

ISSN No. 2221-6103



SANAM DRUPDREY

www.moaf.gov.bt

February 2020



Organic Watermelon



Royal Quinoa



The RNR family would like to wish
everyone a very happy and prosperous
MALE IRON RAT YEAR 2020



May the
NEW YEAR
bring you health,
happiness and wisdom.

TRASHI DELEK !



FOREWORD

Dear Readers,

The Ministry of Agriculture and Forests is happy to present you the tenth edition of the Sanam Drupdrey.

It covers subjects ranging from agriculture to forest to livestock and all associated activities with an objective to promote and accelerate agriculture development through information dissemination and promotion of new and improved agricultural technologies to attain food self-sufficiency, food-security and rural poverty reduction.

It also examines market trends over the years and provides various market insights and information on the farming sector of Bhutan.

The magazine 'Sanam Drupdrey' is one of the demonstrations of commitments to the Ministry's efforts to reach out to agricultural and rural communities. The stories may

be raw but it comes from the frontlines where real actions take place. The policies implemented at the Ministry will only be justified if they are implemented in the field and have direct impact in improving the lives of our rural people.

With this, I would like to congratulate ICTD and all the contributors for highlighting some of the interesting and motivating stories from all around the country.

I am happy to see that our farmers are working towards fulfilling the national objective and the RNR sector goal.

The stories tell me that the youths and our citizens are taking up farming with increased emphasis on commercialisation and agro-enterprise development.

It also overwhelms me to see some of the conservationists making new discoveries and working towards conservation of the environment which

is one of the GNH pillars, a developmental philosophy for our country. Through this foreword, let me also take this opportunity to share that the average growth rate of RNR sector during 11th five year plan (FYP) was modest at 3.35%.

The top five farming constraints being pointed were labour shortage, crop damage by wild animals, insufficient irrigation supply, limited market access and crop damage by pests and diseases followed by others like unproductive land and shortage of land, limited access to seed, tools and equipment and natural calamities.

In light of these constraints, I am happy to announce that the RNR sector's 12th FYP is committed to achieve significant and sustained increasing level of food self-sufficiency with accelerated commercialisation and enterprises development and maintaining environmental sustainability through climate smart and disaster resilient development.

Similarly, the inspiring stories by our colleagues in the field addresses some of the challenges ranging from the pursuit of farming as a calling by educated youths, organic farming, enterprises, human wildlife conflict mitigation and automated irrigation among others.

Such innovative and inspiring ideas are found to indisputably contribute to the sector's 12th FYP goal of, 'Inclusive and sustainable development for ensuring food self-sufficiency and economic self-reliance.'

As the head of the Ministry, I become emotional when I read the

articles in the magazine. I equally rejoice in their moments of joy and triumph and feel their frustration and pain when things go wrong as they sometimes will.

Great results can only be achieved with dedication and diligence. If we are to fulfill the vision of a prosperous and vibrant Bhutan, it must begin with the repository of Bhutan's spiritual, cultural and social values: its farmers and villages.

Lastly, I would like to thank all the contributors for your sheer hard work and perseverance and look forward to even more motivating stories of not only your successes

but also on the lessons learned in the next issue of Sanam Drupdrey.

Trashhi Delek!



Yeshey Penjor
Minister
Ministry of Agriculture
and Forests





EDITORIAL ICTD

Information and Communication Technology Division (ICTD) would like to wish all our valued readers a happy Male Iron Rat Year 2020 by bringing out another exciting issue of Sanam Drupdrey or the RNR Magazine.

The Magazine is an annual and unique publication through which the Ministry shares its motivating stories of success and innovation in the fields of agriculture, livestock and forest with the audience.

Through this tenth edition of the Magazine, we present you eighteen promising RNR stories along with the Ministry's past year highlights and farming tips to try out for better results. We have commendable stories related to vegetable production, automatic irrigation, organic certified products and weed control solution, protected cultivation, quinoa, bio-slurry and foot and mouth disease.

Besides inspiring story of an educated farmer in Sarpang, the magazine highlights the new additions to the list of organic certified products, a significant move closer to becoming an organic nation. Another story worth reading is on chilli production which is picking up particularly in the south. Such success is tremendously helping the country in import substitution while also providing income generation opportunities

for farmers. It is also encouraging to witness how Bhutan is adopting technology into the agriculture farming. The success stories on the introduction of protected agriculture, automated irrigation and bio-acoustic repellent are some great examples which can be now taken to the ground level to offer better working environments to our hard working farmers.

Further ICTD hopes that the story on quinoa will encourage everyone to understand the health benefits of this new smart future food. The promotion of quinoa is expected to immensely contribute in achieving the nutritional as well as food self-sufficiency targets in the days to come. Several other interesting stories are also featured in this edition for readers to enjoy and learn from the field experience.

We hope that Sanam Drupdrey continues to appreciate and highlight the dedication of our farmers and RNR family towards achieving the national goal of food self-sufficiency.

ICTD would like to extend our acknowledgement to all the authors for their valuable contributions in making the publication, Sanam Drupdrey, a huge success.

We wish you all a fruitful year ahead.





The Department of Agricultural Marketing and Cooperatives have registered a logo for B CO-OP (Bhutan Co-operatives). So, all the shop operators are requested to use this standard logo on the B CO-OP shop signboards.

Logo Description

‘B’

The letter **‘B’** stands for Bhutan. It is being identified by the national colour, upper yellow and lower saffron colours.

“CO-OP”

The letters **“CO-OP”** stands for Co-operatives.

A male and a female around it represent farmer’s cooperative members. It is to show that this Cooperative is for these farmers’ groups. It also depicts that their unwavering commitment and endeavour is essential to uphold the values and principles of the cooperatives.

The two entwined leafy structure supporting all others above is to show that these cooperatives are largely dependent on renewable natural resources.

Contents

| TOPIC | Page No. |
|---|----------|
| Foreword | |
| Editorial | |
| A graduate becomes a successful Farmer | 2 |
| Vegetable production picks up in high altitude Dzongkhag of Haa | 5 |
| Automated Irrigation System | 8 |
| Twelve organic certified products hit the market last year | 11 |
| Karmaling farmers venture into commercial production of Chilli | 16 |
| Community seed production group for Upland Paddy | 18 |
| Protected cultivation | 20 |
| Promoting farm based micro-enterprises | 22 |
| Organic weed control trial in Paddy | 25 |
| Bio-acoustic repellent | 28 |
| Royal Quinoa | 31 |
| Re-discovery of <i>Primula chasmophila</i> | 34 |
| Heat tolerant varieties for Cabbage and Cauliflower released | 36 |
| Phrumsengla National Park adds one more new Rhododendron species to the list | 39 |
| Understanding the cost of hybrid tomato production using different mulching methods | 40 |
| FMD outbreak in Pigs | 43 |
| Bio-slurry for sustainable organic agriculture in Bhutan | 45 |
| Bhutan records new fish and bird species | 47 |
| 2019 Highlights | 48 |
| RNR TIPS | 64 |

A graduate becomes a successful Farmer

Her bold decision to take up farming has given her immense sense of satisfaction

Tashi Phuentsho, ARDC-Samtenling



Youth unemployment has become a pressing issue in Bhutan. With more graduates seeking white-collar jobs every year against the backdrop of limited openings, there seems to be no quick fix to this vexed challenge. It is obvious that both policy makers and job seekers have to think out of the box. Encouraged by government policies for job diversification, an increasing number of graduates have started taking up business ventures as a means of livelihood and sustenance. However, not many have entered the agriculture sector.

This is the story of Kamana Gurung, a 32-year-old graduate who chose farming as her profession. She did her Bachelors in Arts from Cluny Women's College in Kalimpong, India in 2012. She has one child and two dependants while her husband is a teacher in one of the private schools in Sarpang. After her graduation, she ran a hotel business at the



“I am looking forward to export few value added products such as organic turmeric and ginger soon.”

-Kamana Gurung

Gelephu hot springs. Despite the business being lucrative, she decided to change course and venture into farming. This decision received mixed responses from friends and family. Nonetheless, she and her husband started exploring for more ideas and reliable source for technical guidance and inputs.

With blessings and encouragement from her parents who are farmers, her final push was her visit to Deepak's commercial vegetable farm at Samtenling. Deepak is one of the progressive farmers in Sarpang today. He makes a good living from selling vegetables and fruits. Kamana's visit to the farm inspired her into starting a similar business of her own. Thereafter, she

approached the Agriculture Research and Development Centre (ARDC)-Samtenling for technical expertise and guidance. Not one to be discouraged easily, she took the plunge headlong despite initial misgivings and apprehensions.

She leased four acres of land and started from scratch. The presence of a research centre in the vicinity was of great help for her. Under their recommendations, she began her first phase of cultivation on a 60 decimal area. She constructed a low cost polyhouse in which vegetable nursery beds were raised. She grew a wide range of vegetables including chilli, tomato and cole crops. Of late, she focuses more on winter chillies and beans. Demand greatly increased after the import ban on these commodities.

In the following year, she expanded her production to the entire four acres of land. Today, a visitor to her farm will observe considerable number of raised beds covered by black and shiny plastic. These are plastic mulches which have become an indispensable part of her farming. Plastic mulches check weeds, control pests and regulate soil moisture in addition to other benefits.

She made enough profit to clear her loan which she had availed for the initial investment. In 2018, she generated Nu.300,000, most of which came from Indian chillies sold between Nu.150-200 for a kilogram. Contrary to what many farmers may feel, she has not faced marketing issues with vendors from different places coming to buy at the field. Some retailers book her produces over phone

while some do it through her Facebook page, P.K Organic Farming. She also sends her produce to schools and the local market at Gelephu. With growing public awareness, she believes that the market for organic produce will increase in the future and plans to apply for organic certification to authenticate her produce.

Farming demands consistent hard work and she is confronted by numerous obstacles that she has to overcome all the time. Pests and diseases are regular challenges but the biggest threat to emerge recently comes from wildlife encroachments. Elephants plundering and destroying crops has become her routine nightmare. They are constructing an electric fence but she believes wildlife threat may be an ongoing feature of a farmer's life in her village.

It has been almost three years since she first started her organic farm. Once an inexperienced farmer, today

she proudly owns an organic farm covering four acres with plans to lease an additional five acres of government land. For crop diversification, she has started growing mushrooms and she is planning to cultivate some fruits as well probably watermelon. On the whole, her bold decision to become a farmer has given her immense sense of satisfaction.

She believes, "That at the end of the day what keeps us going is will power and commitment, the same ingredients that ensure success in everything we do. When you are into business, even an elephant comes to test our resilience and endurance, but it's our choice whether to give in or stand up and I embrace the latter one." This very message she would like to convey to all especially the youth, to never give up and do everything with all of our heart, rain or shine because ultimately the hard work always pays off. She is thankful to the centre, Dzongkhag and gewog extension supervisor for their constant support and supervision. Without them she

believes it would have been impossible to reach this far. If she has to procure everything by herself the investment would have escalated and less likely to have made profits from her field. For instance, inputs like hybrid seeds are very expensive and would have been difficult to afford on her own.

Likewise, plastic mulch, flexible pipes, water reservoir tank and polyhouse are some of the inputs that she has received from the centre and Dzongkhag.

She is more than willing to impart and share her experiences with interested youth. With her advice and example, few of her relatives have already started mass chilli cultivation. This way, she feels that she can not only make her living but contribute to the nation's dream of achieving food self-sufficiency in her small way. "I am looking forward to export few value added products such as organic turmeric and ginger soon," Kamana adds.



Vegetable production picks up in the high altitude Dzongkhag of Haa

Following the introduction of greenhouse



Tshering Doma, ICTD

Kinley Bidha, a 52 year-old woman, has completed another successful year growing vegetables on her farm in the high altitude Dzongkhag of Haa.

Last year, Kinley, the sole bread earner in a family of five was able to earn an income of Nu.0.15 M. She worked hard and is happy with the reward.

Kinley is among many farmers in Bangayna village under Eusu gewog who have ventured into commercial vegetable

production, something they had been denied so far by the harsh climatic condition. In the past, Haaps could grow only potato and radish and focused more on dairy farming. But today, they can opt to grow a rich variety of vegetables, even in winter, thanks to the introduction of the greenhouse.

According to Ugyen Wangmo, the gewog agriculture extension supervisor, the first greenhouse was erected at Bangayna in 2015 involving 15 farmers through the Haa Organic

Farming Support Initiative. The project wanted to address the shortage of locally grown fresh vegetables in their local market. The vegetables brought from other Dzongkhags were very expensive to afford.

Greenhouses have opened new opportunities for Eusu farmers, enabling them to grow vegetables such as tomato, chilli, cabbage, cauliflower, carrots, broccoli, lettuce, spinach, peas, beans, beetroot, coriander and cucumber.



Besides the willingness and effort put in by the farmers, the technical guidance and hands-on training support in cultivation and management of vegetable provided by the Dzongkhag Agriculture Sector has enhance the production of vegetable in greenhouses and has proved to be laudably successful.

During 2018-2019, seven greenhouses were distributed on a cost-sharing basis, making the total number to 37 in Eusu.

The gewog has recorded to have produced 34.7 MT of

vegetables including carrots (7.5 MT), beet-root (2 MT), broccoli and other vegetables (2 MT), potato (12 MT) and tomato (11.2 MT) in the past year. These were sold at the local market as well as in Thimphu and the Food Corporation of Bhutan in Phuentsholing.

In August 2019, for the first time, members of Haa Farm Fresh Tomato group brought their organic tomatoes to the Centenary Farmers' Market in Thimphu for sale, proving that with a simple innovation, tomatoes can be grown in cooler places.

The home grown tomato, which is better and healthier, presents a welcome change from stale imported ones of dubious origins. At present, there are more than 85 households in Haa engaged in growing tomato commercially.

Farmers are thankful to the project and the sector for their support in making vegetable production successful in Haa. But the success is not without the challenges.

Kinley shares a key concern, "Marketing our products is a big challenge with increasing

harvests and limited local demand.” Another farmer, Ugyen Chenzom says, “Thimphu would be the best market for our products, but it is again difficult to compete with imported vegetable items.”

According to the Dzongkhag Agriculture Officer, Karchung, the sector is exploring ways to help farmers in this vital area. Two groups have been formed in Eusu and Samar gewogs to promote not only vegetable production but also to ensure their market. The sector is also planning to supply high yielding seed inputs, link farmer groups to schools,

support micro-irrigation facilities, train farmers on new technologies and create awareness on organic farming.

Meanwhile, the Ministry’s approved strategic plan on the School and Hospital Feeding Program is expected to solve the marketing concerns of the farmers. The program will offer farmers preferential market access to local schools and hospitals.

Today, there are more than 188 greenhouses in Haa with an annual vegetable production of around 779 MT worth about

Nu.14.56 M. Many farmers in Haa, are showing interest to take up vegetable farming. They can see how the new activity is helping their neighbours earn good income for themselves and contribute towards achieving food self-sufficiency in their communities and the nation at large.

As most of the farm work in Haa are carried out by uneducated women like Kinley Bidha, Pema Choden and Ugyen Chenzom, they are the source of inspiration for the youth and other interested groups.





Automated Irrigation System

Economical agriculture innovation for efficient irrigation and water conservation

Dr. Tshering Penjor, Lhap Dorji, Galey Namgay, Dorji Wangmo, Pema Thinley, Tashi Wangdi and Pempa Lhamo
ARDC-Wengkhar

Bhutan is rich in fresh water resources. However, due to climate change and rapid urbanisation, the volume of clean water is diminishing and becoming harder to access. Due to a lack of appropriate irrigation technologies and related infrastructure also, it is often unable to harness water for use in agriculture even where water is abundant. Therefore, efficient water management system through use of proper technology is required for sustainably using this precious resource especially in the

agriculture sector. In this connection, automated micro-irrigation systems may be the best solution.

Automated micro-irrigation system refers to operation of the irrigation system (drip and sprinkler) with minimum human interventions. The system can increase crop yields, save water, energy and labour costs as compared to manual systems. The automation of the irrigation process is important for three reasons to address water scarcity, provide

timely irrigation and derive maximum crop out of every drop. The Agriculture Research and Development Centre (ARDC)-Wengkhar has started to develop an automated or SMART irrigation system using open-source software and hardware solutions since 2016 with initial funding from the EU-GCCA Project and later continued with support from the Commercial Agriculture and Resilient Livelihoods Enhancement Program (CARLEP-IFAD). The hardware controllers are based on open source firmware and

low-cost hardware platform such as Raspberry PI, Arduino, ESP8266 and ESP32 Micro-controller unit boards. The local weather data can be fed to these controllers through Wunderground website which controls the amount of water application to the crop based on the weather parameters preset in the program by the user.

The system can be accessed from any smart phones and personal computers through open source software and mobile applications such as Sustainable Irrigation Program and open sprinkler. These free software and mobile applications enable users to control and monitor irrigation systems virtually from anywhere if it is connected to the internet. It has been tested and demonstrated in different locations in Bhutan. It is found to be economical and has the potential to

upscale in the commercial farms for efficient irrigation and water conservation. Like any technology, it comes with a cost which depends on the type of system, crops and features of the land. The overall cost of an automated irrigation will depend on the type of irrigation set up, drip or sprinkler system.

Project unit cost per area varies upon the type of crops, water source and water pressure for proper functioning of the system. On an average, the overall cost of establishing it in one acre of citrus orchard is about Nu.185,000 which will be roughly similar for other fruit crops. However, the cost will differ for closely planted crops such as vegetables. About 80% of the total cost will be incurred for the purchase of materials and 20% on labour cost for installation of drip-lines and the setting up of the automation system. Labour

cost for installation also depends upon the geological conditions of the field. If the field is located on rocky and undulated terrain, the labour cost will be higher as compared to a field in the plain area. In general, the cost effectiveness of the system increases with larger areas of coverage. This is because one device has the capacity to control irrigation over large areas.

The cost of an automated sprinkler to cover one acre is about Nu.380,000. This is derived from the actual expenditure incurred for establishing automated sprinkler irrigation system in 10 acres pineapple plantation for youth contract farming at Marphang, Trashigang. Sprinkler cost is double that of automated drip irrigation. This difference is due to use of different materials, sizes and installation cost. In general, the sprinkler irrigation system





requires larger volume of water to operate compared to the drip system, hence it needs bigger distribution pipelines and fittings which cost more.

The centre having developed and tested the technology has now started to promote in the field with good results increasing popularity. The idea of automated irrigation system was further extended to solve other water management problems. Kengkhar gewog in Mongar suffered water shortage for many years. Drinking water used to be supplied using pumps.

The gewog administration had been facing difficulty to find a caretaker who would manually operate daily the two electrical pumps for pumping drinking water supply. The two pumps are located about 9 km downstream which supply water to the school, RNR office, gewog office and 70 other households.

With the technical assistance from the centre, the two pumps are now automated and can be run on scheduled basis and remotely switched on and off through mobile applications. This set up helped the gewog providing water supply services to the public more efficiently. Similar installations

are also being supported to address water management problems in Mongar town. Agriculture is an important sector in Bhutan since it provides livelihood to about 57% of the total population. Yet, agriculture remains one of the least attractive sectors and faces critical challenges such as labour shortage, human-wildlife conflict and inadequacy of irrigation water among others. Given these, the use of ICT as indicated in the above six commercial farms and sites especially adapted to our condition has the potential to be of great benefit to farmers.

Further, support in the use of ICT could also open up agri-business opportunities for large number of youth graduating with IT background in the country. Thus, use of ICT in agriculture needs to be promoted and supported at every level to make farming more attractive, productive and profitable.

The centre is now promoting the technology in commercial farms in the eastern regions with financial support from CARLEP thereby putting in place an appropriate technology for efficient water use and management enhancing resilience to climate change impacts.



Twelve organic certified products hit the market last year

Tshering Doma, ICTD

Bhutan's decision to transition to organic farming has been widely appreciated for its environmental and consumer health benefits.

Today, many farmers have ventured into organic farming in the country, successfully taking their products to the market. Some of them are now officially certified organic by the Ministry of Agriculture and Forests.



Bhutan now have 20 nos. of organic products with 12 getting organic certification in 2019. They are *Xanthoxylem* (Thingye), rice, watermelon, cassava powder, tomato, Adzuki bean, Mari Gold, Red corn flower, Blue corn flower, Pink corn flower, kiwi and coffee.

For many, *Xanthoxylem* is just a forest product but for farmers in Nubi gewog, Trongsa it is a source of cash income with an annual earning of Nu.10,000-20,000. *Xanthoxylem* is cultivated by Nubi Menjong Nyamley Tshogdey and sold to Kabab Organic Farm.

The farm utilises the pepper pods to extract essential oil for sale. The oil is believed to be effective for arthritis, digestive distress, febrifuge and

muscular aches. According to the founder, Kuenga Dhendup, the organic certification has helped them widen market opportunities. He is planning to get the organic certification for medicinal and culinary herbs in the future.

The organic watermelon of the Bertey Women Group in Zhemgang have been a big hit in the local market including in Thimphu.

The group marketed around 12 MT of watermelons and 34.928 MT of local rice last year making revenues of Nu.4.2 M and Nu.0.35 M respectively.

According to a group member, Karma Lhamo, "Our organic products have a good demand. It is difficult sometimes to meet the demand particularly for rice."

Sangay Zangmo is one of the members behind the success of the organic certified cassava powder of Green Hills Farm. The group of nine youth under Choerkhorling gewog, Pemagatshel cultivates cassava in 60 acres of land with a weekly production of 400 kgs of powder.

The group earned an income of Nu.0.2 M and hopes to have better opportunities in the future with the organic trademark. At the moment, the use of powder in Bhutan is limited to cakes, pancakes and few other food items unlike in a more advanced country like Thailand where they have diverse cassava products.

Another organically certified product, tomato is grown by the Druk Horticulture Pvt. Ltd



in their model organic farm of 10 acres with 35 greenhouses at Wangsisina. According to a spokesperson, Laqzial Dorji, one tonne of organic tomatoes was produced in the first season of 2019.

The firm is planning to bring their vegetables and strawberries under organic certification and go on a joint venture soon.

The Adzuki bean grown at the Motithang Palace Farm was introduced from Japan as Bhutan was considered suitable to grow the bean naturally.

Samten Zangmo, one of the spokespersons said that 271 kgs of beans were produced in the past year from 20 kgs of seeds. With the organic trademark, the farm is planning to export the beans to Japan in 2020.

The Red Enza kiwi grown by the Ashish Horticulture and Nursery in Tsirang is the first kiwi farm to receive organic certification.

According to the founder, Kalyan Mahat, he started farm in 2016 and produced about 2000 kgs of kiwi till date. He was able to produce around 600 kgs of kiwi in 2019 and earn an income of Nu.400,000. The plants are four years old now and he hopes to go for a commercial production by 2023.

He has already started making value added kiwi products such as kiwi wine, jam, pickle and dried fruits. He is planning to set up a cottage industry soon to upscale the production. Although, kiwi is new to Bhutan, it is expected to gradually pick up considering the potential for international market.





Coffee from Bhu Org Farm is another organically certified product. The farm has produced around 100 kgs of coffee on a trial basis from 3 acres of land.

“I see a huge potential in the local market and outside with the organic trade mark in place,” shared the proprietor, Kamal Pradhan. He is exploring the market in high end hotels as well as planning to export coffee.

The four valuable edible flowers are grown by three young entrepreneurial women of Drachukha Flower Group in Punakha. The group together with Druk Metho process flower petals for export to Switzerland and local market.

This joint venture have helped to reverse the trend of rural-urban migration by developing more lucrative and diverse livelihoods for rural farming communities and empowering women in the villages.

“Our parents have always done sustainable farming to produce enough to eat. But we young people have to come up with new ideas and create sustainable livelihoods for ourselves,” shared Choki Seldon, the group chairperson.

According to the founder of Druk Metho, Thinley Namgay, the dried flower petals have

an ever-increasing demand globally as ingredients in innovative food and beverage products.

While sharing their experiences in organic farming, many members said that dealing with pests and manpower shortage are their biggest challenges.

However, they persist because organic foods have great health benefits and a huge market potential both within and outside the country. They feel that more awareness needs to be created to make people understand about the benefits of organic food and support our local producers.

According to Pema Zangmo from the National Organic Programme, Yusipang, “Getting an organic certification is not easy.” She added that a member applying for an organic certification has to go through





various procedures mandated in the Local Organic Assurance System (LOAS). “Attending a basic training on organic agriculture is an important requirement,” Pema shared.

She further added that LOAS is based on trust to ease marketing and help consumers to identify genuine organic products.

The certified products will bear the Bhutan Organic Logo signifying that products

have been grown locally following the Bhutan Organic Standard provisions under the supervision of the agriculture extension officers.

Other documents, such as the Bhutan Organic Certification Guidelines 2019 and internal control system provide further support to facilitate certification procedures.

Today, many farmers as well as institutions are showing interest to take up organic

farming, according to a spokesperson from Yusipang. Meanwhile, the Ministry has launched the National Organic Flagship Programme to promote organic agriculture and the School Feeding and Hospital Program to support our farmers and ensure safe and nutritious food supply.

With the launch, more organic certified products are expected to hit the market helping Bhutan move closer to becoming an organic nation.



Karmaling farmers venture into commercial production of Chilli

Today 145 households cultivates chilli for better income

Sangay Dorji, RNR-Agriculture Sector, Karmaling

How chilli commercial cultivation became successful in Karmaling gewog is a long story. It begins with several failures that generated new ideas for developing new tactics.

Chilli growing was new to the farmers of Karmaling until its introduction in 2017. It happened when the government banned import of chilli, beans and cauliflower due to consumer health concerns. It was difficult to introduce chilli farming at the beginning. However, it has

become a success story and we can see almost every farmer of the gewog growing chillies now. Chilli farming program was begun with six farmers in 2017. They are the pioneers and the key players in contributing to the success of chilli cultivation in Karmaling.

By 2019, the number of farmers interested in growing chillies increased to 145 households covering 18 acres. Thereafter, cash earnings of 70% of the households in the gewog were improved through commercial chilli farming. Karmaling chillies are now sold

in Thimphu, Gedu and Paro. The success was not without challenges. As chilli farming was newly introduced, neither we extensions nor farmers had past experiences in chilli farming practices. Therefore, most of the farmers did not want to risk their efforts and were reluctant. So we began slowly with only six farmers.

Unlike in open space, we placed the first nursery inside low cost polyhouse with raised beds. The nursery was started in mid-August 2017. However, it was observed that the young seedlings died at



the initial two leaves stage due to high temperature and humidity. With the failure of first staggered nursery, we raised the second nursery inside low cost polyhouse protected by shade. There was 70% germination rate in the shed protected polyhouse nursery. We learned that high temperature and humidity were the main reasons for the failure of the first nursery.

Windstorm with heavy showers poses real dangers. Further, seedlings cannot grow well inside polyhouses due to high humidity and temperature. Therefore, it was realised that raising nursery inside polyhouse in mid and late summer was not feasible in the south.

After several failures in raising nursery beds, both in the open and inside polyhouses, as part of the new interventions and mitigations, we made a new attempt with potting method of

raising nursery. Potting method is the process of raising nursery using plastic cup with potting medium. This program was initiated with five core farmers. The potting medium should consist of sieved top soil and decomposed cattle manure with a sandy base. (Prepare medium contained ratio of 4:3:1 as top soil, manure and sand respectively). Potted cups are seeded with single seed per cup. Those potted cups are kept safely at corridor or in protected roof shed with net fencing to protect from poultry.

Potting method of raising nursery yields with great results providing 95%-99% germination rate in less area as compared to conventional method.

It ensures better care as potted seedlings are raised inside corridor or under roof shed with no transplantation shock. During plantation, besides using mulching film and drip



sets, we incorporated locally developed material such as planter and dicer. These locally designed materials were introduced for the first time in the gewog. Dicer is locally designed and can be used for making holes on plastic mulched bed for transplantation.

While piercing holes on mulching film, dicer can remove or excavate soil from bed thereby creating base for plantation. Holes of 0.5 x 0.5 x 0.5 (Cu.ft) are refilled with decomposed manure before young seedlings are transplanted. These measures ensure a 100% nutrient supply and serve as reservoir for water supply.

Chilli harvesting starts from the last week of October and continues till July. We supply green chilli for about eight months. With 48 household in 2018, the gewog produced about 17 MT of green chillies excluding personal consumption.



Community seed production group for Upland Paddy

Towards sustainable seed supply and supporting climate change impacts

Passang Wangmo and Tshering Choden, ARDC-Wengkhar;
Tshetrim Gyeltshen, ARDSC-Khangma and Tashi Wangdi, Khoma

Rice has occupied a prominent position as a strategic crop for food security in Bhutan. Despite being among the highest per capita consumers of rice in the world, our current self-sufficiency rate is less than 50%. Various interventions such as spring rice cultivation, reversion of fallow land for paddy cultivation, promotion of high yielding varieties and

revival of upland paddy were initiated to contribute towards enhancing rice self-sufficiency at the household level.

Upland paddy, growing rice in dry-lands (mostly rain-fed) is an opportunity to contribute to rice self-sufficiency especially for farmers in the higher elevations (>1800 masl) to diversify maize-based cropping

system. Over the years, upland paddy cultivation through research outreach in the six eastern Dzongkhags which began in 2004 by the research centre is gaining popularity in the region and this is found to be mainly from the consistent availability of quality seeds through the program. However, since consistent supply of seeds through the research outreach program will not be sustainable



in the long run, a Community Based Seed Production (CBSP) program was initiated in Pangkhar with a community under Khoma gewog in Lhuentse. This was one of the communities selected under the outreach program four years ago in 2015 by the Agriculture Research and Development Centre (ARDC)-Wengkhar and the Khoma agriculture extension centre in order to ensure sustainability in seed production for upland varieties.

The 18 members (12 female and 6 male) in Pangkhar began an on-farm trial of some seven different varieties in 2015. These included Zangthi I and II, Machapucharey, Lumang Local, Chandanath I and III and Khangma Maap. A participatory varietal selection by the community selected

Wengkhar Kambja I, (then it was called Machapuchery) introduced from Nepal mainly considering their criteria such as grain colour and size, ease in threshing, suitability in high altitude, more numbers of tillers, long panicles and good taste.

Machapucharey was introduced in 1996 and released in 2017 as Wengkhar Kambja I. It has been two years (2016-2017) since the Pangkharps began growing Wengkhar Kambja I. In early March of 2018, the community decided to form a seed production group. They cultivated a total of 7.5 acres of dry land every year harvesting a total yield of approximately 6 MT thereby increasing their rice self-sufficiency by 75%.

With support from the Commercial Agriculture

and Resilient Livelihoods Enhancement Program, a pair of paddle threshers was provided and foundation seeds were given by the centre.

The group in 2018 produced a total of 6.05 MT of Wengkhar Kambja I seeds. These seeds are being sold to farmers and other centres in order to initiate similar outreach program in their villages.

“This is not the end, the best is yet to come,” Dawa Dema, one of the group members added with a smile as she pocketed the yellow Nu.1000 notes she received from her sale.

With increased production, the community will follow the CBSP maize program to be linked to the National Seed Centre (NSC) as registered seed growers through the collaboration between the centre and NSC. The Pangkharps are encouraged to grow more.

With the impacts of climate change becoming the greatest threat to crop production, the initiation of seed production group for upland paddy can contribute to ensuring sustainable supply of seeds for rice varieties that need less water to cultivate.





Protected cultivation

A viable option for an agriculture-based enterprise

Kinley Tshering and Nita Tamang, Agriculture Production Division, DoA

Protected agriculture technology is a viable option to counter balance the impact of climate change, facilitate year-round production, intensify cultivation and utilise water and other inputs more efficiently. Moreover, the technology has the potential to attract young entrepreneurs into the agriculture sector, create employment and encourage agriculture-based enterprise development.

It is still relatively new in Bhutan. However, the use of polyhouses (both locally fabricated and imported tunnel greenhouses) has been increasing in recent years (1229 greenhouses from 2008-2017) especially for nursery

and vegetable production during off-season. With the ban on import of chilli, beans and cauliflower from 2016 due to high pesticide residual content in them, the move for increasing domestic production, especially during the winter season was initiated.

The harsh winter climate in the country was unsuitable for growing chilli under open condition whereas it was observed that they could be grown under protected cultivation. Therefore, many farmers and youth are now venturing into protected cultivation. In that sense, protected agriculture is highly dynamic part of the agriculture industry and it can revolutionise farming and

deliver better quality vegetables at comparative prices, all year round. Protected agriculture can be classified into two types, Hi-tech and Low input.

The first one refers to the use of hydroponics, soil-less culture and climate-controlled greenhouses. The demonstration of hydroponic system was started in the research centres at Yusipang, Bajo and Samtenling with funding from FSAPP. The cost of a hydroponic system for 120 m² area is around Nu.2.700 M. This covers the fan and pad system greenhouse with top cladding of polycarbonate sheet and sides with UV stabilised polyplastic. The structure is inclusive of climate control, misting and nutrient film

technique grow system. The Low input technique is the promotion of pre-fabricated greenhouses with efficient irrigation system, mulching and insect proof net for growing vegetables under protected cultivation.

Protected agriculture is identified as one of the agri-based enterprises to be promoted by the Department of Agriculture (DoA) in the 12th five year plan. The National Vegetable Program through the normal budget support for 2018-19 promoted and established two protected cultivation for enhancing vegetable production.

A protected cultivation demonstration was established in Tashiding gewog in Dagana in an area of about one acre with farmer group of seven members. Two prefabricated low cost greenhouses of 20 m x 5 m and 25 were installed with two water-

harvesting structures, drip irrigation sets and plastic mulching, incurring a total of Nu.787,256.25. The site is managed by the group established in September 2018.

Further, to encourage youth farming, the program supported the group, Bhutan Smart Shop Enterprise in Thimphu. The program established two prefabricated greenhouses measuring 20 m x 5 m on a cost sharing basis of 80:20 (80% from the program and 20% contribution from group) at Pamtsho.

The group invested a total amount of Nu.4.000 M and have generated a net profit of Nu.0.223 M till date. The shop was established in April 2018 for vegetable production with an online marketing system, it has eight members who are paid employees. The main vegetables grown under the technology were spinach, coriander, lettuce,

spring onion, tomato and chilli. Winter chilli was the main crop grown in 2018 winter season in the protected structure. The group in Tashiding produced 429 kg of green chillies till May 2018 earning an income of Nu. 86,250.

For sustainability, both the groups need to be strengthened through technical and additional material supports for another two years as they are in the initial stage of the program.

Access to finance (credit facilities) for the entrepreneurs for the both cases needs to be assured by the Ministry with technical support to facilitate business proposal development for linking with existing credit schemes such as Rural Enterprise Development Corporation Ltd, priority sector lending etc.



Promoting farm based micro-enterprises

Through post-harvest processing and value addition training



Kinley Wangmo, IFPP Lingmethang; Pema Lhaden and Lhap Dorji, ARDC-Wengkhar

The gradual transformation of farming in Bhutan from subsistence level to semi-commercial and commercial scale leads to surpluses which could be put to beneficial use. Post-harvest loss of farm produce could not only be prevented but yield extra income through value addition. With the

initiation of the Integrated Food Processing Plant (IFPP) from the National Post Harvest Centre (NPHC) in Paro, an IFPP was established in the eastern region at Lingmethang, Mongar and another at Shumar, Pemagatshel.

Both the NPHC and the Agriculture Research

and Development Centre (ARDC)-Wengkhar began a collaborative program on product diversification through processing and value addition targeting crops that had some surplus, low value, short shelf-life and potential for processing and enterprise promotion. Farming enterprise promotion is one of the key strategies of 12th five year plan

with a major development indicator on the number of enterprises developed during the plan period. While farming enterprises such as commercial fruit and vegetable, dairy and poultry are some of the major enterprises promoted by the Ministry, post-harvest processing and value-addition can also be a source of agro-based enterprises suitable for specific target groups. These could include non-farmer groups such as youth, hoteliers and women groups in urban and peri-urban centres.

Farm produce often go to waste both on and off farm. Some of the common crops that have low market value have the potential to acquire higher value through processing and value addition. These include pumpkin and cassava which could fetch better value as powder or cookies. Unripe or rejected fruits can be processed into jams, candies, rolls and so on.

In order to capitalise on the availability of several farm produces that can be value added and the opportunity from various support programs and the ongoing Commercial Agriculture and Resilient Livelihoods Enhancement Program (CARLEP-IFAD), the IFPP at Lingmethang and ARDC-Wengkhar with support of CARLEP began



conducting tests and trials on developing processed products and expansion with potential entrepreneurs mainly through organising hands-on training for interested target groups.

A total of 30 trainings were provided to 710 participants (509 women, 201 male) targeting various groups such as individual farm entrepreneurs, lead farmers, women groups, unemployed

women, hoteliers, nuns, teachers and student clubs. Between 2015-2016 and 2018-2019, a total of some 78 different processed products mainly cookies, candies, pasta, noodles, marmalades, crackers, powders and so on have been developed. Based on these products and some of the previously existing ones such as pickles and jams, the IFPP, ARDC-Wengkhar, Regional Agriculture Marketing and



Cooperative Office (RAMCO) and Dzongkhags have so far set up three enterprises in the eastern region. These include home processed farm products with Yoezer Home Stay, Thidangbi Mongar, Bimkhar and Wominang, Bumdeling Women Group; Urka pickling groups in Trashiyangtse through which a new product 'Urka Pickle' was launched during the 111th National Day in 2018 and Nutri food products, Mongar with a group of youth who established a full time local cookies production unit and sale.

These established enterprises today have marketing links to local retailers and the one-

gewog-one product shops at Thimphu and earn approximate gross income per year of Nu.650,000 by Yoezer Farm Stay, Nu.800,000 by Wominang dried Urka chilli and pickling group and Nu.500,000 by Nutri foods from the sale of cookies and packaged farm products.

While a large number of farmers have been trained in the process of developing the products, not many have started any projects, lack of finance being the main obstacle. CARLEP allocation of funds to Dzongkhags and RAMCO for promotion of agro-processing and value-addition as enterprises is an opportunity that can bring

capacity development into practice for the already trained individuals, groups and any new aspiring entrepreneurs.

Meanwhile, the IFPP and ARDC-Wengkhar will continue research and innovations in product development and give priority to providing technical assistance to the Dzongkhags and RAMCO so that agro-processing and value-addition can be promoted as opportunities to increase income, value addition, promote 'go-local' concept and contribute to establishing micro-enterprises and attract credit investments.





Organic weed control trial in Paddy

Recommends crop rotation of rice for weed control and soil fertility

Kinley Om and Yenten Namgay, ARDC-Yusipang

Bhutan is moving towards becoming an organic country. With majority of our farmers growing rice as the staple crop, some organic initiatives to address the challenges particularly weed related were felt crucial. Weed management and irrigation shortage are the main problems faced by rice farmers.

Hence, the Field Crop Sector and National Organic Programme under the Agriculture Research and Development Centre (ARDC)-Yusipang in collaboration with JICA JPP has been working on organic weed control research for past three rice growing seasons (2017, 2018 and 2019) through observation plots at Tendrelthang (Thimphu), Paro, Chimipang and Bajo.

The research was aimed to establish the method of organic rice cultivation in Bhutan without using any herbicide to control paddy weeds focusing on *Potamogeton distinctus*, (Shochum in Dzongkha and Hirumushiro in Japanese). Shochum is a very problematic weed in rice and it is believed to reduce rice yield by around 34% (Ghimiray, 1999).

To start, the nursery was raised in the second week of April. For Tendrelthang, the nursery was raised in pot type trays with a soil mixture of 1.320 gm defatted soya bean and 10 kg mountain soil. For Chimikha in Paro, the nursery was raised in mat type trays with soil mixture of 3 kg chicken manure and 10 kg red virgin mountain soil. The mixture was

maintained with 40% moisture and fermented inside plastic bag for a month.

Transplanting was carried out using transplanter at Chimikha while it was done manually at Tendrelthang. For transplanting, healthy paddy seedlings (4-5 leaf stage and 15 cm) was selected to avoid insect and disease attack. Water reservoirs or biotopes were established at the top of the rice field to raise the temperature of irrigation water and control harmful insects in the field.

The main method to control weed *Potamogeton distinctus* was done by puddling the rice field three times before transplanting. Each puddling had different benefits. During

Year-wise crop cut data

| Year | Plot | Variety | Harvest area | Total no. of panicle | No. of grains per panicle | Total grain | 1000 grain weight (g) | By product yield (g) | Grain yield (g) | Yield kg/ac |
|------|--------------|--------------|------------------|----------------------|---------------------------|-------------|-----------------------|----------------------|-----------------|-------------|
| 2017 | Tendrelthang | Sasanishiki | 1 m ² | 314 | 97 | 30458 | 22 | 524 | 641 | 2954.13 |
| | Chimikha | Sasanishiki | 1 m ² | 257 | 124 | 31894 | 21 | 513 | 655 | 2650.78 |
| 2018 | Tendrelthang | Sasanishiki | 1 m ² | 334 | 100 | 33400 | 25 | 515 | 702 | 2840.99 |
| | | Khangma Maap | 1 m ² | 271 | 127 | 34417 | 24.5 | 500 | 529 | 2140.86 |
| | Chimikha | Sasanishiki | 1 m ² | 254 | 123 | 31242 | 24.9 | 511 | 536 | 2169.19 |
| 2019 | Tendrelthang | Sasanishiki | 1 m ² | 200 | 90 | 18000 | 22 | 400 | 466 | 1885.90 |
| | Chimikha | Sasanishiki | 1 m ² | 337 | 125 | 42125 | 22.7 | 645 | 750 | 3035.25 |





the first puddling, seeds of *Scirpusjuncooides* (weed) which floats on the surface of irrigated paddy field was removed. The second puddling was carried out 15 days after the first during which the Shochum germinated were puddled and mixed with mud. The second puddling helps in promoting butyric acid fermentation. The third puddling was carried out 10 days after the second to convert the fermented butyric acid to lactic acid.

Transplantation was done after three days following the third puddling to allow a proper settling of the puddled soil. Defatted soya bean was broadcasted in the paddy field right after transplantation. Defatted soya bean was residue from soya bean after the extraction of soya oil. It will help to prevent root rot and has ability to supply 6 times more nitrogen than any other chemical fertiliser. To prepare defatted soya bean, the oil extraction machine was installed at Chimipang with support from Japan.

In the first year, the trial was carried out with Japanese rice variety, Sasanishiki followed by Khangma Maap in the second year and Sasanishiki again in the third year. Crop cut was done in a radius of 56.4 cm from the crop stand and the yield produced was recorded. It was observed that the weed pressure was largely reduced

in the paddy field possibly due to the impact of butyric and lactic acid fermentation in weeds. According to the Japanese experts, crop rotation of rice with soya bean, wheat and mustard should be carried out in order to improve the soil fertility and control weeds pressure in paddy field. The crop rotation was successfully practiced at Paro farmer's site, however it was difficult to carry out the crop rotation at Tendrelthang due to lack of fencing and crop damage by stray cattle.

Apart from technical expertise, NPO-Civil Institute Organic Rice Cultivation, Tochigi Prefecture, Japan also supported the trial with inputs such as pot and mat type trays, seeds (Sasanishiki), wheat (Canadian wheat), Rapeseed (Natane), soya bean (Enrei), manual weeder, oil containers, funnels, filter papers and seed soaking bags. The project has immensely benefitted the organic management of rice weed. Considering the performance of the Japanese variety Sasanishiki in Bhutanese climatic condition, the centre is proposing it for variety release in 2020.

Meanwhile, a similar trial on organic weed control with a proper scientific design has been started for a high altitude site in Tshento-Shari, Paro from 2019.



Bio-acoustic repellent

*Humane and effective means for minimising
the human-wildlife conflict*

**Dr. Tshering Penjor, Lhap Dorji, Galey Namgay,
Dorji Wangmo, Pema Thinley and Pempa Lhamo
ARDC-Wengkhar**

To protect precious crops from wild animals, electric fencing is popular because it is the only solution available at present. However, not all wild animals can be deterred by electric fences, especially Primates (Monkeys; Assamese macaques) as they are clever and agile. Many farmers still have to guard their crops from monkeys even if they have installed electric fence in their fields. In addition, no fence can prevent birds, rodents and insects entering fields. The Agriculture Research and Development

Centre-Wengkhar with funds from Bhutan Trust Fund for Environment Conservation initiated on-station and on-farm research trials in 2017 on the use of bio-acoustic repellent as an alternative method to minimise human-wildlife conflict.

Animals communicate warnings, attract mates, defend territories and coordinate group behaviours through vocal communication. Two types of communication i.e. 'alarm call' signaled in response to threat and 'distress

calls' conveying messages of terror, pain, desperation and final cries of a victim prompt others flee to safety. These communication signals of different birds and animals have been extensively studied worldwide and put into practical applications through use of recorded sounds.

Bio-acoustic devices use distress or predatory calls to disperse the flock causing nuisance or damage. However, most bio-acoustic calls, according to research studies are also species-specific and

may also evoke a response in other species that are taxonomically related to the call-producing species. There are not many research institutes or manufacturing companies which develop bio-acoustic equipment in the SAARC region. Devices from countries like Germany, France and the USA may not work under our conditions due to the difference in the target animal species and also variance in communication signals.

Fortunately, there is one company called Grus Eco-sciences in Bengaluru, India which develops bio-acoustic equipment. They currently market two types, the bird deterrent device known as Harmony Q-5 and the animal deterrent device as Harmony Q-3.

The centre tested these devices in four selected villages of Mongar and Saling gewogs in Mongar since 2017. The devices produce preloaded bio-acoustics sounds targeting thirteen species of animals including the wild boar, elephant and monkeys, in human hearing range of 20 Hz to 20 KHz with the total output energy of 105 dB at one-metre distance. Based on the International Organisation for Standardisation, it is safe on human beings, birds and animals. Each bio-acoustic equipment can covers about 5 acres of agricultural land. The

set up comprises of installation of main amplifier equipment near farmers' houses and extension of loudspeaker in appropriate location for maximum coverage in the field. The 18 AH, 12V lead acidic battery is charged by 30 watts solar panel.

Although the equipment has an option to operate at preset timing intervals, the centre decided to set to manual operation to switch on whenever monkeys and other animals were seen to enter the field. This would prevent monkeys and other animals from getting habituated to the bio-acoustic sounds as well as to minimise disturbing neighbours.

With the exception of one site at Dhedrang village, Mongar the bio-acoustic devices were installed with integration of electric fence system, with monkeys being the main target. Observations of the behaviours of monkeys and birds at different time, dates and frequency were recorded with the help of the farmers, in addition to images captured on trap cameras. A bio-acoustic bird repellent (Q-5 model) was also installed at vegetable seed production block to test against many bird species which attack different fruits, vegetables and crops at the centre. The device also produces pre-loaded bio-acoustic sounds targeting about

14 species of birds including the crows, parakeets and rock pigeons.

To study the effectiveness of the bio-acoustic repellents, quick surveys using simple questionnaire were carried out with all beneficiary farmers in the trial sites. Some of information was extracted from the record sheet which each beneficiary farmer maintained after the installation of bio-acoustic device in their fields. The main crop grown in all trial sites include maize, barley, potato and vegetables. The



crop raiding wild animals such as wild boar, barking deer, porcupines and stray cattle were effectively controlled by the electric fence system in all four trial sites except in one site at Dhedrang where no electric fence has been installed.

The installation of bio-acoustics and the current trial shows that these technologies have been able to reduce crop guarding from as high as 8-10 hours to 1-2 hours daily. Farmers have been losing on average about 32% crop loss every season which reduced to almost no crops losses in all trial sites with the installation of the devices except for one site at Dhedrang where monkeys raided crop when there was no one at home to switch on the device. Further in addition to preventing crop damages and reducing crop-guarding time, other

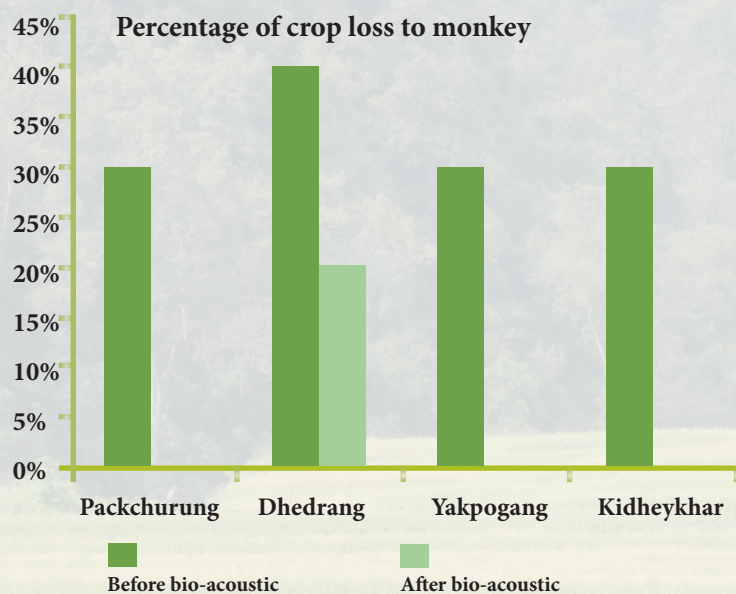
observations mainly on the behavioural changes in animals were also recorded. Raiding monkeys were seen to instantly respond when they first hear the bio-acoustic sounds, producing alarm sounds and running away quickly from the field. However, after one to two months of continuous use of the device, the response of monkeys undergoes a marked change. They tend to remain silent but move away from the field slowly and carefully.

Some farmers in the trial site found that the device is more effective against monkeys when a dummy tiger is kept near the device. Putting off the device at night not only saves the battery; more importantly, keeping it on at night is found to scare sheltered cattle in the village and inflict collateral damage. The device Q-5 model tested for bird repellent was

found to be ineffective for many of these bird species attacking fruits and vegetable seeds except for certain species of wild pigeon. This, according to literature is because of alarm and distress calls in birds are species specific.

Results from the study in Mongar and findings elsewhere suggest that bio-acoustics repellent using natural communication signals to deter wild animals and birds from the agriculture field are potentially humane and effective means of minimising the human wildlife conflict.

In Bhutan where electric fences are popular, integrating the device with the electric fence system can enhance effectiveness and keep the monkeys away for the time being.



Royal Quinoa

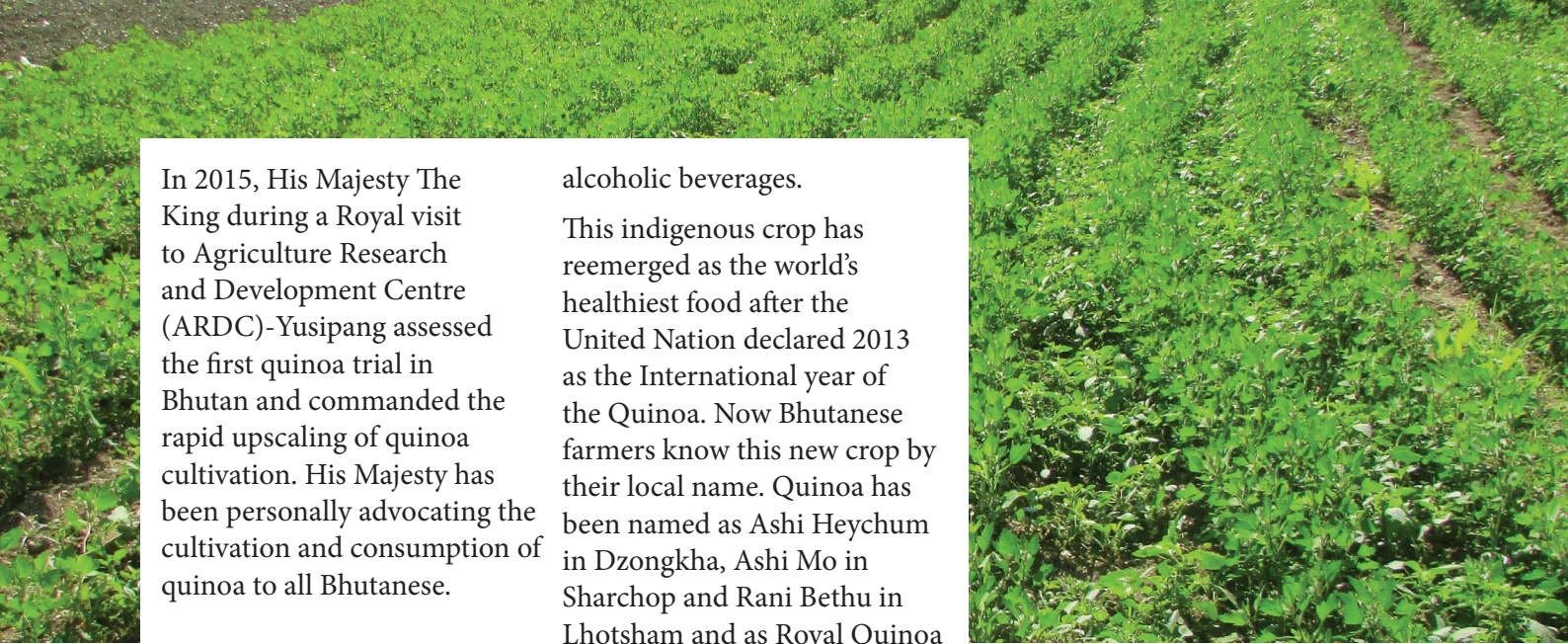
A New Smart Future Food from the pristine Himalayas

Tirtha Bdr. Katwal and Chimi Rinzin, ARDC-Yusipang

The world's scientific community is calling for 'The Great Food Transformation' which aims to promote healthy diet from a sustainable production system. The initiative is seen as an urgent call to action in order to achieve the UN Sustainable Development Goals and Paris Agreement on Climate Change. The initiative further calls for a substantial dietary shifts with increase in the consumption of healthy foods like nuts, fruits, vegetables and legumes produced in a sustainable production system.

Bhutan, a small Himalayan nation and a least developed country with many pressing and urgent development needs is not far behind in pursuing this big global initiative. The country has successfully adapted and is producing one of the 'World's Healthiest Food,' or 'Super Food' or the 'Cinderella' crop, Quinoa (*Chenopodium quinoa* Willd.). Quinoa, a new under utilised crop from the Andes has been introduced and successfully adapted to different producing agro-ecologies in Bhutan.





In 2015, His Majesty The King during a Royal visit to Agriculture Research and Development Centre (ARDC)-Yusipang assessed the first quinoa trial in Bhutan and commanded the rapid upscaling of quinoa cultivation. His Majesty has been personally advocating the cultivation and consumption of quinoa to all Bhutanese.

Quinoa is now a household crop among several Bhutanese farmers who are engaged in subsistence family farming. It is now cultivated in a sustainable Bhutanese mountain farming agriculture systems that is pristine and natural. Many farmers have already started selling homegrown milled quinoa grains in the local markets and popular hotels are serving different quinoa-based cuisines.

Quinoa is an annual crop grown primarily for its edible seeds. It belongs to the family Amaranthaceae. It is known as a pseudo-cereal because its characteristics are very different from those of the true cereals like rice, wheat and maize. It does not contain gluten which most typical cereals do. The tender leaves of quinoa are eaten as any leafy vegetables and milled grains as staple cereals. The leaves and tender stalks can also be fed to animals as fodder. The seeds are also used as poultry feed and for preparing different

alcoholic beverages.

This indigenous crop has reemerged as the world's healthiest food after the United Nation declared 2013 as the International year of the Quinoa. Now Bhutanese farmers know this new crop by their local name. Quinoa has been named as Ashi Heychum in Dzongkha, Ashi Mo in Sharchop and Rani Bethu in Lhotsham and as Royal Quinoa in English.

Quinoa was introduced in Bhutan to promote the nutritious super food and diversify the farmers cropping systems in 2015 from Peru. It was also aimed to promote this versatile crop to the marginal mountain farming environments for adaptation to climate change and enhance food and nutritional security of the Bhutanese people. The Food and Agriculture Organisation initially provided two kilograms of seeds of two varieties which were evaluated and adapted in different parts of the country.

Ashi Heychum has completed four years of adaptation since its first introduction. From a new crop, quinoa has already spread in all 20 Dzongkhags with an estimated area of about 600 acres in 2019. A total estimated production is about 40,000 kgs. Farmers are harvesting average yields ranging from 300-500 kgs

per acre and can certainly harvest much higher yields once they master the art and skill of growing this crop. Four different varieties have been recommended for cultivation. Quinoa is a complete protein with all nine essential amino acids. It also contains the amino acid lysine which is essential for tissue growth and repair. It is a good source of minerals like manganese, magnesium, iron and phosphorous among others. It is also good for people with celiac disease and diabetes.

It has been successfully cultivated from an altitude of less than 150 m in south to up to 3500 m in the north. The time of sowing is very important and depends on the altitude of a place. In the high altitude areas above 1500 m, the crop has to be sown from April until the middle of July. It can be affected by frost if it is sown before April and after mid-July. In the mid elevations that fall in the altitude range of 1000 to 1500 m, sowing time

Four released quinoa varieties

| Bhutanese Name | Original Name | Origin | Plant Height (cm) | Maturity (Days) | Grain Colour | Mean Yield t ha ⁻¹ |
|------------------|--------------------|---------|-------------------|-----------------|--------------|-------------------------------|
| Ashi Heychum-AM | Amarilla Marangani | Peru | 188 | 173 | Yellow | 1.88 |
| Ashi Heychum-AS | Amarilla Saccaca | Peru | 165 | 170 | Yellow | 2.25 |
| Ashi Heychum-123 | Ivory 123 | India | 122 | 150 | Brownish | 2.25 |
| Ashi Heychum-TW | DoA-1-PMB-2015 | Unknown | 120 | 140 | Brownish | 1.88 |

is from April to September. In low altitude and warmer areas below 1000 m, quinoa should be sown from mid-September to November. The quantity of seed required to plant one acre is two kilograms. It is a rain-fed crop and can be cultivated after the harvest of main crops like potato, wheat, or maize. The popular cropping sequence for quinoa in Bhutan is maize-quinoa, potato-quinoa, winter wheat-quinoa and vegetables-quinoa. A total seed required to plant one acre is two kilograms. The application of good amount of farm yard manure at the time of sowing will increase the grain yield.

The Department of Agriculture through its research and development networks, ensures that farmers adapt and integrate quinoa as an additional crop into their traditional cropping systems and no other existing crops are displaced. It recommends the most feasible sowing time and crop rotations that enhance the cropping intensity and produce more food following the nutrient management.

The department is making a concerted effort to promote quinoa as a new nutritious food and climate resilient cereal in the highland areas as it can withstand cold temperature. Farmers are provided with free quinoa seeds and cultivation technologies by the department.

Quinoa is consumed in many different ways. The first step to prepare the quinoa grain for consumption is to remove the husk, the bitter part from the grains. The dehusked grains can be cooked like rice, mixed with rice, prepared as breakfast porridge, turned into soups or ground as flour to bake different products.

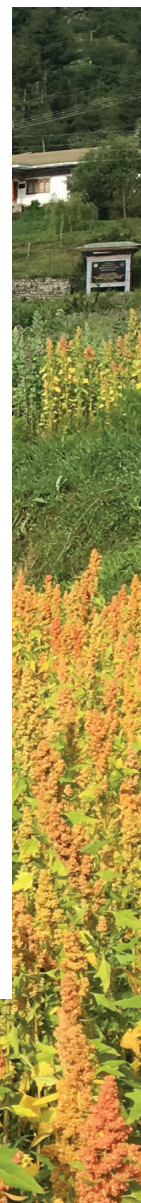
The easiest way to prepare a Bhutanese dish of quinoa is to mix quinoa with rice in the ratio of 20:80 and cook in a rice cooker or prepare quinoa Thuep or porridge.

Despite its small size, Bhutan can contribute to the global initiative of great food

transformation initiative through the cultivation, use and promotion of many native and under utilised species like millets, buckwheat and quinoa. Quinoa cultivation has been successfully adapted to the Bhutanese mountain farming production system. The potential benefits from quinoa include access to healthy and nutritious home grown food, good income, increase in crop intensity and serves as a new climate-resilient crop.

Many farmers are interested to expand the quinoa cultivation and started producing in a natural and sustainable production system. The most important challenge that the quinoa cultivation in Bhutan is facing is the lack of awareness on the nutritional value and limited utilisation by consumers.

To this, we would like to call upon all consumers to make an effort to try, taste and relish this future smart food which is home grown in a pristine environment.



Re-discovery of *Primula chasmophila* at the Black Mountains

The species was first discovered in September 1915

Dorji Duba, Jigme Singye Wangchuck National Park



Primula chasmophila is described as endemic plant of Bhutan in the 'Flora of Bhutan Volume 2' and the 'Plants Endemic to Bhutan Himalaya', a book published by the National Biodiversity Centre (NBC). In both the books, no photographs were provided except for an image of herbarium collection by George Sherriff and a painting possibly due to lack of sighting indicating that the plant was never photographed in recent history. However, it is now certain that the flower has been blooming in secluded crevices of the cliffs at Nabzila in the Black Mountains, hidden from the view of the botanical expeditions and passersby all these years.

In August 2019, my colleague Tshering Wangchuk and I made our maiden expedition to the Black Mountains. We went to set up camera traps to monitor big cats like tiger and snow leopard as well as to investigate threats of poaching. I was always keen to look into each nook and cranny of the region trying my luck on sighting the rare primula which was recorded once upon a time in the region. Unlike our past expeditions where we used to follow the comfortable trail, we climbed down the cliffs after reaching Nabzila and to our amazement, found a unique flower shining amidst the sheer rocks at an elevation of 4448 masl.

Noting the deep violet petals, I was convinced that we were fortunate to re-discover the elusive primula at the original location which was described 82 years ago. We spent about an hour taking pictures from different angles and also collected a specimen. Right after reaching back to station, I consulted with the flora expert Rebecca Pradhan and she confirmed that it is indeed *Primula chasmophila*.

The species was first discovered in September 1915 by Roland Edgar Cooper, a British botanist and Curator of the Royal Botanic Garden Edinburgh during his second visit in Bhutan for a botanical expedition. He visited the

remote and secluded areas in Durshingla, the Black Mountains where he found an endemic and very rare species of primula in Bhutan, *Primula chasmophila* and mentioned that it was found only on this mountain. He saved the holotype in the herbarium and later described the species from the cultivated plant that grew from its seed. In 1937, George Sherriff, another British explorer reached Durshingla which he called Dungshingang and located the same species on a mountain ridge near Nabzila. He described the sighting as scarce and noted that the flower had a deep, rich blue-violet petals.

Both botanical expeditions used the same route; they started from Chendipji to Thaphu (Phobjikha) crossing Lamsela pass and to Baysula, Jaributsha, Galoji, Yakchu, Bjadatsho, Wangjila, Yadebang, Waichenchu, Panchugangthen and climbed up until the track met the main N-S ridge at Nagtsela leading to (the peak of the) Black Mountains.

Since 2012, I have visited the Black Mountains on several occasions for various purposes, including camera-trapping for tiger survey, musk deer survey, high altitude lake assessment and anti-poaching patrolling. I was part of the team that retraced the long-lost trails towards the peak of Jowo Durshing and my camera trap

photos captured the elusive snow leopard in the region for the first time. Our anti-poaching efforts apprehended poachers on few occasions and we perceived increased population of musk deer in the region in recent times. I have photographed countless flowers and birds but I have never seen the primula in the region.

In 2017, NBC also organised a botanical expedition with David Long as a team member to record endemic plants in the Black Mountains region but they too did not record seeing this rare and endemic primula. The fact that it bloomed in relatively inaccessible spots is however, good for the species. Otherwise, the species would have vanished gradually owing to its rarity as each passerby would pluck a part of it. As far as we know, this species only grows in one small location on the Black Mountains range. My team was just fortunate to locate the Bhutanese primula.

Primula chasmophila is a perennial tufted herb with woody rhizome and without powdery substance, leaf base truncate and narrowly decurrent on petioles and peduncle hairy, calyx bell-shaped, leaves at flowering ovate-oblong, 1.5-4 x 1-2.5 cm, flowers 1-5, blue-violet and funnel-shaped. It is found in grassland ledges and peaty rock crevices of very steep cliffs ranging between 4265-4880 m.



Heat tolerant varieties for Cabbage and Cauliflower released

Suitable for warmer areas

Loday Phuntsho, Karma Yangzom, Kelzang Lhadon, Thinley Wangdi, Duptho Wangmo, Sonam Tashi, Sonam Pelden and Tshering Pemo
ARDC-Wengkhar

The Bhutanese market is now expected to have a regular supply of cole crops on sale with the release of cabbage (Asha and Bengal King) and cauliflower (White Express 50 and Pragati 40), the heat tolerant varieties that can be grown even in summer.

Both varieties were evaluated on-station for three consecutive years at the Agriculture Research and Development Centre (ARDC)-Wengkhar, ARDSC-Lingmithang and

Khangma with on-farm trials conducted in five eastern gewogs for one year. The trials showed that the yield is comparable with the existing cabbage varieties.

Vegetable production so far has been seasonal which force to import the vegetable worth of Nu.3 B in 2018 in off season alone. Cabbage, cauliflower and broccoli are among the major vegetables in demand. However, as these crops prefer cool weather, their

production is largely limited to winter season to early spring which leads to shortage in the summer. They are available from November to mid-February in low altitude areas (600-1400 m), mid-August to end of February in mid-altitude areas (1400-1900 m) and July to mid-March in high altitude areas (1900-2500 m).

Warmer weather either leads to premature flowering (bolting) or affects proper formation of head (compactness of head) in

cabbage and formation of curd in broccoli and cauliflower. Further with the expected rise in temperature due to climate change, these cool-weather crops are likely to suffer severe production setback against rising demand.

The heat tolerant varieties are the solution for the above stated challenges. They were formally released for commercial cultivation by the 21st Variety Release Committee and endorsed by the 5th National Seed Board Meeting of the Ministry in 2019.

The evaluations of the heat tolerant vegetable varieties were supported by the Vegetable Program under ARDC-Wengkhar and the EU-Climate Change Adaptation Program in RNR Sector.



| Variety name | Botanical name | Family | Source | Parents/pedigree | Special characteristic | Average yield | Description |
|--|---------------------------------------|------------|-----------------------------------|-----------------------------|------------------------|--|--|
| 1. Bengal King | <i>Brassica oleracea var capitata</i> | Cruciferae | Ahuja Private Seeds Limited India | Hybrid | Heat tolerant | 12.3 tonnes/acre on station and 10.5 tonnes/acre on farm | Larger head size than Asha. It has a glossy attractive colour. It takes 68 days to mature. |
| 2. Asha | <i>Brassica oleracea var capitata</i> | Cruciferae | East West Seeds, India | Hybrid | Heat tolerant | 8.6 tonnes/acre on station and 6.6 tonnes/acre on farm | Smaller compact head size of less than 1 kg. It takes 66 days to mature. |
| Recommendation for both varieties | | | | | | | |
| Agro-ecological zone | | | | Ideal growing season | | | |
| 1800-2100 m | | | | May to July | | | |
| 1400-1800 m | | | | April to August | | | |
| Below 1400 m | | | | March to September | | | |

| Variety name | Botanical name | Family | Source | Parents/ pedigree | Special characteristic | Average yield | Description |
|--|--|------------|-----------------------------------|-----------------------------|------------------------|--|--|
| White Express 50 | <i>Brassica oleracea</i> var <i>botrytis</i> | Cruciferae | Ahuja Private Seeds Limited India | Hybrid | Heat tolerant | 3.7 tonnes per acre on station and 3 tonnes per acre on farm | Bigger curd size than Pragati 40. It is bright white in colour. It takes 41 to 63 days to mature. |
| Pragati 40 | <i>Brassica oleracea</i> var <i>botrytis</i> | Cruciferae | East West Seeds, India | Hybrid | Heat tolerant | 2.8 tonnes per acre on station and 2.1 tonnes per acre on farm | It has smaller head size than White Express 50 and more heat tolerant than White Express. It is bright white in colour. It takes 41-59 days to mature. |
| Recommendation for both varieties | | | | | | | |
| Agro-ecological zone | | | | Ideal growing season | | | |
| 1400-1800 m | | | | May to July | | | |
| Below 1400 m | | | | May to September | | | |





Phrumsengla National Park adds one more new Rhododendron species to the list

Jigme Sonam, Pema Tobgay and Phuntsho Wangdi
Phrumsengla National Park

More than 1200 rhododendron species are said to exist in the world with diverse forms ranging from creeping shrublets to moderate sized trees according to Gibbs, Chamberlain and Argent 2011.

In Bhutan, 46 species of rhododendrons are recorded of which four species are found to be endemic (Pradhan, 1999). Phrumsengla National Park had the record of 30 rhododendron species as per the plant list of Pradhan, 2000

and 7 new species were added during the field excursion for publishing Flora of the park. Of 37 species, three were said to be endemic to Bhutan (TNP, 2000). The new species, *Rhododendron cameliiflorum* Hook.f. was sighted on 18 June 2019 from Sengor (27°20'28.37"E, 91°02'20.66"N).

It was observed closed to road (1-2 m approximately) in co-existence with *Rhododendron pendulum* Hook. f. and *Pleionehookeriana* (Lindl.)

Rollisson at an altitude range of 2900-3000 masl approximately. It is synonymously known as *Rhododendron cooperi* I. B. Balf and *Rhododendron sparsiflorum* Nutt. The species is categorised as a least concern under the Red List of Rhododendrons. Its global distribution is known from Bhutan, India and Nepal in the evergreen oak and Hemlock forests. It flowers in between June-July. With this addition, the park now has 38 rhododendron species and 890 plant species in total.

Understanding the cost of hybrid tomato production using different mulching methods

For weed control and better productivity



Kezang Tshering, Tashi Gyalmo and Thinley Pem
ARDC-Yusipang

Tomatoes are priced out of the reach of many Bhutanese consumers. Thus, the general consumers opt for imported tomatoes which are cheaper. Accordingly, there seems to be limited demand for local tomatoes in the domestic market. Due to lack of information, policy makers and consumers are not

sure whether the high price of locally produced tomatoes is due to cost of production or the high price charged by vendors.

A simple observation trial was carried out in the Agriculture Research and Development Centre (ARDC)-Yusipang to study and compare the cost

of tomato production in a polyhouse using two different mulching materials with no mulch as the check. Nursery was established in March 2018 by sowing seeds of the hybrid tomato variety (Cosmic). The trial was established in a polyhouse (20 m x 5 m) and the area was divided into 3 beds of equal size (22.4 m²).

The soil in all the 3 beds was mixed with equal amounts of farm yard manure. Out of the 3 beds, the first bed was mulched with black plastic sheet and holes were prepared through the plastic sheet by keeping a spacing of 60 cm between the holes and 50 cm row to row.

The second bed was mulched with chopped Artemisia leaves after 2-3 weeks from transplanting date and the third bed was kept without mulch as the control plot.

On 8 March, hybrid tomato seedlings from the nursery were transplanted in the beds with a spacing of 60 cm plant to plant and 50 cm row to row. There were 71 numbers of tomato seedlings transplanted in each bed. Irrigation was provided through drip system and the frequency of irrigation was based on the soil moisture

condition of the beds. After 2-3 weeks from the date of transplanting, about 1 inch thickness of chopped Artemisia leaves was applied in one of the beds as a mulching material. Weeding was done in all the beds as and when required.

During the growing period, all the plants were pruned and a single main stem per plant was maintained. Staking was provided with bamboo sticks and jute threads were used to keep the plant straight and upright.

The first harvest of tomato fruits was done on 9 August 2018 and the last harvest was done on 25 October 2018. In total, tomatoes were harvested 11 times during the cropping period and the crop duration lasted for 230 days (7-8 months) starting from seed sowing in the nursery to the

last date of harvest. All inputs including labour were recorded during the implementation of the observation trial. As a result, it was noticed that there was heavy incidence of weeds in the bed without mulching material. Although, there is no cost on mulching, it required more labour to remove the weeds and the yield of tomato in this plot was lower than other plots. So, it indicates that the economic return is less, if the field is not mulched.

The bed mulched with Artemisia required lesser weeding and the yield was higher than the plot without mulch. Thus, it indicates that the economic return is better if the plot is mulched with Artemisia or any locally available mulching materials.

In the plot with plastic sheet mulching, the intensity of



weeds was very low and the yield of tomato per plot was higher than the other two plots (Artemisia leaves mulch and no mulch). The cost of tomato production under plastic mulch is worthwhile because of good economic return.

The trial result showed that the total operation cost is lowest in the plastic mulch plot and highest in the plot without mulch.

Although the cost of plastic is expensive, it is compensated by the reduction in expenditure on weeding and higher yield of tomatoes, and the cost of production is lower than other treatments. While in the plot without mulching, the expenditure on weeding operations was high and the yield is low making production less worthwhile.

In terms of yield, the plot with plastic mulch is highest followed by the plot with

Artemisia leaves mulch and the plot without mulch is the lowest. Thus, there is a great benefit in applying mulching technology to enhance crop yield and production. In any business, lesser expense means less risk. Likewise, in this study the total operating cost in plastic mulched plot is lower than the plot with Artemisia mulch followed by the plot without mulch.

The study was carried out from March-October 2018 and the information generated from this study clearly indicates that the yield of tomatoes under plastic mulched condition is much higher than the other two conditions.

Similarly, the cost of production was also found to be the lowest with the highest profit margin. While on the other hand, the plot with no mulch resulted in the highest cost of production with the corresponding

lower yield and lowest profit margin. The highest yield in the plastic mulched plot could be attributed to the very minimal weed pressure and subsequently the vigorous and healthy growth of the plants and fruits. The reduced weed pressure could have also reduced the incidence of diseases and pests.

The intense weed pressure in the control plot (no mulch) could have hampered the growth of the tomato plants by competing for nutrients and water resulting in the lowest yield.

Although, the use of plastic mulch showed excellent results, the impact of non-bio-degradable plastic wastes on soil is a great concern. Therefore, mulching with locally available and eco-friendly mulch materials like Artemisia leaf, straw, saw dust, leaf litter and others may be the better options.

| Plot | Total expenditure (Nu.) | Yield (kg) | | Income Nu.60 per kg | Production cost/kg | Profit (Nu.) |
|-------------------|-------------------------|------------|-------|---------------------|--------------------|--------------|
| | | Plot | Plant | | | |
| Plastic mulched | 7603.75 | 642.00 | 3 | 38520.00 | 12 | 30916 |
| Artemisia mulched | 8060.5 | 445.47 | 2 | 26728.20 | 18 | 18668 |
| No mulch | 8660.5 | 381.81 | 1.8 | 22908.60 | 23 | 14248 |



FMD outbreak in Pigs

NPiRDC experience sharing

Singay Om, NPiRDC

Foot-and-mouth disease (FMD) is caused by a highly contagious virus which affects all cloven-hoofed domestic animals including cattle, sheep, goats, pigs and buffalo (OIE, 2008).

The virus belongs to the *Aphthovirus* genus of the family *Picornaviridae* and has seven clinically indistinguishable serotypes. These are the O, A, Asia 1, SAT 1 (South African Territory), SAT 2, SAT3, and C. Serotype O is the most commonly recorded FMD V serotype in Bhutan. Since 2003, there are records of occurrence of the Pan Asia strain of the Middle East–South Asia topotype of type O. The last recorded outbreaks of other

strains of FMD in Bhutan were serotypes C (1991), A (2012) and Asia 1 (2002) (NCAH, 2016).

Gelephu Thomde saw the first outbreak of FMD in pigs on 15 October 2018 at Namkhaling. It rapidly spread to Rabdeyling and Jamphelling Demkhongs, and subsequently in other gewogs.

On 1 November 2018, a lactating sow and eight piglets showed a signs of FMD. A technical team confirmed it on 2 November and the ban for movement of pigs was imposed immediately to prevent further spread. In total, 798 pigs were infected of which 376 died. The

final case reported was on 28 February 2019. Despite bio-security system in the farm and bi-annual FMD vaccination, the probable source of infection were believed to be water/air (contaminated Dungkhola water source), birds (presence of myna, sparrows and crows in the sties), stock persons (possibility of contaminated livestock products being brought to sheds) and mismatch of vaccine type use and virus circulating in the country.

The common clinical sign for FMD is high fever. The disease is rarely fatal in adult animals but there can be high mortality in young animals due to high fever. Unlike cattle, affected

adult pigs can eat because of minimal lesions in mouth, tongue and lips. It was also noticed that stricken sows produced around 50% less milk. The virus causes a high fever between two and six days followed by blisters mostly on the snout, teats and between the hooves and feet, and cause lameness. The majority of affected animals can recover from the disease but it often leaves them weakened and debilitated. As for the sucklers, by the time they showed symptoms of the disease before mortality, very few could be saved by treatment.

Various disease management actions were taken by the National Piggery Research and Development Centre (NPiRDC) in Sarpang including strengthening of farm bio-security, reduced movement of pigs and stock persons from one shed to another, staff monitoring tour to farmer's field, input supply to the Dzongkhags was stopped, constructed temporary sheds for isolation and reported the cases to RDCL-ECR, Zhemgang on a weekly basis. The centre also stopped mating of sows for a month, checked temperature in piglet every morning, evening and night;

cleaned and treated the lesions twice a day, and fed antibiotics mixture in feed. They arranged artificial milk for piglets to reduce mortality and also fed them glucose and vitamin C. They injected antibiotic to pregnant sows to prevent and control sudden death to sucklers on farrowing.

Numerous consultations were done with senior veterinarians following the outbreak for disease containment program. With outbreak, the farm technicians got valuable first hand practical experience about FMD symptoms in pigs.

They learn the disease management techniques such as how to diagnose FMD and report immediately, keep stock of FMD related medicines and equipment, keep the standard operating procedures in place, and train farm attendants for smooth functioning during the outbreak. They also learn to deploy different strategies to reduce the mortality of piglets, wash FMD lesions effectively, manage debilitated pigs and immediately suspend animal mating to break the chain of FMD cases and prevent spread of disease in breeding animals. No new cases were

reported since 28 February 2019. The verification team comprising from BAFRA, Thromde Veterinary Hospital and satellite laboratory, Gelephu visited the farm on 1 April 2019 to confirm the absence of disease in all animals and monitored the bio-security measures. The ban on the movement of pigs was lifted on the day. Prior to re-occupation of the farrowing and rearing sheds, adequate steps were taken to ensure sheds sanitisation, disinfection and fumigation. All the empty sheds, farm tools and creep boxes were washed with potassium permanganate solution, Khorsaline and lime. Rest of the sheds was also cleaned.

With occurrence of FMD cases in many parts of the country, the centre suggests proper study to be conducted by the Department of Livestock on sero-typing of the actual causative agent to get rid of such unwanted disease. Effectively preventing and dealing with this terrible disease will halt the huge economic loss and thereby take the country along the way to achieve self-sufficiency in livestock products.





Bio-slurry for sustainable organic agriculture in Bhutan

Jigme Wangchuk, National Organic Programme

Bio-slurry provides a viable answer to nutrient depletion of many agricultural soils. More importantly, it is found to boost agricultural and horticultural production and enhance plant and soil nutrients.

Bio-slurry techniques have been tested and used by organic growers in several parts of Bhutan under the National Organic Programme. Bio-slurry is an anaerobic decomposed organic material that is produced as a result of digestion of organic matter inside the digester.

The residue of the fermentation comes out as sludge which is known as digested bio-slurry; its nutritional value is greatly improved if urine is collected in the digester. Bio-slurry discharged from the reactor retains all nutrients originally

present in the feeding material which makes it a potential organic fertiliser. If compared to traditional manure or chemical fertiliser, bio-slurry as plant nutrient is more beneficial.

It is pathogen-free, odourless and does not attract flies as well as reduces weed growth by up to 50%. It is an excellent soil conditioner; it adds humus and enhances the soil's capacity. It also repels termites and pests that are attracted to raw dung or manure.

When applied as compost or as slurry, it improves soil fertility and structure resulting in improved crop yields and reduced erosion. After being stored for a few days or mixed in a 1:1 composition with water, bio-slurry can be applied directly to vegetables or fruit crops around the household. Bio-slurry has been used as

organic plant nutrient for over five years. Most of the farmers allow bio-slurry to flow freely out of the slurry chamber. Several farmers have channelled the slurry to the kitchen garden, fields or orchards. Few farmers scoop out the slurry using buckets and apply to agricultural crops and dry any excess slurry.

Bio-slurry technique has tremendous potential to become a mainstream plant nutrient and pest management resource for organic farming. It has been proven that the use of bio-slurry in liquid form or as composted slurry can enhance soil micro flora and improves plant health and vigour which has direct impact on the productivity of crops.

The use of bio-slurry is also known to reduce pest, disease and weed incidence in organic

agriculture systems. It is economical in terms of farm cost as it reduces dependence on chemical fertilisers, pesticides and herbicides. It will also help generate some income to farmers through sale of bio-slurry compost. The major and micro elements

released from biomass and animal wastes are captured and efficiently used as slurry and compost preventing loss of essential plant nutrients. Besides the potential to off-set carbon through mitigation of methane emission from agriculture waste, bio-slurry

techniques can directly increase soil carbon storage. Such practice will have direct impact on soil fertility improvement and contribute positively towards mitigation of adverse effects of climate change.

Progress in utilisation of bio-slurry

| No. of Agriculture official trained | No. of farmers utilisation of compost | No. of gewogs covered | Total area under bio-slurry use (ac) | No. of Dzongkhags covered | No. of compost unit | Production of compost in (MT) |
|-------------------------------------|---------------------------------------|-----------------------|--------------------------------------|---------------------------|---------------------|-------------------------------|
| 87 | 120 | 14 | 13 | 9 | 7 | 12 |

Nutrient analysis

| Nutrient analysis | pH | Nitrogen | Available K | Available |
|-------------------|------|-------------|--------------|--------------|
| | 7.79 | 37.39 mg/kg | 495.07 mg/kg | 437.02 mg/kg |

Source: National Soil Services Centre



Bhutan records new fish and bird species

Bhutan added a new fish, Striped dwarf catfish (*Mystus vittatus*) and two bird species, Pin-tailed Parrotfinch (*Erythrura prasina*) and Rusty-tailed Flycatcher (*Ficedula ruficauda*) to the list of species. It was recorded from the Phibsoo Wildlife Sanctuary (PWS).

Striped dwarf catfish is a species of catfish of the family Bagridae. It is found in brackish water systems with marginal vegetation in lakes and swamps with a mud substrate of asian countries of Pakistan, India, Sri Lanka, Nepal, Bangladesh and probably Myanmar. However, in PWS, it was first recorded in 2017 and consecutively in 2018 in running Singye stream at an elevation of 213 masl (26°46'18.78"N; 90°11'23.83"E). The population is known to be decreasing in recent years due to catching, pet trading and habitat destruction (IUCN, 2010).



Pin-tailed Parrotfinch is a common species of estrildid finch under passeriformes order of estrildidae family. It is found in southeast asian countries of Malaysia, Brunei, Cambodia, Indonesia, Laos, Burma, Thailand and Philippines. In PWS, it was recorded on 6/7/2018 at 176 m (26°45'27.1"N; 089°56'19.0"E). According to Payne, R. (2018) in Hand Book of the Birds of the world, the bird feeds in open areas on paddy rice, cereals, greens and fruits and inhabits montane and lowland moist forest in bamboo thickets, forest edges, and underbrush. It is also a paddy pest in southeast asian countries.



The Rusty-tailed Flycatcher is partially migratory and a small passerine bird mainly found in northern region of Indian sub-continent. The bird is common in northern and western India, Pakistan and Nepal. It is a rare bird in east India, Uzbekistan and Tajikistan (Birdlife International, 2016). The bird has rufous upper tail-covert and tail with flatter forehead and crown feathers are slightly rose forming a crested appearance to nape. It has indistinct eye-ring, plain face with faint supercilium and an orange lower mandible (Grimmett et al., 2011). It was first recorded in Phibsoo Range on 15 July at an elevation of 306 m (26°46'31.42"N; 90°11'38.36"E).



2019

Highlights





105 new recruits for Ministry

Hundred and five new RNR recruits attended the Induction programme from 9-11 January in Thimphu. They were briefed by the respective departments on their mandates and an overview of the RNR sector plan and priorities were presented to them including the HR situation and its issues. They were also sensitised on BCSR 2018 and its relevant rules, ethics and integrity tools.

At the closing ceremony, the Hon'ble Sanam Lyonpo shared that our responsibility as RNR officials is to interact with people of 20 Dzongkhags, 205 gewogs and farmers to help them.



HR Conference 2019

The Ministry of Agriculture and Forests organised a Human Resource (HR) Conference in Samdrup Jongkhar from 29-31 January with a theme, 'Enhancing decentralised HR functions by networking between the central agencies and field offices'. It was attended by 66 administration assistants and focal asset declaration administrators (ADAs) of the Ministry.

The Hon'ble Agriculture Secretary during the opening address said that the role of the administration assistants and the ADAs have become crucial and commended for ensuring 100% asset declaration and compliance rate.



RNR Extension Conference 2019

The RNR Extension Conference 2019 with a theme, 'Knowing More From The Grassroots', was held in Gelephu from 11-12 February for the gewog extension staffs of Bumthang, Trongsa, Zhemgang, Sarpang, Samtse and Tsirang. It was aimed to share the national aspirations and expectations from extension personnel and learn field issues and recommendations through which the 12th FYP programs are better implemented.

A total of 138 participants attended the conference. It was organised with funds from EU-RNR Sector Support Program.



5th RBFE in Samdrup Jongkhar

His Majesty The King graced the inauguration of the fifth Royal Bhutan Flower Exhibition at Tendrelthang, Samdrup Jongkhar. The Fourth Druk Gyalpo, Her Majesty The Gyaltsuen and His Royal Highness The Gyalsey along with the Royal Family members also graced the event. The Prime Minister and the other guests were also present.

The exhibition held from 21-27 February with a theme, 'Building clean, safe, organised and beautiful living environments for general well-being and happiness' was dedicated to the Birth Anniversary of His Majesty.



RNR Census 2019

The RNR Census 2019 was carried out from 1-31 March to enumerate RNR activities in all the 205 gewogs and Thromdes. The enumerators were the gewog officials, supervised by the Dzongkhag sector heads and nationally coordinated by the RNR Statistics Division of the Ministry.

The census adopted the Computer Assisted Personal Interview (CAPI) method where the enumerators interviews respondents using Android tablets. CAPI is expected to enhance the data consistency, transmission speed and save time.



Resilient Mountain Solutions

The Department of Agriculture and ICIMOD join hands for the project titled, Resilient Mountain Solutions (RMS) in Bhutan to focus on the land livestock economy in the high mountains and entrepreneurship development on agro and natural resource based enterprises.

Haa has been identified as a pilot project site. The project in place from March 2019-December 2021 will promote organic farming and gender friendly technologies, facilitates product development and diversification and support women entrepreneurship among others.



6th World Wildlife Day

Bhutan observed the 6th World Wildlife Day at Minjiwoong Central School, Samdrup Jongkhar on 3 March. With a theme, 'Wildlife-The Next Door Neighbour, Enable Harmonious Co-existence', the day raised awareness on the importance of wildlife and shared the conservation efforts that the rangers put towards safeguarding the wildlife in Bhutan.

It was organised by Jomotsangkha Wildlife Sanctuary with support from the Nature Conservation Division. The 68th session of United Nations General Assembly declared 3 March as a World Wildlife Day.



RNR Extension Conference for west and west-central region

The RNR extension conference for the west and west-central region was held from 4-5 March at College of Natural Resources, Lobesa. Around 170 livestock and agriculture extension agents covering 81 gewogs and representatives from the Ministry attended it. It was chaired by the Hon'ble Agriculture Secretary.

The conference discussed the extra initiative required from the field colleagues as well as the farming community aftermath the phase out of WFP school feeding program. The field colleagues were given the forefront opportunity to present their innovative and successful stories.



Ninth South Asia and Central Asia Man and Biosphere Network meeting

The Ninth South Asia and Central Asia Man and Biosphere Network meeting was held in Thimphu from 25-27 April with a theme, 'Citizen Science in Biosphere Reserves'. It was aimed to build the regional capacity in biosphere reserve (BR) management through experience sharing, raising awareness with interested participating states without BR and explore opportunities and strategies for citizen science in fulfilling the logistic function. The meeting helped Bhutan to have a better understanding of the process of nomination and managing a biosphere reserve.



Global Food Policy Report 2019

The Hon'ble Sanam Lyonpo, Yeshey Penjor and the Director General for the International Food Policy Research Institute, Dr. Sheggen Fan launched the Global Food Policy Report 2019 in Thimphu on 29 April.

The eighth edition of the report highlights that a system wide transformation is needed to revitalise rural areas, not only to achieve the Sustainable Development Goals (SDGs) but more broadly to make rural areas vibrant and healthy places to live and work. One of the most practical ways to achieve SDGs is focusing on the needs of rural areas and address growing challenges, the report suggests.



Towards food safety enhancement

Thirty eight officials attended the first consultative workshop to develop a set of potential national food safety indicators with a One Health approach that can be used to assess the effectiveness of the national food safety systems from 2-4 May in Paro.

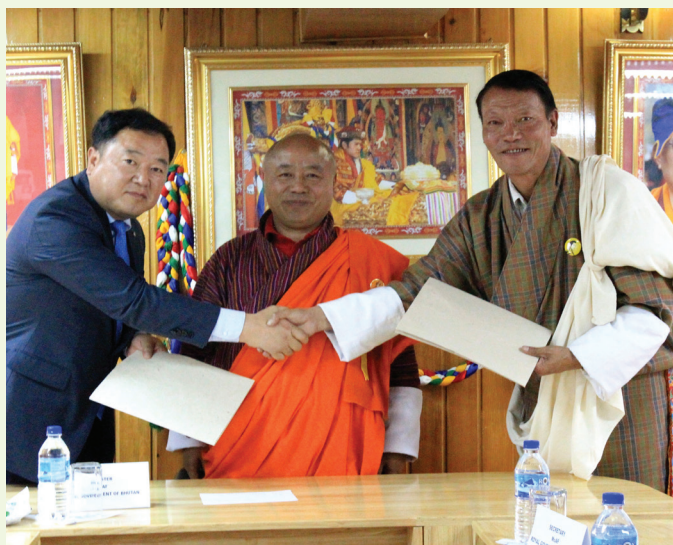
The development of food safety indicators will help Bhutan to review its current status of food safety, help identify the areas that need interventions and serve as a tool to mobilise resources for food safety. A technical working group has been also formed to ensure that the Bhutan adopts the best suitable food safety indicators.



International Biodiversity Day

The International Biodiversity Day was observed on 22 May at Buli Central School, Zhemgang to create awareness on the importance of biodiversity conservation and recognise the important role of farmers as custodians of our agro-biodiversity.

A seed fair, an exhibition and a quiz on Bhutan's biodiversity was organised. Farmers from Buli and nearby gewogs participated in the fair and students took part in the quiz. In addition, a book titled, 'Biodiversity Statistics of Bhutan 2017' was launched which highlights for the first time, a total of 11,248 species of all biodiversity groups found in Bhutan.



MoU between MoAF and KRIBB

A memorandum of understanding (MoU) was signed between the Ministry of Agriculture and Forests and Korea Research Institute of Bioscience and Biotechnology on 3 June to strengthen a technical cooperation in the fields of bio-safety, bio-prospecting and bio-technological advancements.

With the MoU in place, the Ministry will enhance the bio-discovery research and support in bio-prospecting as well as open the opportunities to tap on the resources and knowledge of bio-technological advancement in agriculture. It is valid for 5 years from the date of signing and may be renewed based on the consent of both parties.



Bhutan Organic Guarantee System

The National Organic Programme (NOP) launched the Bhutan Organic Guarantee System documents on 5 June. The documents including the standard side and the conformity assessment enables a producer/products to access the Bhutan Organic Mark which is essential for organic farming in the country. It will serve as a manual and guidelines for organic farmers during the certification process.

The Local Organic Assurance System certified products were also launched. NOP certified three private farms, two farming cooperatives and five products from four Dzongkhags.



First World Food Safety Day

On 7 June, BAFRA celebrated the first World Food Safety Day, the resolution adopted by the United Nations General Assembly in 2018. The day was an opportunity to strengthen efforts to ensure that the food we eat is safe.

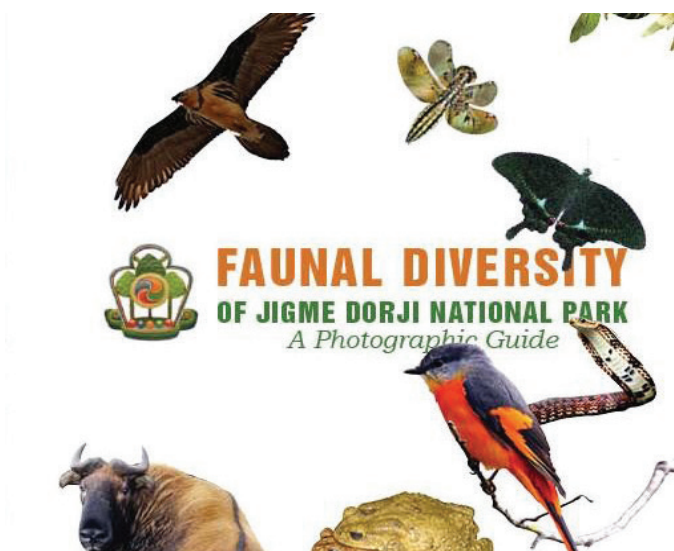
BAFRA and relevant agencies celebrated the event by creating awareness on food safety to highlight that everyone involved in the food systems has a part to play. World Food Safety Day messages, posters and aprons were circulated to reach the masses.



World Day to Combat Desertification

The Ministry of Agriculture and Forests observed the World Day to Combat Desertification on 17 June in Mongar at two sites, Thridangbi chiwog in Saling and Drangmaling chiwog in Tsamang. The day with a theme, 'Let's grow the future together' created awareness amongst farming communities on sustainable land management (SLM) practices.

Around 230 participants brought sixty acres of land (35 acres in Thridangbi and 25 acres in Drangmaling) under the SLM interventions and planted fodder hedgerows and fruit plants. It was also celebrated in Wangphu gewog, Samdrup Jongkhar by developing 70 acres of land.



Photographic Guide on Faunal Biodiversity of JDNP

The first edition of 'Faunal Biodiversity of Jigme Dorji National Park a Photographic Guide' was published. It covers the photographic illustration with taxonomic classification, habitat and distribution information of 33 species of mammals belonging to 14 families, 90 species of birds belonging to 28 families, 21 species of reptiles belonging to 5 families, 12 species of amphibians belonging to 6 families, 14 species of dragonflies and damselflies belonging to 4 families, 41 species of butterflies and 3 species of wild bees. The updated checklist of faunal diversity of Jigme Dorji National Park (JDNP) is also included.



Third SAARC multi-stakeholders meeting

Thirty five delegates from SAARC countries: Bangladesh, Bhutan, Maldives, Pakistan, Sri Lanka, Nepal and SAARC Agriculture Centre and Secretariat attended the third multi-stakeholders dialogue on Agriculture with a theme, 'Sharing seed to enhance Food Security: Seeds without Borders in SAARC Member States' as access, availability and affordability of quality seed of appropriate plant genetic resources to achieve higher and resilient crop productivity.

The meeting held on 24 June highlighted major recommendations on the thematic issues related to seeds without borders.



4th Meeting of SAARC Agriculture Ministers

The Agriculture Ministers and Secretaries of the Member States of the South Asian Association for Regional Cooperation (SAARC) unanimously reaffirmed their commitment to regional integration to promote agriculture and rural development in the region during the 4th Meeting of SAARC Agriculture Ministers held from 24-27 June in Thimphu.

Delegates agreed to promote multi-sectoral approaches and actions to attain higher level of food and nutrition security and promote climate resilient agricultural technologies among others.



National Dog Population Management Strategy

The Department of Livestock launched the National Dog Population Management (DPM) Strategy to improve the health and welfare of dogs, reduce dog population, achieve zero human deaths due to rabies by 2030 and create a positive impression of Bhutan for visitors making Bhutan a safer and happier place with minimum nuisance and dog threats on 1 July.

The revised strategy will mainly mainstream the DPM program in the country, ensure animal birth control and encourage adoption of stray dogs through community-based approaches and human behavioural changes.

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Department of Livestock, Ministry of Agriculture & Forests
Laboratory Information Management System (LIMS)
Laboratory Services Unit

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Department of Livestock, Ministry of Agriculture and Forests, Serbithang, Thimphu Bhutan
Designed & Developed by Nyamchoe Consultancy, Thimphu Bhutan.

Laboratory IMS for veterinary activities

The Department of Livestock launched the Laboratory Information Management System (IMS): <http://lims.ncah.gov.bt> on 1 July to ensure efficient management of the country's veterinary laboratory information. It has the features for online entry of sample details, test result, diagnosis and recommendations.

It will help the veterinary laboratories to track real time samples from submission to testing and reporting. The database system will immensely help in electronic storage, enhanced security and easy analysis. It will also enable to generated reports for policy interventions.



BEFIT 2019

About 52 Cottage and Small Industries (CSI) entrepreneurs exhibited their products and services at the Bhutan Economic Forum for Innovative Transformation (BEFIT) 2019 held in Thimphu from 16-18 July.

With a theme, 'Catalysing the Cottage and Small Industries Sector to drive Bhutan's economic diversification', BEFIT saw a wide range of expertise for sharing the best practices and discuss innovative solutions and challenges to catalyse the CSI in Bhutan.



Cordyceps auctions in Wangdue and Gasa

Thirty-eight bidders participated during the cordyceps auctions held from 22 July till 22 August. The auctions held in Wangdue and Gasa sold about 356 kgs and saw withdrawal of 80 kgs cordyceps.

Among cordyceps growing gewogs, Dangchu in Wangdue recorded the highest collection of about 145 kgs while Kashi was the lowest with 0.77 kg. The highest bid recorded was Nu.2.04 M per kg for Lunana and lowest Nu.0.251 M per kg at the same auction site. Overall, the revenue generated through cordyceps auction was about Nu.221.90 M.



World Rangers Day

The World Rangers Day was celebrated on 31 July at Chelela, Haa to pay a tribute to those rangers who have lost their lives or those who were injured while performing the duty in protecting the natural resources.

The Ministry honoured Rinchen, a forester with Phibsoo Wildlife Sanctuary who lost his right eye while chasing away elephants. The day introduced a new insignia system for every rank in the forestry profession which will have stars on the colour and a logo of the department on shoulder flaps. Besides, the day inaugurated the Chelela Sagala Trail and launched 24 forestry publications.



Ministry signs APA with Prime Minister

The Hon'ble Prime Minister, Dr. Lotay Tshering signed the first annual performance agreement (APA) for the fiscal year 2019-2020 with the Hon'ble Sanam Lyonpo, Yeshey Penjor on 8 August.

The Ministry aims to enhance food and nutrition security, improve the rural economy and promote sustainable management and utilisation of natural resources through increased production and strengthened infrastructures among others. The Ministry has a budget of Nu.3.2 B to achieve its objectives in 19-20. The APA between the Agriculture Secretary and heads of the departments and agencies was also signed on the day.



NOFP signs APA with Prime Minister

The annual performance agreement (APA) 19-20 for the National Organic Flagship Programme (NOFP) was signed between the Hon'ble Prime Minister, Dr. Lotay Tshering and the Hon'ble Sanam Lyonpo, Yeshey Penjor on August 22.

The programme with a budget of Nu.1 B will focus on increasing and enhancing organic production, value chain and market and strengthening policy and regulatory environment. A major focus in 19-20 will be to enhance the technical capacity of the stakeholders.



Livestock Input Farms Strategy and Management Plan

The Department of Livestock launched the first edition of the Strategy and Management Plan of Livestock Input Farms on 30 August to achieve the livestock product self-sufficiency for a prosperous Bhutanese society. The strategy will streamline the mandates and functions of the livestock input farms and commodity centres towards fulfilling 12th five year plan and priorities.

The department also signed its annual performance agreement for the financial year 2019-2020 with its respective divisions, central programs and units on the day.



DAO's and National Commodity Coordinators meets

A consultation meeting between the Dzongkhag Agriculture Officers (DAOs) and National Commodity Coordinators was organised in Thimphu from 26-30 August. It focused on the annual performance agreements synchronisation of the gewog, Dzongkhag and regional plans. Participants also discussed work plan for the National Organic Flagship Programme, validated the RNR Census 2018 results and sensitised on the School and Hospital Feeding Programme.

The Hon'ble Sanam Lyonpo graced the closing session. The Program Directors of central programmes also joined the closing session to discuss cross cutting activities.



Forest Engagement Note

The Ministry of Agriculture and Forests and the World Bank jointly launched the forest engagement note for Bhutan titled, 'Pathways for Sustainable Forest Management and Socio-equitable Economic Development' on 2 October in Thimphu.

The book articulates opportunities for supporting Bhutan's sustainable development aspirations including its constitutional commitment to maintain at least 60% land area under forest cover and better respond for vulnerabilities such as climate change and natural disasters. It will be contributing to the Bhutan Country Partnership Framework.



Pramer Bamdhir farmroad and baily bridge for Trashiyangtse

The Hon'ble Sanam Lyonpo inaugurated a 14 km Pramer-Bamdhir farmroad and a 170 ft baily bridge with a carrying capacity of 24 MT on 11 October in Trashiyangtse.

The farmroad was constructed at a cost of Nu.21.35 M while the bridge was built at a cost of Nu.19.5 M with funds from the Royal Government of Bhutan. They will benefit 85 households connecting Berteng, Bamdhir, Betsamang and Zhapang villages under Bumdeling gewog. The bridge will reduce the walking distance by more than five hours to reach Trashiyangtse town.



Mushroom spawn production equipment for NMC

His Excellency, Mr. Shingo Miyamoto, the Minister for Economic and Development, Embassy of Japan in India inaugurated the Mushroom Spawn production equipment at the National Mushroom Centre (NMC) on 15 October.

The equipment including sawdust crusher mill, high temperature and pressure cubic steriliser, moisture analyser, hot air oven, electronic balance, deep freezer and refrigerated van were procured through the Human Security Project, Embassy of Japan in 2018.



World Food Day in Sakteng

The World Food Day was celebrated on 16 October in Sakteng Lower Secondary School, Trashigang with a global theme, 'Our actions are our future, healthy diets for zero hunger world'. Around 1600 participants attended it creating awareness for those who suffer from hunger and the need to ensure nutritious food diet for all.

The best school farm awards were taken over by Bajo HSS, Yebilaptsa MSS, Tshaphel LSS, Wongchiloo PS and Zangkhar PS with cash prizes, certificates and rolling trophies. Various programs such as poster and essay writing competition, treasure hunt were also organised.



Value chain studied books and HR system

The Ministry of Agriculture and Forests launched the value chain studied books on potato, apple and honey and the Human Resource Information System (HRIS), both funded by EU-TCP on 18 October in Thimphu.

The value chain studies were carried out to improve the quantity and quality of production, enhance income and ensure efficiency in value addition activities. With the HRIS in place, the Ministry will have accurate HR information of the RNR officials such as promotion, transfer, leave, secondment, disciplinary, separation and training.



Bhutanese farmer wins the Agriculturalist Award 2019

Chimi Dema, an aspiring dairy farmer from Gogona, Wangdue received a prestigious FAO's "Model Agriculturalists" award on 18 October at the FAO Regional Office for Asia and Pacific in Bangkok, Thailand.

Chimi is an active member and also serves as the dairy technician at the milk processing unit of Gogona Gonor Yargay Chethuen Detshen. She produces 3 types of western/Swiss hard cheeses, stir yoghurt beside normal butter and cottage cheese. With help of the priority sector lending loan, she had built an improved dairy shed and bought 20 Holstein Friesian dairy cows to start her farm.



Cost of Production for horticulture and field crops

The Department of Agriculture organised a write-shop from 21-25 October 2019 at Namsay Chhoeling Resort, Paro to develop the national and regional Cost of Production (CoP) for various horticulture and field crops based on the nationwide CoP survey carried out by four Agriculture Research and Development Centres (ARDCs) and National Mushroom Centre (NMC).

Participants included the officials from the Agriculture Research and Extension Division, NSC, ARDCs, ICTD and NMC.



Natural product development facility at Dzedokha

The natural product development facility at Dzedokha village in Loggchina gewog, Chukha was inaugurated on 21 October. It will be used for the production of nature based products Zhinor massage balm and liniment oil, using the essential oil from Zingiber cassumunar locally known as 'Phacheng'. The Zhinor massage balm and liniment oil is proven to relieve joints and muscle pains and the plant itself is historically valued by locals for its medicinal value.

The facility will be operated as a social enterprise by three operators identified by the Dzedokha Phacheng Detshen under the Access and Benefit Sharing framework.



Bir Kulo Irrigation

A 2.1 km Bir Kulo Irrigation System was inaugurated in Dophuchen, Samtse by the Hon'ble Lyonpo, Lok Nath Sharma on 22 October. It was constructed by the Department of Agriculture with a budget of Nu.17.5 M from the Food Security and Agriculture Productivity Project. It will benefit 53 households covering an area of 150 acres.

Lyonpo also handed over the constitution and bylaws to the members of the Somlachen and Mithun Bir Kulo Irrigation Water Users Association. Prior to the inauguration, the members were trained on the operation and maintenance of the irrigation system.



4th Royal Highland Festival

The 4th Royal Highland Festival was celebrated on 23-24 October at Langothang in Laya, located above 3800 masl attracting more than two thousand visitors. It provided an opportunity for visitors to experience the yak based livelihood and unique nomadic culture.

Various entertaining programs such as animal parade, tug of war, horse race, cattle show, strongwoman competition, wrestling, run and lottery along with various cultural dances steal the heart of visitors. One of the festival attractions was the 25 km Laya run with ninety-three participants including 34 females and 17 foreigners.



Youths promotes bee farming in Pemagatshel

Twenty-seven school dropout youths from seven gewogs and 10 livestock staff in Pemagatshel were trained on beekeeping from 15-21 November. The trained youths will be the ambassadors to promote bee farming in Dzongkhag.

It was organised by the Dzongkhag Livestock Sector with technical backstopping and fund from the National Highland Research and Development Centre, Bumthang and the Dzongkhag Development Grant (DDG) respectively. During the certificate awarding ceremony, Dasho Dzongda committed to support the new initiative in Dzongkhag through DDG fund.



Organic package of practices for commodities under NOFP

Participants from livestock, agriculture, forests and BAFRA attended a writeshop to develop an organic package of practices for 12 selected commodities under the National Organic Flagship Programme (NOFP) from 20-23 November in Phuentsholing.

The selected commodities in the 12th five year plan are buckwheat, quinoa, ginger, cardamom, mushroom, turmeric trout, lemongrass oil, chilli, asparagus, cauliflower and beans. The package of practices will serve as a tool for experts and farmers to ensure organic production.



MoU between Department of Agriculture and JICA

On 25 November, a memorandum of understanding (MoU) was signed for a general grant aid titled, Project for Improvement of Farm Machinery for Hiring Services of Tillage (Phase 2) between the Department of Agriculture, Gross National Happiness Commission and JICA. It will improve the accessibility of hiring services for farmers and agricultural productivity contributing to farmer's income and sustainable agriculture in Bhutan. Through the project, the department will procure 200 power tillers, 150 mini power tillers, 30 tractors and 20 numbers of combine harvesters.



Ministry and DHI join hands to enhance dairy value chain

The Ministry of Agriculture and Forests and Koufuku International Limited, a subsidiary of Druk Holding and Investments (DHI) signed an agreement to implement the project activities for the dairy value chain under the Commercial Agriculture and Resilient Livelihoods Enhancement Program on 4 December. One ultra high-temperature plant and a processing unit in Deothang, Samdrup Jongkhar and a medium scale cheese processing unit in Nanglam, Pemagatshel will be established under the joint venture.



Regional Symposium on Organic Agriculture

The Regional Symposium on Organic Agriculture: Youth engagement and enterprise development was held from 18-20 December in Paro to discuss the organic agriculture in the Hindu Kush Himalaya (HKH) and how the member countries can develop appropriate institutional mechanisms and foster business partnerships. Experts from 11 countries attended it.

The symposium concluded with an adoption of a strong resolution that all HKH countries have great potential for using organic farming as a means to achieving the Sustainable Development Goals. Local organic certified products were also available for display and sale.



Organic agriculture and certification training

Officials including the organic focal officers from 20 Dzongkhags and three agriculture research and development centres (ARDCs) along with BAFRA officials attended the training of trainers on Organic Agriculture and Certification from 24-27 December in Paro.

Participants learned about the organic seed production and soil fertility and nutrient management techniques, Bhutan Organic Guarantee System and relevant organic inspection and monitoring templates among others. They also visited the organic demonstration site at ARDC-Yusipang.



Workshop on Antimicrobials in animals

Around 55 officials met to discuss the usage patterns of antimicrobials in animals in Bhutan from 25-27 December in Thimphu.

Participants discussed the current regulating mechanisms of Antimicrobial Use (AMU) in livestock, agriculture and others as well as the role of stakeholders in monitoring the AMU and related issues.

The workshop will help Bhutan to develop a national AMU monitoring system for to understand the Antimicrobial Resistance situation in the country and accordingly develop measures.

RNR





Seedling production

Semi-dry bed method

This method is recommended in areas where there is shortage of irrigation water or in areas where wet-bed method is not possible. Follow the steps below:

- Prepare a well-levelled field with fine pulverised soil.
- Apply well-decomposed farm yard manure and thoroughly mix with the soil. About 3 kg

of farm yard manure will be enough for a seedbed of 1 m x 3 m.

- Make raised beds 10-13 cm high, 1 m wide and any convenient length.
- Broadcast un-soaked or dry seeds uniformly on the seedbeds. About 1 kg seed will be sufficient for an area 6 m².
- Cover the seeds using a thin

layer of fine soil mixed with well-decomposed farm yard manure.

- Irrigate the bed immediately after sowing. The beds should be just soaked. Never flood.
- Check the moisture of the seedbed and irrigate when necessary.
- The seedlings will be ready to transplant 30-35 days after sowing.

Source: RNR Newsletter

Damping off

Damping off is a disease that occurs in nursery and when it occurs the whole nursery is destroyed within a short period of time.

Therefore, to avoid the occurrence of this disease, farmers are advised to raise nursery in a well-drained soil because this disease occurs in moist soil with inadequate drainage. It is a soil-borne disease and partial sterilisation of soil can be done by burning

trash on the nursery beds before sowing the seeds.

In addition farmers are invariably advised to treat the seeds with Thiram or Captan (fungicides) before sowing at 2 g per kg of seed.

Alternatively, drench the nursery with Mancozeb solution at 3 g per litre of water as soon as the symptoms appear.



Source: RNR Newsletter

Chilli wilt



The sudden wilting of chilli plant is a main symptom. There is neither resistant variety nor chemical that ensures 100% control to this disease.

Nonetheless, the following cultivation practices can provide effective control of the disease:

- Raise seedlings on soils where chilli is not grown for last three years.
- Follow a two-year crop rotation with crops other than

tomato, brinjal and cucurbits.

- Planting should be done on raised beds, about 15-20 cm high and provide good drainage.
- Use disease free seeds to grow your own seedling instead of buying seedling from unknown sources.
- Remove crop residues from the field soon after the harvest is over. The crop residue should be composted.
- Do not practice high density planting.

Source: RNR Newsletter

Bio-digester

Bio-digester is waterproof containers made using bricks and cement to ferment the biomass that are available in the farm. Making manure from weeds and other plants available in the field provides a cheap and effective way of increasing and maintaining nutrient in the soil. The liquid can also be used for controlling the pest and disease in all the crops.

Ingredients

- Green plants (weeds, waste plant that have no use etc.).
- Animal manure.
- Cattle urine.

Preparation methods

- An effective brew is made from green plants.
- Combination of tree leaves, grasses and soft and hard weeds will result in a good mix.
- The materials are filled up to the brim of the tank.
- A layer of cattle manure of 15 cm height is spread on the waste.
- If cattle urine is available in plenty, the tank can be filled with urine otherwise

potable water can be used.

How to use?

- The degradation of the materials will be completed within 30-45 days.
- The outlet of the tank at the base can be opened to collect the solution.
- One part of the solution is diluted in 10 parts of water and sprayed on the foliage of the crops.

Benefits of bio-digester

- Provides nutrient to crops by foliar sprays.
- Helps to avoid the use of synthetic chemicals like fertilisers.
- Local resources can be used efficiently.
- Helps to save cost in crop production.
- Preparations are environmentally friendly and protects the beneficial organisms.
- Helps to use the local and traditional knowledge.
- Utilises farms wastes efficiently.
- Empowers the farmers to be self-reliant.



Main effects

- Excellent in nutrient management in vegetables and fruit crops as soil nutrient improvement and plant health improvement.
- The target crop are all vegetables and fruits. The scale of application needs to be maintained with one part of the solution diluted in 10 parts of water. There is no limitation of application, can be used weekly or fortnightly on crops.

Source: RNR Newsletter

Cabbage moth

Mamestra brassicae



Why is it a problem?

Cabbage moth larvae are large and feed individually. They feed within cabbage heads and even the presence of a few larvae within a head can completely spoil it for market. Once inside the cabbage, they can be difficult to find and control.

Where and when is it a problem?

This pest is poorly studied in Bhutan but is expected to be common across the cole crops growing regions.

When can damage be expected?

Early season cole crops may escape significant damage as moth populations may not yet have started building up.

Hosts

This pest can utilise a wide range of legume and brassica

hosts. In Bhutan, it has been reported on cabbage, cauliflower and asparagus, although it is only a significant problem on cabbage.

The size of the larvae and the nature of the damage means that even low numbers of larvae (one or a few per cabbage) can destroy its marketability. Careful, regular monitoring and physical control is therefore necessary to limit their effect especially prior to larvae entering the heads.

Monitoring

Inspection for cabbage moth presence and damage needs to be part of regular (twice-weekly) crop monitoring for a wide range of cole crops insect pests. Aim to detect larvae before they enter the heads. Larvae can be hard to find so search during the early morning or evening including among leaves.

Management

Search plants for larvae and feeding damage. Remove and destroy larvae as they are found. It is best to find and control younger larvae as locating them in older plants requires searching in amongst cabbage heads.

Autumn ploughing has been found to be effective in Japan probably because it exposes pupae in the soil to predators and the weather.

Chemicals are not recommended. They are unlikely to be effective once larvae enter the head.

Source: National Plant Protection Centre



Weeds in paddy

Why is it a problem?

Rice is the staple diet of the Bhutanese people. Weeds are one of the constraints to rice production. In a weed survey conducted in the rice growing areas of western Bhutan, at least 19 different species were found infesting transplanted rice (Dorji et al., 2013).

Broadleaf weeds dominated among weed types followed by sedges and grasses. In areas where shochum (*P. distinctus*) is the dominant weed, reported yield loss is about 37%.

Where and when is it a problem?

Weeds are a problem in all rice growing areas within Bhutan. The dominant species differs with cultivation methods and climate zone. For instance, shochum is a temperate weed

found mainly between 1200 and 2500 masl. *Echinochloa colona* is a dominant weed in areas where upland rice is practiced.

Major weeds of rice

1. Broad leaves

- They are easily identified but grasses and sedges can be harder to differentiate.
- Leaves are normally wide, veins branch out in different directions.
- Young seedlings (dicots) have two leaves.
- Stems are often branching.

2. Sedges

- Perennial only.
- Leaves are narrow, arranged in sets of 3.
- Stems are solid, triangular

in cross section and lack nodes.

- Rhizomes are often modified for food storage and propagation.

3. Grasses

- Annual, biennial or perennial.
- Leaves are narrow, arranged in sets of 2.
- Stems are rounded or flattened and are hollow.

When can damage be expected?

The critical period is when competition between crops and weeds is greatest for nutrition, light, space and moisture. For transplanted rice, the critical period is from 20 to about 50 days after transplanting. Weed management should focus on minimising competition

between paddy and weeds during the critical period (20 to about 50 days after transplanting). Weeds in rice fields can be managed through a combination of mechanical weeding, hand weeding and flooding. Pre-emergence weedicide can be applied to control grasses and sedges soon after transplantation. Shochum is the main aquatic weed and requires special management attention.

Mechanical weeding

Initial land preparation, usually a dry ploughing some time prior to transplanting. Flooding and wet-ploughing immediately before transplanting.

In larger terraces mechanical weeding is also feasible for post-planting weed control provided the crop has been planted in rows. Rotary weeders can then be pushed between the two rows, greatly reducing labour requirements.

Flooding

Flooding is by far the most important method of weed control in rice fields. Most dryland weeds are completely

suppressed by submergence. This leaves only the truly aquatic species to deal with. For best results it is essential that the paddy fields are kept continuously flooded to a depth of at least 3 cm. However, this may have to be modified when managing shochum and some insect pests and diseases.

Fields need to be as level as possible so that no dry or deeply flooded spots occur. This flooding regime encourages shochum which will need to be managed using other means.

Manual weeding

Hand weeding is by far the predominant method in Bhutan. First weeding should be done within three weeks of transplantation. Second weeding should be done four weeks after first weeding.

If necessary and especially in the case of serious infestation by shochum, a third hand weeding is recommended. When hand weeding shochum the rhizomes can remain up to 20 cm in the soil. They are difficult to remove so additional weeding and other

management approaches may be needed.

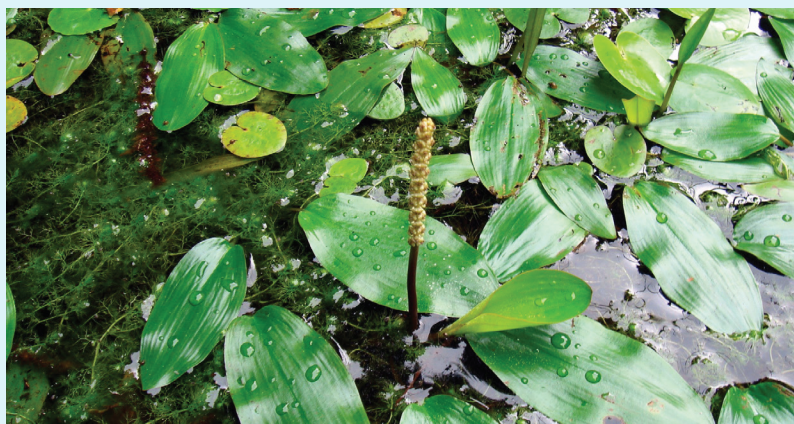
Chemical management

Over-reliance on chemicals will hasten the development of herbicide resistance. Minimise the use of chemicals through the use of additional management methods such as hand weeding.

Butachlor is a pre-emergence herbicide applied at 10-12 kg/ac, 2-3 days after transplanting to control grasses and some sedges. While applying butachlor, fields should be drained of water but soil must still be saturated. Fields should be re-flooded 24 hrs hours after application of butachlor. Gloves should be worn when broadcasting the granules. Butachlor does not control shochum and other broadleaved weeds.

For shochum, ethoxysulfuron is being tested on-station and on farmers' fields. The preliminary evaluation showed good results.

Source: National Plant Protection Centre



HOTLINES



Ministry of Agriculture and Forests (MoAF)

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2. Bhutan Agriculture and Food Regulatory Authority

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3. Department of Agricultural Marketing and Cooperatives

-2009

4. National Centre for Animal Health

-1244

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Produced by:

Information and Communication Technology Division (ICTD)
Directorate Services
Ministry of Agriculture and Forests (MoAF)
Thimphu

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February 2020

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