sharing basis in the 11th five-year plan. Such intervention, although inevitable poses high risks of introducing exotic diseases into the country despite having strict quarantine measures in place. Thus, to minimise such risks and address the problem of meeting dairy cattle demand within the country, the National Dairy Research and Development Centre (NDRDC) in Yusipang imported and initiated a field trial on Artificial Insemination (AI) with sex-sorted semen in Bhutan from August 2014 till March 2018.

The research was conducted on-stations (Government farms) and on-farms at various Dzongkhags to validate the effectiveness of the technology. The trial on the use of sexed semen in heifers and cows up to 3rd lactation resulted in AI success rate of 44.4% and confirmed that the use of sexed semen can produce 89.6% of female birth under Bhutanese farming environment (Rai et al., 2019). The birth of a female calf was within the range of 80-90% female birth assurance provided by sexed semen producing companies. With the promising result obtained, the

centre has initiated the Heifer Production Scheme using sexed semen technology in the 12th plan.

The Hon'ble Sanam Lyonpo launched the Sexed Semen Technology in July 2020 along with guidelines for implementation modalities. The release of technology was timely with the growing demand for dairy heifers and accelerate their production across the country.

Prior to the technology release, the centre carried out a series of groundworks including a refresher course on the technology application in all regions involving 101 field staff. Besides, consultative meetings with Dzongkhags' Livestock Officer and field staff of 16 Dzongkhags/farm managers, government dairy farms were conducted. The centre procured over 6000 doses of sexed semen from the USA and Denmark to speed-up the application of the technology.

The scheme is implemented within the promising Contract Heifer and Bull Production Program (CHBPP) and dairy farmers groups (DFG) on a cluster village approach. The areas for the scheme were selected based on the performance of AI centres covering the progressive CHBPP/DFG, availability of fluent AI technician and adequate breedable heifer population.

The sexed semen costs USD 18-20/straw which is almost six times more expensive than the progeny tested semen (USD 3-4/straw). Therefore, it is recommended that the use of sexed semen be targeted in first-timer heifers and cows in 1st lactation only since the fertility of cow declines with the increase in lactation numbers. In order to ensure judicious use of sexed semen the key officials from Dzongkhags and gewogs expected to be involved directly or indirectly in implementation of the scheme were sensitised before implementation of the scheme.

The scheme was implemented in 16 Dzongkhags covering 27 AI centres and 3 central units with the distribution of 1718 doses of sexed semen in the year 2019-20. As of 31 August 2020, a total of 776 AI and birth of 100 progenies; 10 male and 90 female were reported. The female birth with the sexed semen as reported accounts for 90% which is equivalent to the findings during the field trial.

The technology is expected to reach 72 AI centres among CHBPPs/DFGs by end of the 12th plan and cover 60% of total AI centres in the country (120 AI centres in 2019-20). For higher AI conception rates and better uptake of AI program in the country, the centre is continuously thriving to provide AI refresher courses to all livestock extension staff and train more community AI technicians for uninterrupted AI services.

Towards better conservation and management of forests

National reports on Forest Emission and Forest Reference Levels published

Dorji Wangdi, Arun Rai, Jigme Tenzin, Kinley Dem, Sigyel Delma, Norbu Wangdi and Lobzang Dorji, Department of Forests and Park Services
Kezang Yangden, WWF Bhutan

Bhutan has developed the national Forest Reference Emission Level (FREL) and Forest Reference Level (FRL) reports under the project, Reducing Emissions from Deforestation and forest Degradation (REDD+) mainly to take stock of emissions and removals from the forest sector and set a baseline to measure future performances. The data collected is also expected to provide overall guidance for the planning and implementation of activities in forestry and other relevant sectors. As per the Warsaw Framework on REDD+, countries implementing REDD+ need to have a FREL and FRL to serve as a benchmark for assessing the performance of REDD+ activities based on the national circumstances.

FREL and FRL were submitted to the UNFCCC platform to strengthen Bhutan's position and commitment under its Nationally Determined Contribution by revalidating the forest cover, instituting a system to quantify and monitor carbon stocks and establishing a benchmark for tracking its performances in terms of forest conservation and management.

Bhutan's FREL and FRL includes four REDD+ activities namely, reducing emission from deforestation, sustainable management of forests (SMF), conservation of forest carbon

stocks and enhancement of forest carbon stocks. Carbon pools included in FREL and FRL are aboveground biomass, belowground biomass, deadwood, litter and soil organic carbon. Besides CO_2 emissions, non-CO_2 emissions, viz. methane (CH_4), carbon monoxide (CO) and nitrous oxide (N_2O) from forest fire have also been included as CO_2 equivalent.

Deforestation data over the reference period of 10 years from 2005-2014 was generated from satellite images using the global forest change product and geospatial analysis. The average annual loss of forest to different categories of non-forest land (cropland, grassland, settlement and other lands) was then obtained for estimation of emission. The total deforested area is then multiplied by the difference in carbon density of forest land and non-forest land to estimate the emission of CO_2 due to deforestation. The emission factors or the carbon density was calculated using the data from the National Forest Inventory (NFI) and biomass equations.

CO_2 emission from SMF and conservation of carbon stocks were determined from the timber harvest data maintained with the Department of Forests and Park Services. The timber volume was converted into biomass using the wood density and biomass expansion factor. This was further multiplied by a carbon fraction of 0.47 to convert the biomass into carbon in the volume of timber harvested.

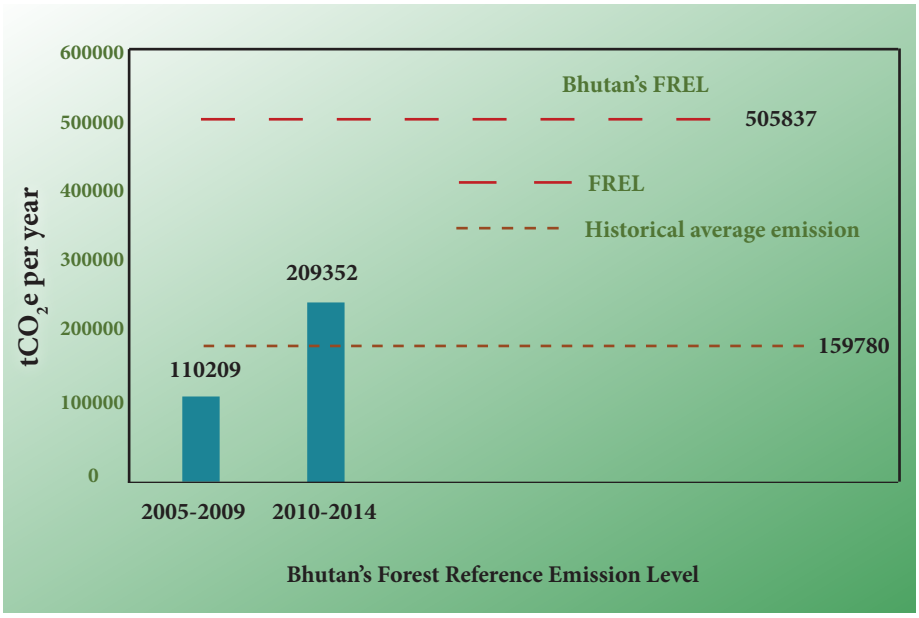
Emission from forest fire was based on the forest burnt area data maintained with the Department and biomass per hectare values from the NFI data. The non-CO_2 greenhouse gases CH_4, CO and N_2O were converted to CO_2 equivalents based on the global warming potential of the non-CO_2 gases.

CO_2 removal as a result of forest growth from the SMF and conservation of carbon stocks was calculated based on forest area and the annual biomass increment from the NFI. The biomass growth rate of the forest is 2.01 tonnes of dry matter per hectare per year.

The carbon stock enhancement was based on a non-forest area brought under plantation. Of the total area brought under plantation, only 50% of the total area was used for the estimation, considering the reported average survival percentage of plantations (which is around 50%). The area under successful plantation was multiplied with an annual biomass increment of 2.01 tonnes to generate forest carbon stock enhancement. For transparency, consistency and future reporting, separate reference levels for emission (FREL) and removal (FRL) were reported.

The FREL for deforestation is constructed by calculating the historical average emissions from deforestation and adding an upward adjustment of 0.1% of biomass carbon stock applicable for countries with high forests and low deforestation.

Bhutan being a developing country with high forests and low deforestation, an adjustment for FREL construction was required and is justifiable. The adjustment was determined based on the assessment of the national circumstances and future projections of developmental activities in the country. With the adjustment, the average annual emission due to deforestation increased to 505,837 tonnes of CO_2 from the historical average of 159,781 tonnes of CO_2.



Bhutan's Forest Reference Emission Level

The FRL for SMF, conservation of forest carbon stocks and enhancement of forest carbon stocks is constructed using historical sequestration rate without applying any adjustment. CO_2 and non-CO_2 emissions due to timber harvesting and forest fire are subtracted from the total CO_2 sequestration by forest. The average net annual removal of Bhutan's forest (FRL) is 8,539,085 tonnes of CO_2. FREL and FRL were developed using the currently available national and relevant global data. The reports were funded by the Forest Carbon Partnership Facility of World Bank with technical support from the Food and Agriculture Organisation, UN. Bhutan would be improving the FREL and FRL submission in the future with the availability of new data and updated methodology. Bhutan's conservation history is driven by the strong political support and visionary leadership of our Monarchs. This has resulted in low deforestation and an increase in forest cover over the years with a positive contribution to climate change mitigation.

The benchmark set by the FREL and FRL demonstrates that the continuation of these efforts to maintain the status quo can be considered as a good performance and positive contribution to the mitigation of global climate change.

The complete documents on FREL and FRL are available at www.dofps.gov.bt or https://redd.unfccc.int/submissions.html?country=btn

REDD+ activity:	Emission ($tCO_2e\ yr^{-1}$)		Removal ($tCO_2e\ yr^{-1}$)		Net removal ($tCO_2e\ yr^{-1}$)		Historical average ($tCO_2e\ yr^{-1}$)
	2005-2009	2010-2014	2005-2009	2010-2014	2005-2009	2010-2014	
SMF	287,273.53	260,976.83	-6,703,186.87	-6,444,120.23	-6,415,913.34	-6,183,143.40	287,273.53
SMF-Fire	373,242.65	343,990.38			373,242.65	343,990.38	373,242.65
Conservation	41,251.89	36,357.03	-2,423,226.08	-2,832,277.27	-2,381,974.19	-2,795,920.24	41,251.89
Enhancement			-8,929.87	-9,521.57	-8,929.87	-9,521.57	
FRL ($tCO_2e\ yr^{-1}$)		-8,539,085.79					

New Discovery

Bhutan discovers three new orchid species

Bhutan discovered three new orchid species namely, *Bulbophyllum trongsaense, Chiloschista densiflora* and *Chiloschista himalaica*.

Bulbophyllum trongsaense was discovered from Trongsa by a team from the Range Office, Trongsa and Bumthang Forest Division. The name was derived from the place of its origin. It is currently distributed in Trongsa and Lhuentse.

The species was collected on 20 September 2019 but it was concluded as a new species worldwide in 2020. It has yellow with reddish-maroon spotted flowers and is found growing on trees. The identity of the plant was not known till date. As per the International Union for Conservation of Nature Red List categories and criteria, the species is endangered in the country.

The other two species, *Chiloschista densiflora* and *Chiloschista himalaica* were discovered by a team from the National Biodiversity Centre (NBC), College of Natural Resources and the Department of Forests and Park Services.

Chiloschista densiflora was discovered from Zhemgang in 2014. The sample is deposited at the National Herbarium, NBC and cultivated at the Royal Botanical Garden in Serbithang. It is named in reference to the densely flowered inflorescences.

Chiloschista himalaica was discovered from Chukha in 2015 and is also deposited at the National Herbarium. It is named in reference to the known general area of distribution in the Himalayas.

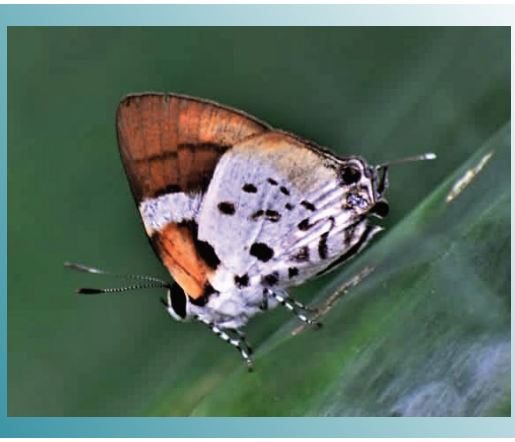
The discovery of such species is a clear indication that the country is rich in biodiversity and needs further exploration to have precise numbers of wild flora and fauna in the country. Bhutan is likely to harbour around 500 species of orchids as many parts of the country are still under surveyed.


Bulbophyllum trongsaense


Chiloschista densiflora


Chiloschista himalaica

Witch butterfly specie recorded



'Witch', one of the butterfly species was recorded in Bhutan for the first time. It was sighted at Jomotsangkha, Samdrup Jongkhar by Ghana Shyam Bhandari, a forester working in Jomotsangkha Wildlife Sanctuary. With the addition, Bhutan now has 759 butterfly species. The butterfly is scientifically known as *Araotes lapithis*. They are a small butterfly found in the Indomalayan realm that belongs to the lycaenids or blues family. According to experts, butterflies are indicators of a healthy environment and ecosystems. They are important pollinators to most agricultural crops and a food source to predators like birds, spiders, lizards and other animals.

Two new snail species discovered from Bhutan

Erhaia jannei

Erhaia pelkiae

Bhutan discovered two *Erhaia* snail species namely, *Erhaia jannei* Gittenberger and Stelbrink and *Erhaia pelkiae* Gittenberger and Gyeltshen.

The news was published by a team of officials from the National Biodiversity Centre, Bhutan (NBC), Ugyen Wangchuck Institute for Conservation and Environmental Research and the Naturalis Biodiversity Centre, the Netherlands in ZooKeys in April 2020.

The species were discovered from brooklet with a prayer wheel along the road in Geneykha, Thimphu in 2018. It was confirmed using DNA sequencing along with morphological descriptions. Their specimens are deposited at NBC. Shells of *Erhaia jannei* are obliquely ovoid with 3½-4 convex, shouldered whorls that are separated by a deep suture and clearly higher than broad. It is yellowish brown in colour with fine irregular growth lines and some blackish brown periostracal ridges, one of which runs from the apertural columellar border into the umbilicus.

Shells of *Erhaia pelkiae* are elongated ovoid with 3½ convex, shouldered whorls that are separated by a deep suture and clearly higher than broad. It is light yellowish brown in colour with fine growth lines and some brown periostracal ridges.

2020

Highlights

3rd Foothills Festival

The 3rd Foothills Festival in Gelephu was held from 16-18 January with a theme, 'Being the economy's change maker.' It was aimed to showcase a diversity of the Dzongkhag's culture and promote Sarpang as a hub for sporting events in the country.

Various RNR products were exhibited by agri-based entrepreneurs, state own enterprises and farmers from Sarpang's 12 gewogs for visitors to explore and enjoy. In addition, stalls were also set up for them to try local cuisines and delicacies. Marathon, bicycle race, traditional games and cultural programs were the entertainment part of the festival.

Tsirang inaugurates a model poultry farm

A model poultry layer farm with a capacity of 500 birds was inaugurated at Pelrithang in Gosarling gewog on February 7. It was funded by JICA with technical inputs from Miyagi Farm Co to transfer effective organism (EM) technology based farming knowledge to Bhutanese farmers.

The farm will promote the use EM to reduce farm odour without requiring to change litter materials for years to save labour and ensure continuous supply of eggs. The farm is fitted with technology with steam heating system for brooding to reduce dependency on electricity.

105 new recruits join the Ministry

A hundred and five new recruits join the Ministry of Agriculture and Forests in February. Out of 105, 28 were agriculture, 28 livestock, 40 forest, 3 BAFRA and 1 marketing officials. The graduates attended two days induction programme on 6-7 February to understand about the vision, mission and overall mandates of the RNR Sector.

Gracing the closing ceremony, the Hon'ble Sanam Lyonpo congratulated the new RNR staff. He urged them to work hard and play a central role in the effective delivery of RNR services at the grass root level.

Yak breeding bull exchange program

The Department of Livestock handed over one young yak breeding bull to the Government of Sikkim and two young yaks breeding bulls to Government of Nepal on February 28 to address the emerging issue of inbreeding and reduced productivity in yaks.

The program was a part of the Kangchenjunga Landscape Conservation and Development Strategy and Regional Cooperation Framework and National Highland Development Program. Yaks play a significant role in ecosystem management and food security of the highlanders in the Kangchenjunga Landscape covering an area of 25,081 sq km in Nepal, India and Bhutan.

New yak cooperative in Bumthang

Forty yak herders, 30 males and 10 females from Chhokor Toe at Thangbi met to understand and form a yak cooperative from 8-10 March. Chhoker Toe has two yak groups, Khendrock and Dhurdrock with 40 herders.

During the meeting, the selected 7 cooperative principles were discussed such as voluntary and open membership, democratic member control, members economics participation, education, training and information, cooperation among cooperatives and concern for the community. The cooperative was named as 'Bumthang Chhokor Lanor Nyamlay Tshogdey.'

Urban and Peri-Urban Agriculture program

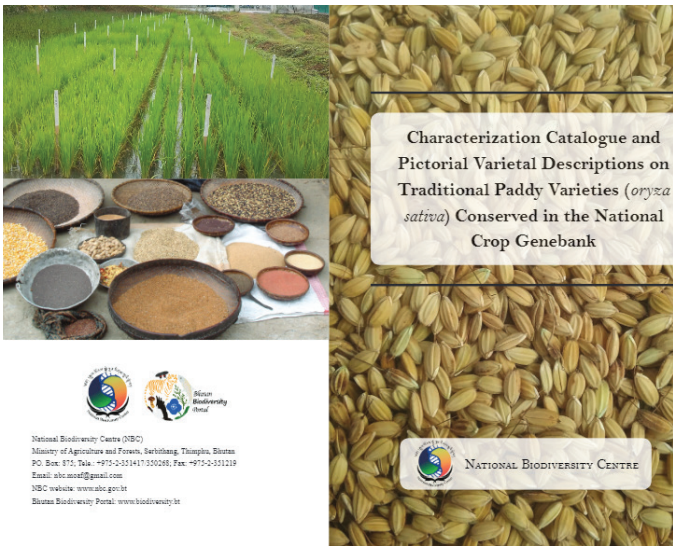
The Department of Agriculture launched the Urban and Peri-Urban Agriculture program in Bebena, Thimphu on May 6 by handing over 6.58 acres of land to 10 groups including 60 beneficiaries. They were mostly tourist guides and tour operators identified by the Tourism Council of Bhutan.

The program was initiated as a part of the preparedness plan to ensure food security in the country during the COVID19 pandemic through supplying vegetables for urban markets and providing alternative employment and income generating venture to laid-off employees.

Vegetable on Wheels launched in Thimphu

To deliver all the essential vegetables and fruits at a doorstep, Vegetable on Wheels was launched in Thimphu on May 7, the first of its kind in the country. Sangay Needup, an aspiring entrepreneur is behind the business idea.

The shop offers the vegetables and fruits that are available at the market at a minimal price and ensures they are clean and hygienically packed making the consumers' shopping experience convenient. They will procure all locally produced vegetables through Dzongkhag coordinators who will facilitate the coordination with farmers.



A book on Traditional Paddy Varieties

Coinciding with the International Biodiversity Day on May 22, the National Biodiversity Centre (NBC) released a publication on 'Characterization Catalogue and Pictorial Varieties Descriptions on Traditional Paddy Varieties (oryzasativa) Conserved in the National Crop Genebank.'

The publication makes phenotypic data available to strengthen information on traditional rice varieties in the country and facilitate the utilisation of germplasm conserved among others. NBC carried out the collection of traditional crop varieties since 2005 to conserve crop germplasm for food and nutritional security.

Improved yak breeds for Laya

Laya received two breeding bulls and a female yak from the Nucleus Yak Farm at Tang to improve yak breed and revive declining yak herding practices in the gewog.

The National Highland Research and Development Centre and Research and Extension Division under the Department of Livestock handed over the yaks to gewog's Mangmi and Assistant Dzongkhag Livestock Officer, Gasa on May 28. There are around 60 yak herders in Laya.

This was the first time the centre distributed yaks to highland communities based on their demand for breeding bulls.

Agricultural Market Information System

The Agricultural Market Information System (AMIS): https://amis.gov.bt was launched on June 24 to enhance the information flow for agriculture products.

The first of its kind, the online system will have real-time prices of 37 commodities from 23 markets across the country. The data will be collected by the agriculture extension officers on a weekly basis. It will benefit small and medium-sized enterprises and farmers in Bhutan empowering them to get better prices and enhance their living standards.

4th Bhutan Journal of Animal Science

The 4th issue of Bhutan Journal of Animal Science (BJAS) launched on July 3 provides a unique platform for all the researchers to share new knowledge and research technologies among relevant stakeholders to facilitate an informed decision.

It presents 24 papers highlighting both historical and contemporary questions in various livestock development areas such as production, breeding and genetics and health. It encourages young and novice authors to submit works addressing the fundamental and scientific aspects together with practical issues.

National plan for PPR

The National Peste des Petits Ruminants (PPR) prevention, control and eradication plan 2020 was released on July 3 for proper management of livestock diseases.

PPR outbreaks are reported mostly through the import of live animals. As part of the global effort to eradicate the disease by 2030, Bhutan has been actively implementing various strategies to prevent, control and eradicate the disease. The document outlines the strategies and activities to eradicate PPR from Bhutan by 2028 through the adoption of a global strategy.

National Apiculture Strategy and Action Plan

The National Apiculture Strategy and Action Plan was launched on July 3 to enhance apiculture development in the country. It highlights the important issues and provides a practical approach to optimise the sustainable utilisation of the rich diversity of honeybee resources for greater socio-economic benefits of Bhutanese people.

The National Highland Research and Development Centre in Bumthang developed the document jointly with the National Dairy Research and Development Centre and Regional Livestock Research and Development Centres at Wangdue and Tsimasham.

AFoCO to help promote community forests and NWFPs

The Gross National Happiness Commission and the Asian Forest Cooperation Organisation (AFoCO) signed a memorandum of understanding for the project, Sustainable Community-Based Enterprises for Improved Livelihood in presence of the implementing partner, Department of Forests and Park Services on July 8. The project aims to promote community forests and non-wood forest products (NWFPs) by establishing community-based enterprises, developing alternative income sources and enhance technology on climate change adaptation. The AFoCO commits an amount of US$ 1,000,000 to the government over the next five years.

New crop varieties

The Ministry of Agriculture and Forests released the high yielding and heat tolerant varieties for 6 crops in July to provide farmers an alternative option for diversifying farming and enhance income.

The varieties include Maize, Wengkhar HTM1, Bean: Bajo Semchum-1-P, Plum: Yusi-Prune 1, Pineapple: Samtenling Kongtsey 1 and Samtenling Kongtsey 2, Banana: Samtenling Ngangla 1 and Tea: Sam Ja 1 and Sam Ja 2.

The released crop varieties were evaluated as per the Standard Evaluation Guidelines for Field and Horticultural Crops of Bhutan.

Highland Dairy Products Shop

A Highland Dairy Products Shop was opened in Olakha, Thimphu on July 22 to make the value-added highland products available for customers at a reasonable price.

The shop is run by a youth group of five members from Sakteng of which three are university graduates and two tourist drivers.

The group was formed in April 2020 after the yak cooperatives in Sakteng and Merak found it difficult to market their products amid COVID19 pandemic and approached them for help.

10th International Tiger Day at Nubi

The 10th International Tiger Day was celebrated at Nubi in Trongsa on July 29 highlighting the importance of tigers not only in Bhutan but also across the world.

As a part of the celebrations, a semso of Nu.5000 for improved breed and Nu.2000 for local and bulls was provided to all the owners of cattle killed by tigers in 2020.

A publication, Nga gha mo? for primary school children and a board game for school children "Tag dang Nor" was also launched on the day.

Bhutan records six new tiger

Bhutan recorded six new tiger in 2020 which was announced during the International Tiger Day on July 29. Out of six, one tiger each was sighted in Jomotshangkha Wildlife Sanctuary and Phibsoo Wildlife Sanctuary while four were sighted under the Divisional Forest Office, Sarpang. Bhutan confirmed 103 tigers in the country through its last national tiger survey in 2015.

The Department of Forests and Parks Services and WWF Bhutan is exploring innovative ideas to compensate tiger affected communities through insurance schemes and engaging them in tiger conservation.

National REDD+ Strategy and Action Plan of Bhutan

Coinciding with the World Rangers Day on July 31, the Watershed Management Division launched the National REDD+ Strategy and Action Plan of Bhutan. It was developed involving all stakeholders.

The strategy provides a long-term vision and policies and measures to address the drivers of deforestation and forest degradation and enhance forest conservation and sustainable forest management. It will contribute to preservation of Bhutan's rich forest biodiversity, enhance livelihoods and uphold the carbon neutrality pledge of the country.

World Rangers Day

Bhutan celebrated the World Rangers Day on July 31 by launching the revised insignia system for forestry officials.

All the forestry officials will now adorn a unique insignia in their combat uniform pegged to the position classification system of the Royal Civil Service Commission. The design of the insignia features the Blue Poppy, the forestry logo and the colour of our national flag as stripes that will be worn based on the ranks.

Globally, the day is observed to commemorate rangers who have lost their lives or are injured in the line of duty.

6th RBFE in Haa

The 6th Royal Bhutan Flower Exhibition (RBFE) in Haa was hosted virtually on August 14 offering a visual treat to people across the country by bringing the gardens to their screens amid the COVID19 situation.

The exhibition in Haa was not confined to one place but spread across all over the Dzongkhag including dungkhags, gewogs and schools. There were around 21 gardens covering the main valley with four major sites at Sinchupang, Lhakhang Karpo, Chumigna and Herbal Garden. The gardens highlighted the natural wealth of Haa including local flower species and medicinal plants.

35th session of FAO APRC

Bhutan hosted the virtual 35th Session of the FAO Regional Conference for Asia and the Pacific (APRC) in Thimphu from September 1-4.

More than 490 delegates from the FAO member nations attended the conference to discuss the region's present food security situation focusing the COVID19 implications on food systems. It also served as a platform to highlight examples of partnerships, innovation and digital technologies on food security and nutrition.

APRC is being held once in two years on a rotational and voluntary basis amongst the member states.

Agreement signed between DoFPS and GBCL

An agreement was signed between the Department of Forests and Park Services (DoFPS) and the Green Bhutan Corporation Limited (GBCL) on September 16 to implement the plantation program. It will enhance the overall success of the country's plantation program with proper implementation modality.

GBCL started the plantation activities in 2016 covering a total of 1163 hectares of new plantation with a fund of Nu.81.46 M and maintaining 1173 hectares of old plantation with a fund of Nu.21.61 M.

Run Wild with Tendrel

More than 1 M runners participated in the WILD RUN campaign for Tigers, Elephants and Pangolin held from September 25-October 4. A tiger from Bhutan, Tendrel Zam was featured in the Adidas Runtastic app along with Adjany, an elephant and Pamoja, Pangolin.

Tendrel Zam had the highest competitors with 565,197 runners, followed by Pamoja with 308,892 participants and Adjany with 145,430 participants.

The campaign was aimed at giving a voice to 1 M species that are under threat to extinction at the UN General Assembly Biodiversity Summit.

World Rabies Day

The World Rabies Day was observed in majority of the Dzongkhags on September 28 with a global theme, "End Rabies: Collaborate, Vaccinate".

According to the Regional Livestock Development Centres and the Dzongkhag Livestock Sectors, a total of 2968 dogs and cats were vaccinated against rabies and 1099 pets were registered through the National and Dzongkhag Veterinary Hospitals, Thromde Veterinary Hospital and Satellite Laboratories, and Livestock Extension Centres. Besides, pet deworming and sterilisation services were also provided on the day.

National Organic Centres

The National Centre for Organic Agriculture in Thimphu and the National Seed Centre in Paro became the first two centres in the country to be registered as organic centres under the Bhutan Organic Guarantee System, the first step for organic certification in October.

They commit to adopt the organic farming practices at their farms and will have to adhere to Bhutan Organic Standard (BOS) requirements to certify their products as organic and access Bhutan Organic Mark.

The centres will be assessed for compliance to BOS to get certified under the Local Organic Assurance System.

Foresters attend arms and drill training at MTC

A group of foresters including 23 fresh recruits of forestry officers, 6 rangers, 24 foresters and 12 drivers joined Military Training Centre (MTC) at Tencholing, Wangdue for month-long arms and drill training on 10 October. Out of them, 11 were females.

Participants were trained on proper wearing of uniform, accessories and other accouterment and proper adornment of insignia. They were also trained on drill, disciplines and salutations, personal appearance and turn out. In addition, the trainees learned basic handlings of arms and ammunitions.

World Food Day

Bhutan celebrated World Food Day on October 16 with a global theme for 2020, "Grow, Nourish, Sustain. Together. Our Actions are our Future".

The theme aptly reflected the government's efforts to make food systems more resilient so that they can withstand the shocks from increasing price volatility, climate change and supply chain disruptions.

The day launched the rice fortification awareness video and announced the winners for the School Agriculture Programme annual awards and the food recipe contest.

Range offices inaugurated at Mendrelgang and Tsirangtoe

Tsirang Forest Division upgraded two beat offices at Mendrelgang and Tsirangtoe gewogs to full-fledged Range Offices in October.

Mendrelgang Range Office will look after the jurisdiction of 207.60 km^2 covering gewogs of Mendrelgang, Barshong and Patsaling and cater the forestry needs to 1076 households. Tsirangtoe Range Office will look after the jurisdiction of 223.25 km^2 covering Phungtenchu, Tsirangtoe and Sergithang gewogs and cater the forestry services to 1295 households.

e-RNR Crop Advisory

The Ministry of Agriculture and Forests launched an e-RNR Crop Advisory, a mobile app targeting the Bhutanese youths to help them take up farming for their livelihoods in November.

The app is an easy platform to disseminate information on know-how of growing agricultural crops through textual, picture and video contents. It hosts farming information on crops such as tomato, chilli, cabbage and cauliflower highlighting how to grow them starting from nursery management to harvesting. It is available on Google play store for download and works on Android phones.

DoFPS receives Royal Enfield bikes

The Department of Forests and Park Services (DoFPS) received 16 Royal Enfield bikes through the project, Enhancing Sustainability and Climate Resilience of Forest and Agricultural Landscape and Community Livelihoods in Bhutan on November 10.

The bikes will help the Forest Management Units to ensure the effective monitoring and patrolling activities within the project area. The project which started in October 2017 will come to an end in October 2023 and is financed by GEF-LDCF with GNHC as the national implementing partner.

Tiger Conservation Excellence Award

The Royal Manas National Park received the Tiger Conservation Excellence Award on November 23. The Manas Tiger Reserve in India also received the same award. It marks the 10-year anniversary of all 13 tiger range countries who committed to double the wild tiger population by 2022 through the strategy TX2.

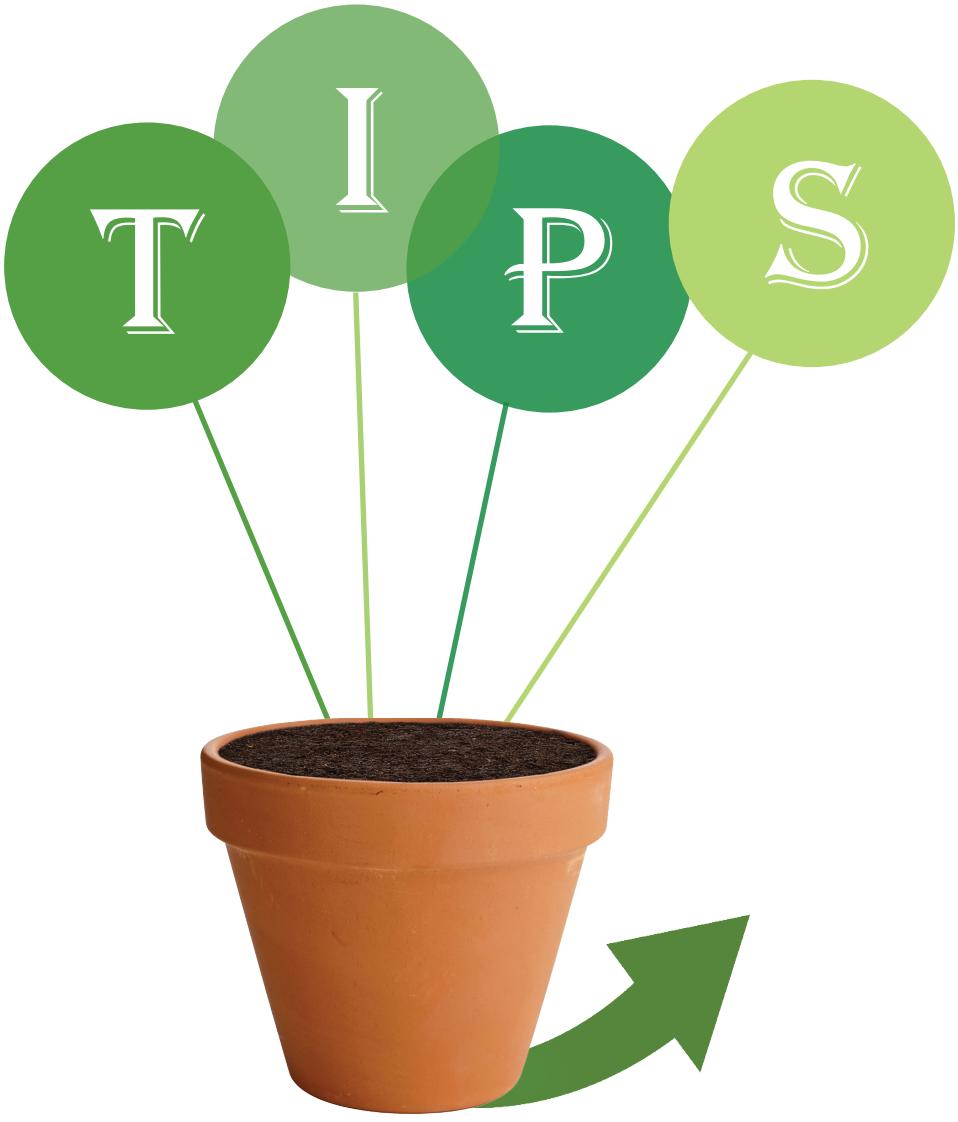
The tiger population in the park increased from 12 in 2008 to 26 in 2018 and from nine in 2010 to 25 in 2018 in the Manas Tiger Reserve. The awards include a financial grant to assist the ongoing tiger conservation.

Civil Service Award Day

The Ministry of Agriculture and Forests celebrated the 'Civil Service Award Day' on December 10 in Thimphu.

The dedicated service awards have four categories: gold medals for services of 30 years and above, silver for services of 20 years and above, bronze medals for services 10 years and above, and a Lifetime Service Award. Eighty RNR staff were awarded with gold, 107 with silver and 210 with bronze medals while thirty-five staff received the lifetime achievements award. The annual award launched in 2013 comprises a medal and certificate signed by His Majesty The King.

RNR



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How to avail Third-Party Organic Certification?

The Bhutan Agriculture and Food Regulatory Authority (BAFRA) is mandated to provide third-party certification for organic agriculture. It is to facilitate trade, market access, fair competition and consumer trust of products both at the national and regional levels.

BAFRA operates Organic Certification Scheme as per ISO/IEC 17065:2012 to provide third party organic certification mark based on Bhutan Organic Standard (BOS). BOS covers scopes for crop production, animal husbandry, aquaculture, wild collection, apiculture, processing, handling and storage. However, this issue will exclusively cover the certification of agricultural crops.

The processes involved in BAFRA's organic third-party certification are as follows:

Certification Process

1. Application

The interested applicant must submit an application with necessary information to BAFRA in the prescribed form, available from www.bafra.gov.bt.

Application review

BAFRA reviews the application to assess the readiness of the applicant for organic certification. Accordingly, the applicant is informed of the outcome of the review.

2. Farm Audit

After successful registration, BAFRA carries out on-site farm inspection on a mutually agreed date, as per Bhutan Organic Standard. During farm audit, BAFRA inspectors assess some of the following critical activities:

- Composting of farmyard manures and kitchen wastes for improving soil fertility.

- Use of crop rotations, intercropping and agro-forestry systems.
- Selection of crops which are adaptable to the local conditions.
- Management of biodiversity to provide natural pest regulation.
- Use of water resources in a sustainable manner through minimum tillage, use of legume cover crops, green manures etc.
- Conservation of topsoil and erosion control measures.
- Restriction on burning of vegetation during land preparation.
- Prohibition on the use of Genetically Modified Organisms (GMOs).
- Prohibition on the use of chemical pesticides and fertilisers.
- Appropriate measures adopted by the client to identify and avoid potential contamination.
- Records of farm inputs and its source, farming operations, processing, handling, storage etc. shall be maintained in the Farm Diary.

During inspection, relevant samples such as water, soil and product may be drawn for laboratory analysis. The samples are tested in approved laboratories.

In case of Farmer's Group(s), the inspectors will also assess proper functioning of the Internal Control System (ICS). ICS is a quality assurance system based on group's internal procedures or rules. The National Centre for Organic Agriculture imparts training on organic principles and practices and implementation of ICS.

If non-conformities are observed during audit, BAFRA informs the applicant to take corrective actions and BAFRA verifies its adequacy.

Review Process

When the inspection activities are completed the evaluation reports are reviewed to ensure that it fulfills the Organic Standard and the certification requirements and a recommendation for the grant of certificate is made to Certification Committee of BAFRA.

3. Certification Decision

The decision for grant of certification is made by BAFRA's Certification Committee and the applicant is informed of the Committee's decision.

4. Grant of Certificate

For successful applicants, BAFRA issues a license and agreement on the use of the Certification Mark is signed between BAFRA and the applicant. This information is made publicly available by BAFRA. The certified client may use the organic Certification Mark on the certified product.

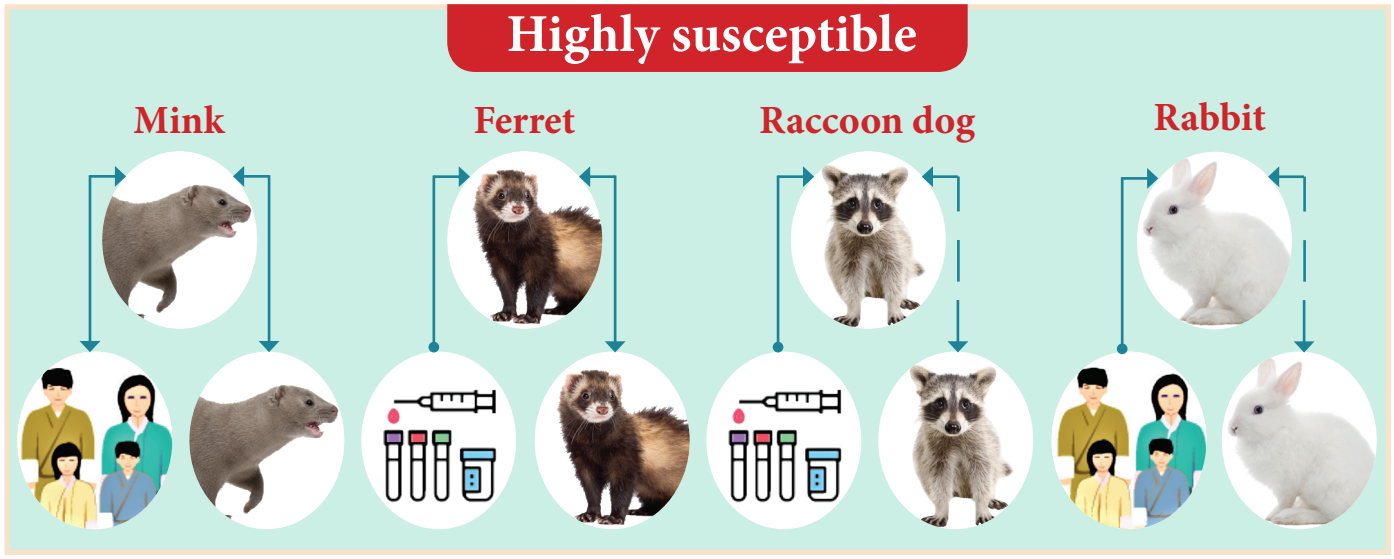
5. Recertification

The validity of certificate is for three years and surveillance will be conducted by BAFRA at site at least once a year to ensure continued fulfillment to BOS. The client is required to apply to BAFRA for renewal before the license expires.

Source: BAFRA

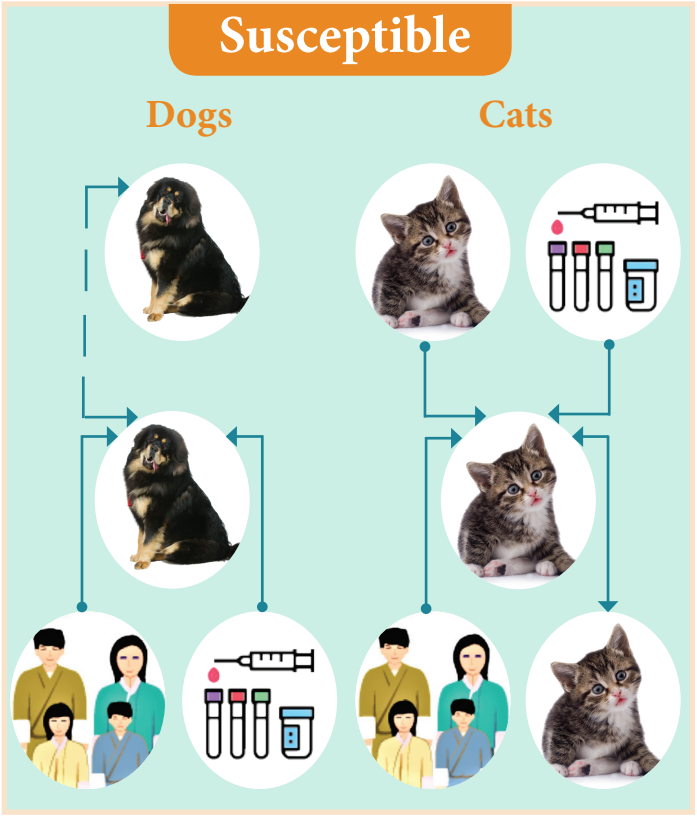
Fast facts on COVID19 infection in animals

DOs and DON'Ts



What you should do while entering farm?

- Workers and visitors should park their vehicles in designated areas.
- Non-essential visitors should not be allowed on the premises.
- For large farms, stagger arrival of workers entering the farm.
- Discourage the presence of dogs, cats, wild animals and pests.
- Ensure appropriate management of waste, faeces and other materials.
- Use an all-in-all-out strategy with cleaning and disinfection before restocking.
- Provide and wear appropriate Protection Personal Equipment (PPE).



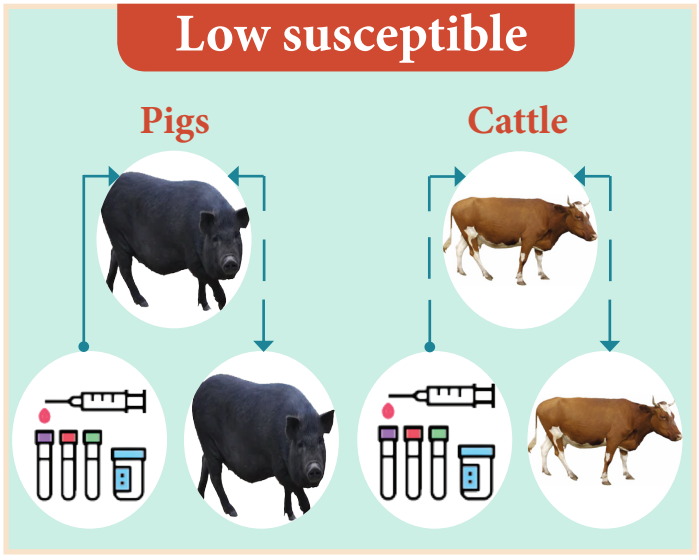
What you should do while in farm?

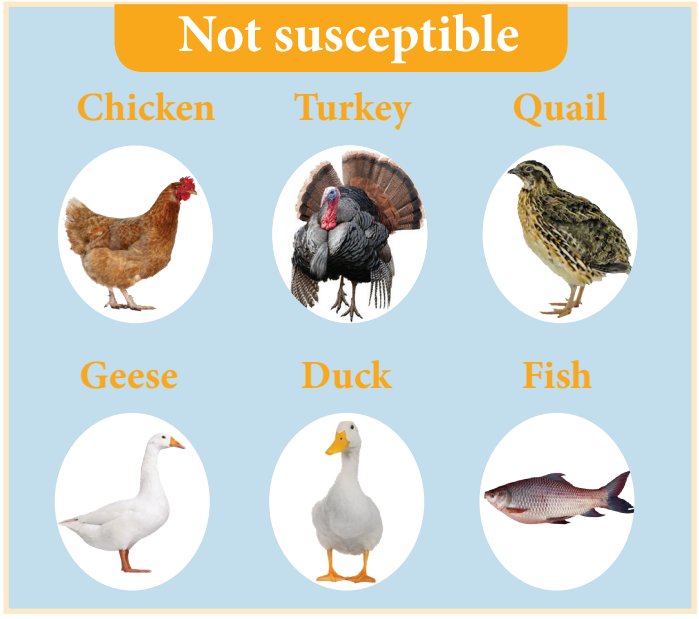
- Wear new or cleaned and disinfected PPE.
- Use foot-bath with clean disinfectant.
- Clean and disinfect all spaces using recommended disinfectant.
- Maintain farm enclosure to prevent entry of other animals.
- Avoid rotating workers among different farms.
- Ensure physical distance between farm workers.
- Prepare for a possible shortage of the workers.
- Disinfect farm tools before and after use.
- Practice basic personal hygiene-hand washing.
- Raise awareness among farm workers about how SARS-COV2 spreads.

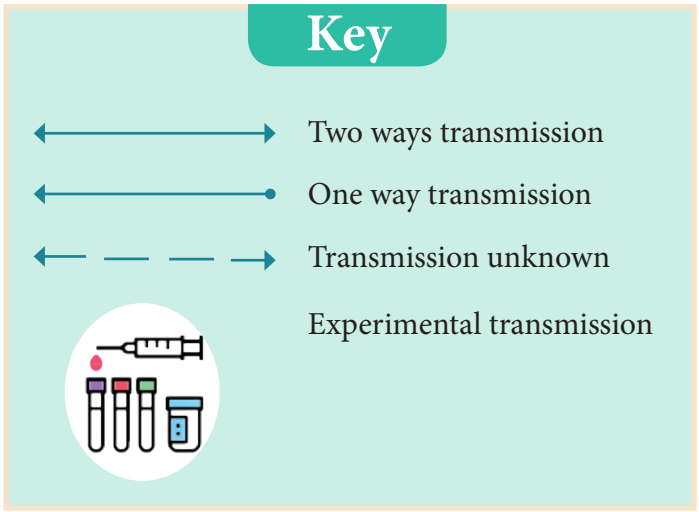
What you should do if your animals come in contact with SARS-COV2?

- No domestic animals should be abandoned, rejected or killed without the evidence of animal-to-human and animal-to-animal transmission.
- If they have been in contact with infected animals or humans or show clinical signs should be brought to the attention of the relevant animal health authorities.

Source: National Centre for Animal Health







Biochar
Organic material

What is biochar?

Biochar is a solid material obtained from the carbonisation thermo-chemical conversion of biomass in an oxygen-limited environment. (*International Biochar Initiative online: FAQS*)

Benefits of biochar

1. Improvement of soil structure.
2. Soil pH adjustment.
3. Colonisation of effective microbes.
4. Temperature keeping effect.
5. Strengthen cell walls and support plant growth by silicon (Si) of biochar.
6. Reduction of risk from soil borne diseases.
7. Pot weight saving by mixing with nursery soil.
8. For deodorant (e.g. cattle shed).

Be careful when handling fire. Keep children away from during the fire-work in progress.

How to make biochar?

1. Fill straw into a 10 L can with some holes.
2. Place the can into a barrel
3. Ignite straw.
4. Set a chimney.
5. Fill husk up to a half of barrel.
6. Wait for 80% carbonising.
7. Fill husk again to full of the barrel.
8. Wait for carbonising.
9. Remove the chimney and distinguish biochar.
10. Rap up the barrel for cutting off oxygen.
11. Leave the barrel one night to stop burning.
12. It is ready to use.

How to use biochar?

1. Nursery soil mixture

Soil recipe

Soil and sand =Soil 4 buckets + sand 3 buckets

Biochar= 3 buckets

Compost= 1 bucket

Bokashi= Half bucket

Suphala= 1 handful

a. Fill biochar (10-15% of total).

b. Fill nursery soil.

c. Overlay surface by biochar. Sow a seed/transplant seedling.

d. Done.

2. Soil structure improvement

a. Scatter biochar on planting bed or place.

b. Mix with soil.

3. Uprooted seedling treatment

a. Put a grab of biochar into a watered wash tub.

b. Stir up.

c. Soak seedling roots into the water. It is keepable for 2 days.

4. Deodorant

Deodorant effect is one of the biochar's feature. Scattering biochar on cattle shed can suppress the smell (not 100%).

5. If biochar becomes ash, it is useful as well.

>Mineral supplements

>pH control to alkaline

>Aphid, fungi control

Source: ARDC-Bajo

Bokashi
Organic material

Bokashi, the fermented organic fertiliser is a Japanese word originating from a situation of fungus with visible filaments and spores. The various reasons for making Bokashi in organic farming are improving garden/farm quality, integrated disease control and utilisations of organic wastes. Bokashi making is not difficult but requires some preliminary skills and experiences to produce even quality which depends on the freshness, materials and inoculant microbes. Rice/ wheat/bucket wheat bran are the most suitable materials for making Bokashi in Bhutan and all inoculant microbes are available around farm yard.

Bokashi can be used as:

1. Fertiliser for all basal and top dressing with or without chemicals.

2. Soil sterilisation starter when use with grain bran or green manure for quick decomposition and improve soil microflora.

3. Disease control: Use top dressing and furrow application (as an antagonistic microbe functions).

4. Pest control: Sprinkle Bokashi from the top of leaves for army worms (young instars) and hairy caterpillars.

5. Composting enhancer: Inoculants usage for any type of compost for better quality and quick composting.

6. Feed grade.

How to make Bokashi using rice bran? You need the following basic materials and measure the amount firmly:

- 70 L or 80 L bucket: 1 pc
- 2 m x 2 m plastic sheet: 1 sheet
- Used newspaper: 3-4 pcs
- Jute rope: 4-5 m
- Rice bran: 50 kg
- Water: 10 L
- Sugar: 500 g
- Natural salt: 50 g
- Phum (Yeast): 1 small spoon
- Plain yoghurt: 1 large spoon
- Over ripen fruit: 100 g
- Trichoderma: 10 ml

Process

1. Put sugar, salt, dried yeast, plain yoghurt and ripen fruit into 10 L water bucket and stir well.

2. Add and mix the above dissolve water gradually and evenly a whole of rice bran. Mix well to avoid lumps.

3. Fill the mixed rice bran up into the bucket tightly and expel the air. Lay newspapers on the rice bran.

4. Cover the bucket by plastic sheet and bind it by jute rope tightly. Then put a weight.

5. Store the bucket in some cool place. Sometimes, check the fermentation smell inside the bucket. Fruity and sour fragrance like 'Ara' is a proof of success but the failure stinks freaking.

How to use Bokashi?

1. Soil fertility improvement

Continuously applying Bokashi can improve soil fertility due to the organic carbons and

beneficial microbes returning into the soil. The importance of rich balanced micro flora is known well for good soil fertility and the Bokashi can work as core microbes and antagonistic microbes.

Application

a. Use Bokashi as basal or top dressings.

b. Use Bokashi with green manure (50 kg/acre at plowing).

c. Use Bokashi 0.1% v/v (=1/1000 v/v) with added farm yard manure.

2. Soil biological sterilisation (+basal fertilisation)

Trichoderma is one of the important useful microbes naturally existing in leaf mould in healthy natural forest surface soil. Bokashi fermented with *Trichoderma*, this can reduce soil borne disease risks in combination with other alternative/integrated biodiversity control methods. If you do rice bran soil sterilisation, no need for the basal fertilisation.

Application

a. Materials are grain bran (rice, wheat, buckwheat).

Grain bran 0.5-1 kg/ m^2+Bokashi 5-10 g/m^2

(or mustard green)

b. Apply and immediately plow into the soil. After watering enough, cover the soil by vinyl sheets. Additional 1-2 times of plowing the area recommended.

c. The sterilisation period is 1 month. Keep soil moisture until transplanting or sowing.

3. Organic fertiliser

Bokashi can work efficiently and quickly in combination with increasing soil fertility, biodiversity and better quality yields. You can partially or totally replace chemical fertiliser depending on the amount of Bokashi.

Application

Equivalent nitrogen amount per acre:

Bokashi 250-500 kg

=Suphala 50-100 kg

=Compost 2500-5000 kg

4. Decomposing accelerator

Bokashi can improve manure/ compost quality and speed up fermentation. It highly depends on temperature and water content, however, mixing in 1% (=1/100 v/v) Bokashi is effective for this purpose.

Application

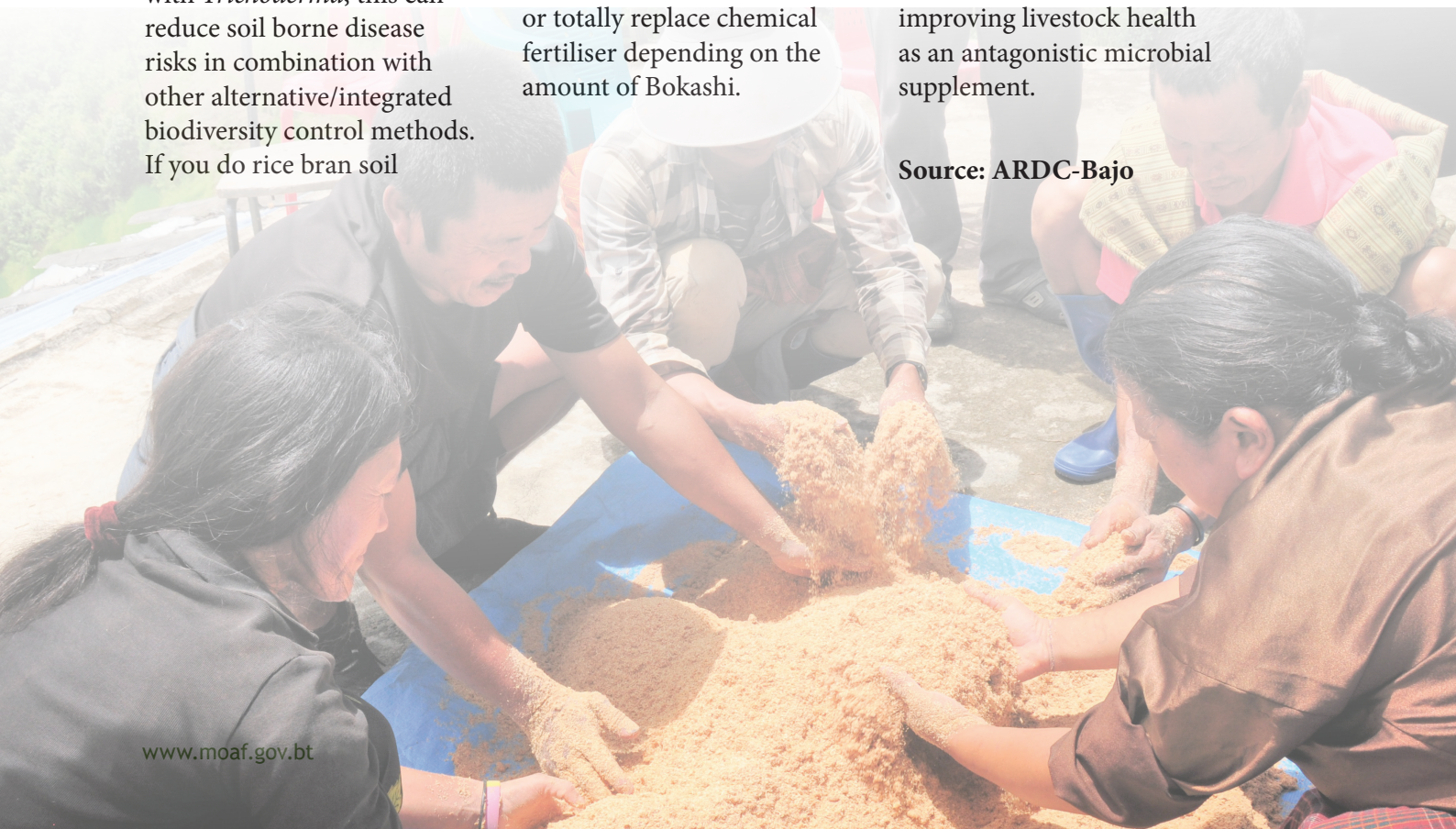
Mix Bokashi.

(0.1% volume of compost)

5. Feed for livestock

Rice/wheat/buckwheat bran Bokashi made precisely can be used as special feed for improving livestock health as an antagonistic microbial supplement.

Source: ARDC-Bajo



Most forest fires occur because of human carelessness, a few things you can do to prevent forest fire

Take care of your campfire after camping

Snub out your cigarette properly after smoking

Take proper precaution while burning debris

NURTURE THE NATURE, SAVE THE FUTURE
LET'S COME TOGETHER TO PREVENT FOREST FIRES
EVERY LIFE COUNTS

Report to Royal Bhutan Police at 110 or the nearest Forest Office in case of forest fire

ONLY YOU CAN PREVENT FOREST FIRES !

Source: Department of Forests and Park Services

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