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SANAM DRUPDREY

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New variety Yusi Maap likely to revolutionise potato production

Saving wild animals

Integrated fishery farm-An inspiring story of Nanong

On the occasion of the 110th National Day Celebration in Haa, His Majesty The King conferred National Order of Merit to 34 forestry officials including 8 Gold, 10 Silver and 16 Bronze medals for their selfless and tireless effort in the conservation and protection of environment and watersheds. His Majesty in his Royal Address also expressed his appreciation to all the 1789 foresters serving in the country and remembered those foresters who expired in the line of duty.

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The RNR family would like to wish
everyone a very happy and prosperous
EARTH MALE DOG YEAR 2018

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

Losar tashi delek !

Produced by:
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FOREWORD

Dear Fellow Readers,

After travelling throughout the Kingdom to experience problems first hand, to understand the ground realities and to propose solutions along with my colleagues of the Ministry of Agriculture and Forests, I am aware that there are many activities that may not be common knowledge to those not directly involved with these issues. Therefore, I am very pleased to see that together with the Ministry's website, *Sanam Drupdrey* is playing a crucial role of educating, informing and raising issues that are most relevant to agriculture, livestock and forestry in the Kingdom of Bhutan.

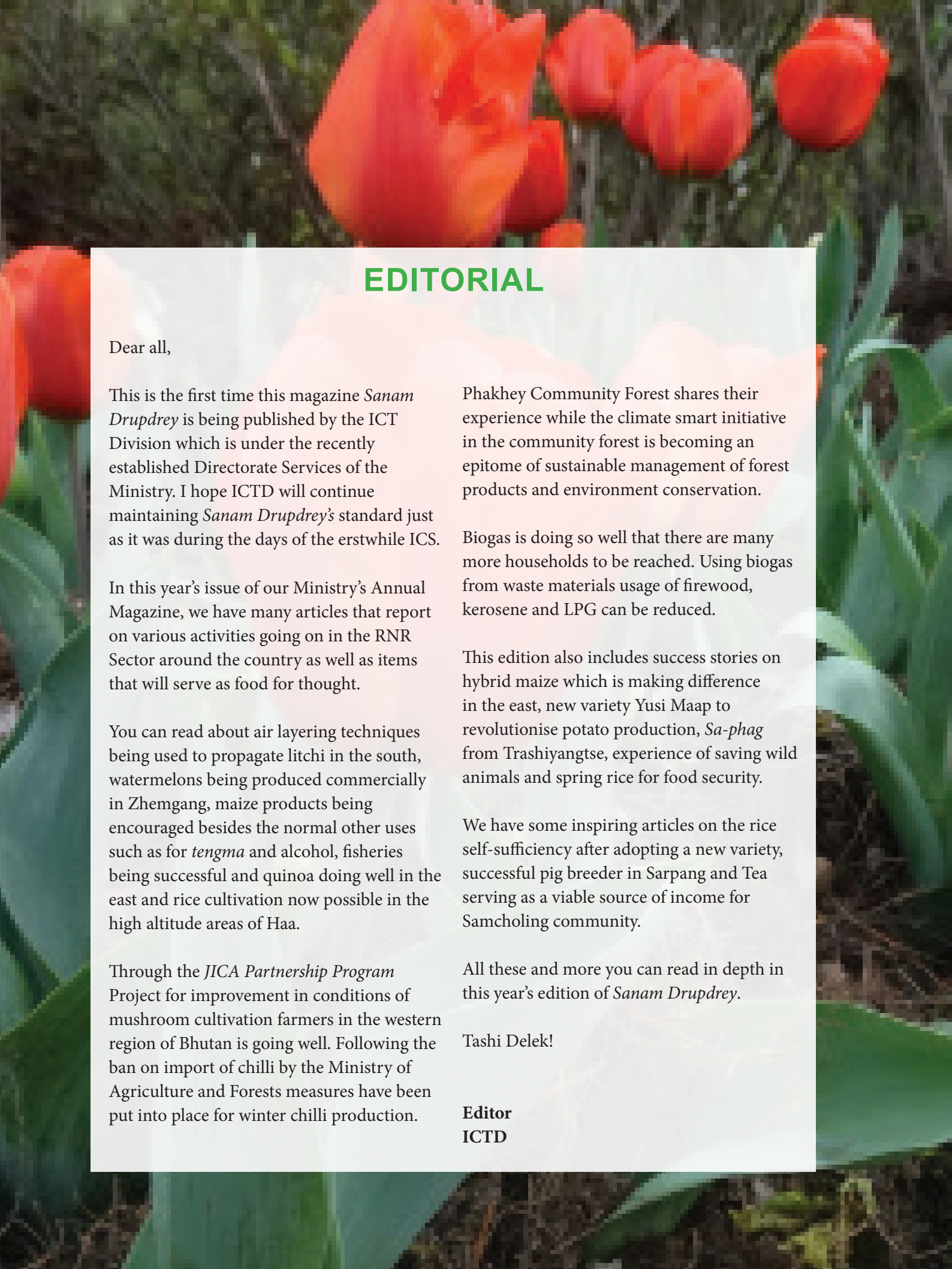
The Ministry is happy to present the 8th edition of the *Sanam Drupdrey.* This edition highlights the performance of the Ministry and its relevant agencies including numerous ongoing and successful projects implemented, lessons learnt and first hand experiences shared from the fields from various sectors. The magazine has done excellently before and I am sure it will continue to do amazingly henceforth.

2017 was a great year for the RNR family members. The Ministry focused on enhancing self-sufficiency by increasing production of rice, vegetables, meat, eggs, chicken, dairy products and fruits. One of the significant initiatives to promote the production of winter vegetables has been a huge success in 2017. The RNR activities have tremendously contributed in enhancing the livelihood of rural people and ensuring the sustainable utilisation of natural resources. The Ministry also launched a number of significant activities to celebrate the first Birth Anniversary of HRH The Gyalsey such as Integrated Yak Conservation and Breeding Centre, Regional Centre of Tiger and Cats Research, Wildlife Rescue and Rehabilitation Centre, National Forest Inventory Report and A Century of Orchid Records in Bhutan among many others.

As the country moves into 2018 and the Year of the Earth Male Dog, I am proud to say the Ministry, all its departments and agencies, and most importantly all the energetic and diligent members of the RNR Family have strived the hardest and the past years have thus proven most fruitful and successful. I am honoured to say that it is accepted by all who know of us and our activities that the Ministry of Agriculture and Forests has made huge strides forward.

Let me not delay you further and therefore allow you to go straight into the magazine, so let me on behalf of the entire RNR family wish you a Very Happy and Prosperous Male Earth Dog Losar 2018 and Happy Reading.

Yeshey Dorji
Minister



EDITORIAL

Dear all,

This is the first time this magazine *Sanam Drupdrey* is being published by the ICT Division which is under the recently established Directorate Services of the Ministry. I hope ICTD will continue maintaining *Sanam Drupdrey's* standard just as it was during the days of the erstwhile ICS.

In this year's issue of our Ministry's Annual Magazine, we have many articles that report on various activities going on in the RNR Sector around the country as well as items that will serve as food for thought.

You can read about air layering techniques being used to propagate litchi in the south, watermelons being produced commercially in Zhemgang, maize products being encouraged besides the normal other uses such as for *tengma* and alcohol, fisheries being successful and quinoa doing well in the east and rice cultivation now possible in the high altitude areas of Haa.

Through the *JICA Partnership Program* Project for improvement in conditions of mushroom cultivation farmers in the western region of Bhutan is going well. Following the ban on import of chilli by the Ministry of Agriculture and Forests measures have been put into place for winter chilli production.

Phakhey Community Forest shares their experience while the climate smart initiative in the community forest is becoming an epitome of sustainable management of forest products and environment conservation.

Biogas is doing so well that there are many more households to be reached. Using biogas from waste materials usage of firewood, kerosene and LPG can be reduced.

This edition also includes success stories on hybrid maize which is making difference in the east, new variety Yusi Maap to revolutionise potato production, *Sa-phag* from Trashiyangtse, experience of saving wild animals and spring rice for food security.

We have some inspiring articles on the rice self-sufficiency after adopting a new variety, successful pig breeder in Sarpang and Tea serving as a viable source of income for Samcholing community.

All these and more you can read in depth in this year's edition of *Sanam Drupdrey*.

Tashi Delek!

Editor
ICTD

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Supporting the thousands of people living in the protected areas through job creation and community improvements

Strengthening the enforcement and management of the protected areas

MAKING GREEN CHILLIES AVAILABLE IN WINTER

44.25MT of green chillies expected for December 2017

Kinley Tshering and Nita Tamang, DoA

If import substitution is a grand policy of the government, the ban on import of chilli by the Ministry of Agriculture and Forests came as a blessing in disguise.

Following the findings of excessive pesticide residues in imported chillies, import of chillies was banned in July 2016. This resulted in a huge shortage of chillies almost creating a pandemonium of sorts in a nation that is famed for its fondness for chilli so much so that *'Ema Datshi'* is unofficially being called the national dish.

The down side of the ban was that chilli price skyrocketed up to Nu.700 a kilogram. Without imports, there was a huge shortage of green chillies especially during the winter.

In 2016, the country imported 1,846.06MT worth Nu.59.003M of green chillies from India (Bhutan Trade Statistic 2016). As per the record from January to March 2017, a total of 157.89MT which converts to a worth of Nu.4.147M of green chillies were imported from India. The data from Food Corporation of Bhutan (7 December 2016-8 April 2017) shows a total of 223.05MT worth Nu.5.570M of green chillies imported from India to meet consumer demands during the lean season. It is also revealed from the figures that 10.94MT was declared 'transportation losses' and only 212.10MT were sold in the domestic market.

With the development of such dramatic episodes, it became more urgent for the Department of Agriculture (DoA) to put in place some measures, hard and fast.

Green chillies-leading the way for winter vegetable production

One of the plans ready to swing as a part of National Vegetable Program was production of winter vegetables with major focus on green chilli production. Therefore, DoA in collaboration with Agriculture Research and Development Centres (ARDCs) and Dzongkhags prepared production plan for commercial winter chilli production through consultation meetings organised in June 2017.

The winter chilli production plan was implemented in the southern foothills of the country in places where there was assured irrigation water because of its favourable agro-ecological zone. In total, about 688.66 acres of land comprising wetland and dryland was planned to be brought under chilli cultivation in 62 gewogs of 8 Dzongkhags and 4 farms of Farm Mechanisation Corporation Ltd (FMCL).

The major production support was provided in the form of inputs such as efficient water use facilities, protected cultivation technologies and quality seeds from National Vegetable Program. The growers were also provided with capacity developments through awareness, demonstration and hands on practice on winter chilli production techniques in collaboration with respective ARDCs and Dzongkhags. Production inputs provided to growers (Dzongkhags and FMCL) amounts to a total of Nu.20.947M.

To ensure effective utilisation of the inputs supplied for the intended purpose, an agreement was signed between the Dzongkhag, gewog and beneficiaries with grower ensuring that they will use the inputs exclusively for vegetable production and that they will produce chilli for minimum of three years. Also from the second year onward, investment should be made by the respective farmers or have it done through credit investment from the REDCL.

Production management practices adopted

Three Indian hybrids such as PAN 1498, SV2319HA and SHP 4884 were promoted for commercial production in all the production sites. The staggered production system was adopted right from the nursery stage to ensure continuous supply of green chillies to the domestic market during the lean season.

Nurseries were raised in groups in a particular area for every cluster of production sites and then seedlings were distributed to individual farmers based on the area. Some seedlings were also raised in ARDCs as a backup as well as to be distributed to other farmers. Low cost poly-houses were constructed in all the nursery production sites. The first staggered nursery raising was done during first week of August 2017 and fortnightly thereafter till fourth staggered nursery.

The seedlings were transplanted in the main field when they attained 4-5 true leaf stage (30-35 days) in their individual farmland. In the main field, the planting was done in both open field and under protected cultivation with

or without plastic mulch and drip irrigation installed. The first staggered nursery transplants were mostly transplanted in open field and without plastic mulch while from the second staggered nursery transplants the plants were provided with plastic mulch and some were planted under poly-houses as a measure to overcome drop in temperature during the plant growth and development stage. Chilli is a day-neutral plant but requires an ideal temperature of 20 °C-30°C for its growth and development. Temperature below 15°C will result in reduced crop yield.

Based on the national average yield of 1.60MT per acre as of 2015, the total expected production from 688.7 acres of land would be about 1011.92MT 2017 winter. The national average yield (1.6MT/ac) takes into account the summer chillies produced within the country too, therefore, the expected production was estimated at higher side.

The expected production for the month of December 2017 from the first staggered transplants as submitted by the Dzongkhags was 44.25MT. The production is low as most of the first staggered transplants especially in low-lying areas were damaged by continuous rain after transplanting.

Expected production from 1st staggered transplants for December 2017

Dzongkhags	Estimated Production (kg)
Dagana	24070
Pemagatshel	12500
Samdrupjongkhar	2580
Samtse	2540
Zhemgang	1270
Tsirang	780
Sarpang	290
Chukha	215
	44245

Based on the expected production submitted to Department of Agricultural Marketing and Cooperatives (DAMC), it was decided that following marketing strategies be implemented:

- DAMC will support in linking the producers with the market both local and major domestic market such as Centenary Farmers' Market (CFM) in Thimphu based on the market demand analysis.
- Linking producers with local vegetable vendors or vegetable vendor association of CFM in bringing the fresh chillies to CFM.
- Creating competition in the market and have indirect control over the final retail price, Youth Business Cooperative of Thimphu will be linked with producers to market fresh chillies in CFM.
- Formation of farmer's marketing group within the production sites and supporting the group with subsidy in the form of transportation and other packaging materials

New variety Yusi Maap likely to revolutionise potato production

It is high yielding, nutrient dense and late blight resistant

Yadunath Bajgai, Tshering Dochen , Lobzang, Sangay Tashi Gyeltshen and Tshering Lhadon
National Potato Program, ARDC-Yusipang

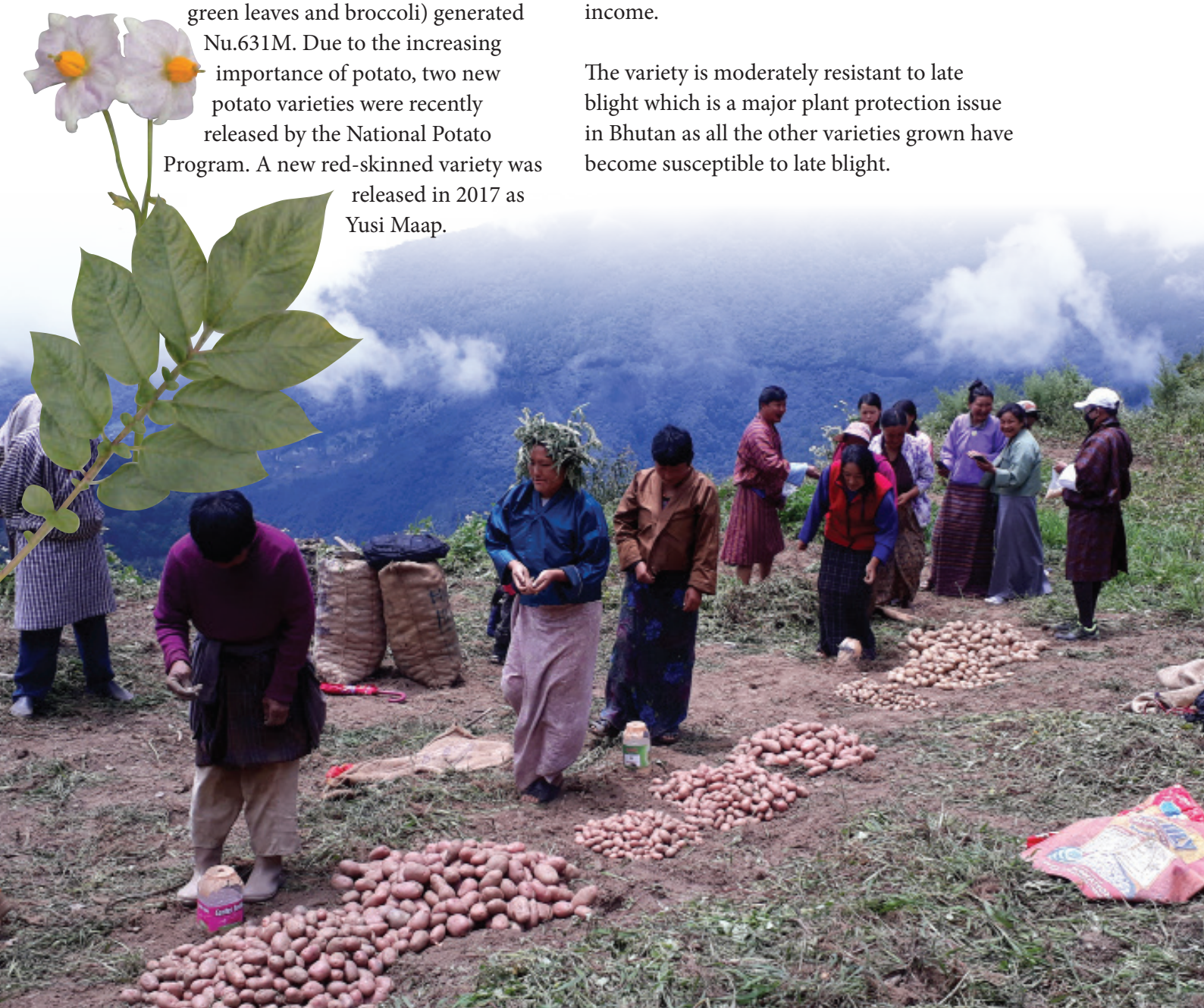
Potato is the only non-cereal food crop that has become one of the widely traded horticultural commodities in Bhutan. Potato is grown in all the Dzongkhags and is widely consumed as vegetable. Farmers in many Dzongkhags such as Bumthang and Haa rely on potato for their livelihood since they buy cereals through the income from potato and thus, potato acts as a cash crop indirectly.

Due to its commercial nature, potato cultivation has gained popularity and has transformed the Bhutanese agriculture from subsistence to an emerging market oriented agriculture. However, the yield of potato in Bhutan has remained more or less constant over the past one decade due to lack of diversity of varieties, late blight infestation and degeneration of potato seed quality. Hence, varietal development research was carried out to generate new varietal technology over the past few years.

According to Agriculture Statistics, potato generated Nu.797M in 2016 and other main vegetables (asparagus, chilli, cabbage, cauliflower, carrot, radish, beans, peas, green leaves and broccoli) generated Nu.631M. Due to the increasing importance of potato, two new potato varieties were recently released by the National Potato Program. A new red-skinned variety was released in 2017 as Yusi Maap.

In the three demonstration locations of Chang, Chapcha and Kazhi gewogs, Desiree yielded the least among the three which further shows that yield potential of the variety has declined possibly due to late blight damage and deterioration of seed quality. Analysis on the farmers' preference ranking showed that Yusi Maap was most preferred in all the three locations probably due to the red skin and better yield. On the whole, the results indicated that new varieties, particularly Yusi Maap taken up fast for adoption due to the market preference for red skinned potato. The results of this study show that it has potential to positively impact potato production and enhance farmers' livelihood through higher yields and better income.

The variety is moderately resistant to late blight which is a major plant protection issue in Bhutan as all the other varieties grown have become susceptible to late blight.



Dr. Kadian from CIP regional office New Delhi and Dr. Yadu from NPP inspected late blight damage of three potato in June 2017 above Jamba Lhakhang in Bumthang. While Desiree was completely damaged, Yusi Maap partially damaged and Nasephey Kewa Kaap (NKK) was not damaged by late blight due to the blight resistant characteristics of these varieties. It was realised that Yusi Maap and NKK are answers to late blight disease.

Further, Yusi Maap is a nutrient-dense (high Iron and Zinc, and moderate vitamin C content) variety. To some extent, the variety is also expected to address malnutrition in children and women whose diet consists of some potatoes in one form or the other. This is the first micro-nutrient dense variety released in Bhutan and is expected to revolutionise consumption pattern because of the stereotype thinking that potato can only provide carbohydrate in the diet.

Two new potato varieties were released by National Potato Program

	Varieties		
	Yusi Maap	Nasephel Kewa Kaap (NKK)	Desiree
Accession no.	CIP392797.22	CIP393077.159	CIP800048
Year of release	2017	2014	1988
Characteristics	High yielding, red skinned, high Iron and Zinc and moderate vitamin C content and moderately resistant to late blight.	High yielding, pink eyed and resistant to late blight.	It is a relative high yielding, red skinned and has been popular variety in Bhutan for long.
Average yield in Chang, Thimphu in 2017	6.5MT/acre	10.4MT/acre	5.1MT/acre
Average yield in Chapcha, Chukha in 2017	12.6MT/acre	14.5MT/acre	8.4MT/acre
Average yield in Kazhi, Wangdue in 2017	8.8MT/acre	10.9MT/acre	2.3MT/acre
Farmers' preference ranking in general	First	Second	Third

Micro-nutrient content of Yusi Maap according to CIP

Nutrient name	Content	Categories
Vitamin C	59.85 to 89.7mg/100g dry weight basis	Moderate
Iron	> 18.45mg/kg dry weight basis	High
Zinc	> 16.5mg/kg dry weight basis	High

Biogas project: Beyond the target

The success of the project has made more people wanting to install bio-digesters

Project Implementing Unit
Bhutan Biogas Project
Department of Livestock

Not long ago, farmers would laugh if they were told to make fuel from the waste their cattle generated. They would not now!

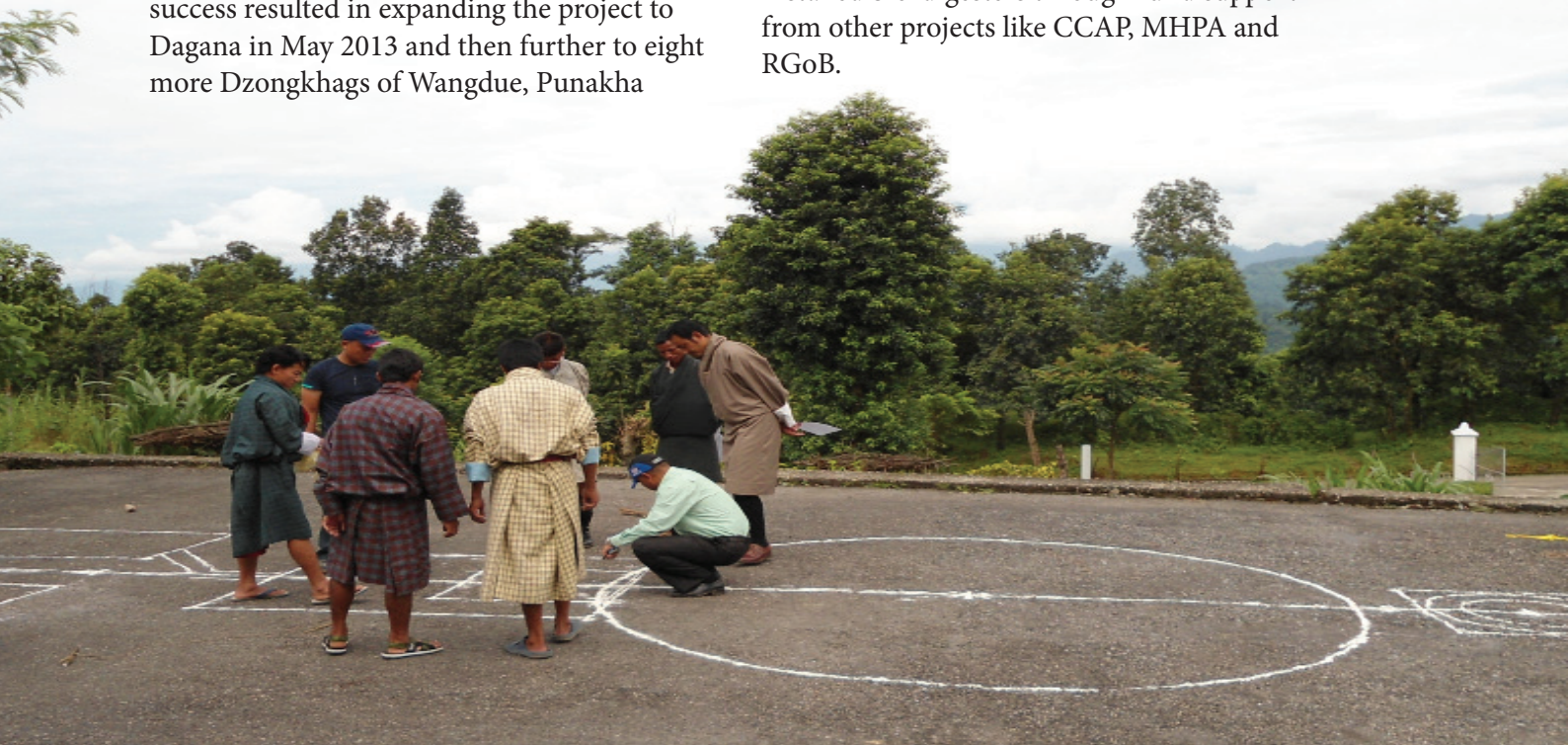
After 5003 domestic bio-digesters across the country, against a target of 4633 as of December 2017, they are laughing their way towards a new method of cooking and heating without having to fight fumes.

If there is one successful project in the country, it is the Bhutan Biogas Project (BBP). Implemented by the Department of Livestock (DoL) since the start of the project in March 2011 with financial support from Asian Development Bank through the Department of Renewal Energy, the project has not looked back given its popularity and success after the initial hiccup.

The project began with a modest target of installing 1600 domestic size bio-digesters in Samtse, Chukha, Sarpang and Tsirang. Its success resulted in expanding the project to Dagana in May 2013 and then further to eight more Dzongkhags of Wangdue, Punakha and six eastern Dzongkhags in 2014 with an additional target of 3600 bio-digesters by December 2016.

A SNV study in 2009 reported that Bhutan consumed about 1.0 to 1.2MT of fuel wood per year. About 70% of this is used for cooking and heating. Bhutan's fuel consumption of about 1.2 tonnes per capita per year is among the highest in the world. In addition, Bhutan has been importing large quantities of fossil fuels, 5.7MT of LPG and 5.2MT of kerosene in 2008 for cooking, heating and lighting. The data indicates that there is high need to provide alternative to supplement conventional cooking fuels, mainly fuel wood and biogas plants could be suitable option, the study recommended.

The biogas project has come to the rescue. Given its success, the project was extended until December end 2017. It was agreed that 4633 family size domestic bio-digesters would be installed as total target covering additional Dzongkhags like Gasa, Paro, Haa and Bumthang. As of now, the project covers 17 Dzongkhags excluding Thimphu, Trongsa and Zhemgang. But these Dzongkhags have also installed bio-digesters through fund support from other projects like CCAP, MHPA and RGoB.



The project has also established three medium scale biogas plants (two 75 cum and one 50 cum) constructed in government livestock farms in Samtse, Gelephu and Wangkha which were installed on cost sharing basis with DoL and BBP.

The biogas has become a popular alternative energy source to supplement conventional fuels for cooking, substitute for LPG, reduce GHG emission, dairy development to increase dairy products, increasing agricultural production by application of bio-slurry as an organic fertiliser which contributes to significant improvements in terms of human health and sanitation of the rural communities.

One factor behind the success is the functionality of the biogas plants. Users are happy with the performance and this story has been encouraging more farmers to install biogas plants. Farmers have realised the importance and usefulness of biogas and there are still lot of farmers coming forward to install bio-digesters.

Today, there are over 17,000 households already identified as potentials to go for the bio-digester construction as per the market study report 2009 done by SNV, Bhutan. Meanwhile, the DoL will continue to install 4400 domestic bio-digesters in 12th FYP under Livestock Biogas Program to reach the program to all the potential households.

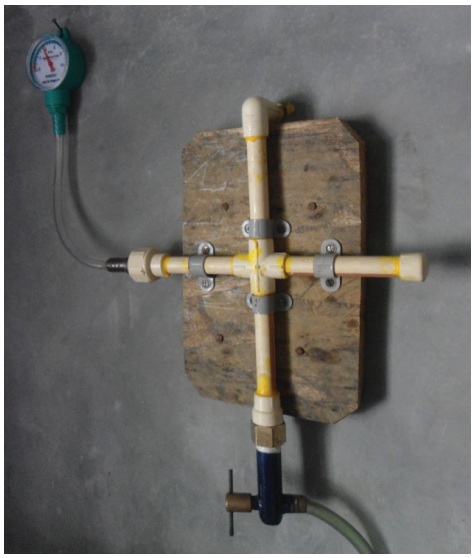
There is a huge saving from the use of biogas as it is produced using waste materials. One biogas plant can save Nu.38.50 a day when replacing firewood, Nu.14 from kerosene and almost Nu.16 from the use of LPG.

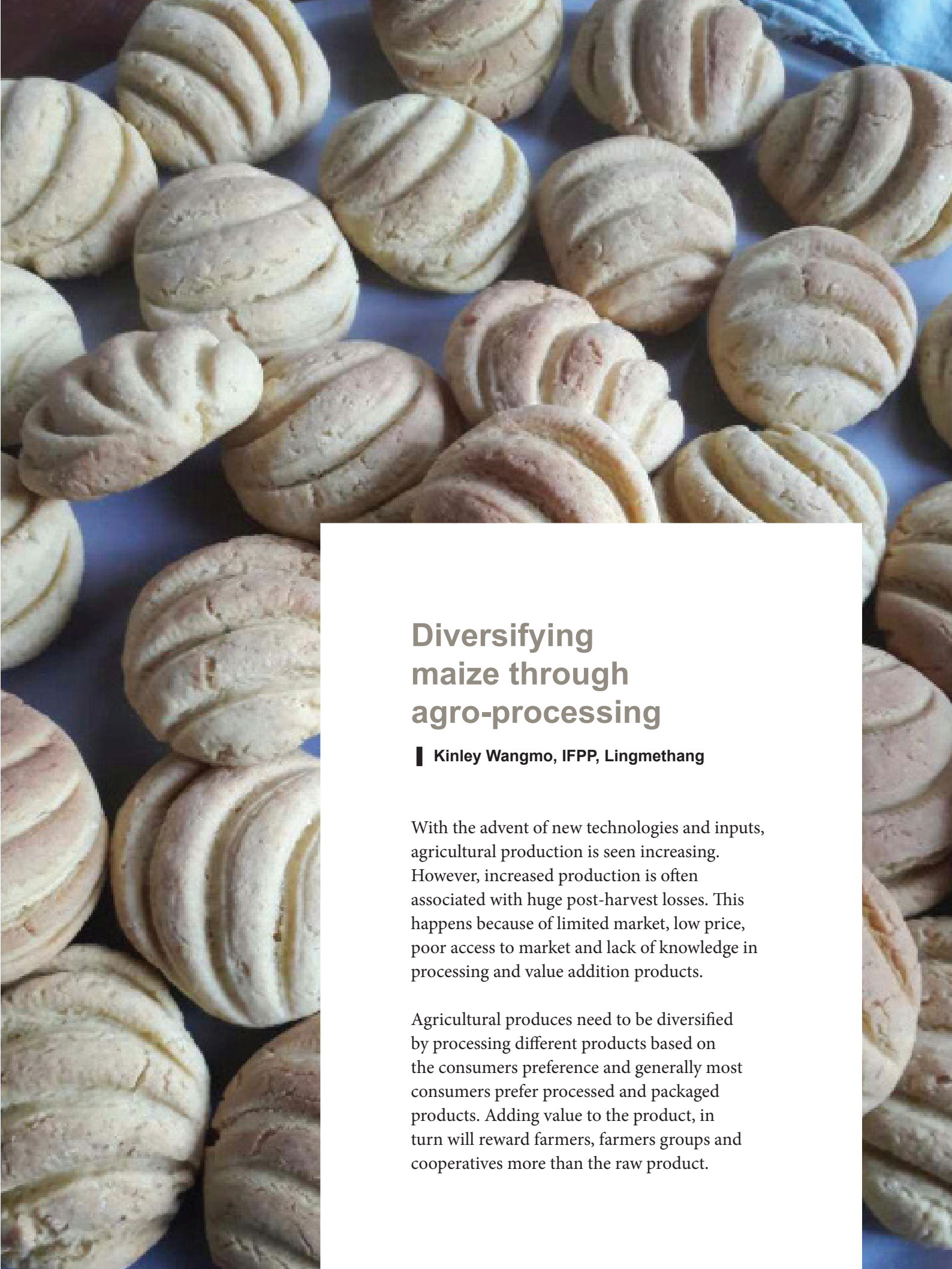
Savings from one bio-digester in one year

Sl. No.	Fuels	Qty. saved per day	Cost per unit (Nu.)	Total cost saved per day (Nu.)	Total cost saved per year (Nu.)
1	Firewood	5.5kg	7	38	14,052.50
2	Kerosene	0.7litre	28	14	5,110
3	LPG	0.45kg	35	15	5,807.15
4	Electricity	4kwh	2.45	9.80	3,577
			64.80	**78.21**	**28,546.65**

Total bio-digesters installed: 5003
Savings from 5003 bio-digesters = 5003 x 28,546.65 = 142,818,889.95
(About Nu.143M)

Despite constraints which hinders installation of bio-digesters in the country because of cheap electricity supply (free up to 100 units), available of biomass resources, distribution of LPG on subsidised rate, geographical distribution of human settlements and rugged terrain, BBP has been successful in carrying out the project activities for the period covering over more than six years (March 2011 to December 2017) by establishing strong foundation of biogas program which will be carried forward in all twenty Dzongkhags even after the completion of project period.





Diversifying maize through agro-processing

Kinley Wangmo, IFPP, Lingmethang

With the advent of new technologies and inputs, agricultural production is seen increasing. However, increased production is often associated with huge post-harvest losses. This happens because of limited market, low price, poor access to market and lack of knowledge in processing and value addition products.

Agricultural produces need to be diversified by processing different products based on the consumers preference and generally most consumers prefer processed and packaged products. Adding value to the product, in turn will reward farmers, farmers groups and cooperatives more than the raw product.

Maize is one such product where value addition technique can yield several other products. It is a low hanging fruit as it neither necessitates huge capital investment nor sophisticated equipment and machineries.

In Bhutan, maize is grown all over the country particularly in the eastern region where it is considered as staple diet. Maize is a high yielding crop compared to other cereals. However, in today's modern age, maize consumption is on the decline and thus it's utility.

Supposedly the 'poor man's cereal' is usually made into *kharang* (grits), *bokpee* (flour), *tengma* (bitten corn) and to brew alcohol. Not anymore now.

Integrated Fruit Processing Plant (IFPP) in Lingmethang in collaboration with the National Maize Program at the Agriculture Research Development Centre (ARDC)-Wengkhar has now initiated product development through hands on practice trainings with farmers which also involves unemployed youth and housewives. Products are first developed on a trial basis at the centre; it is then evaluated and promoted.

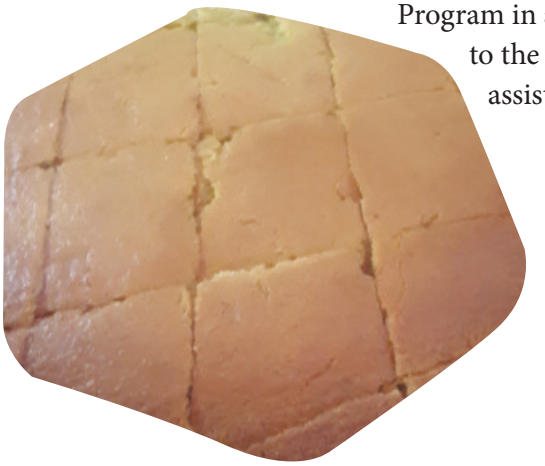
Product development on maize has also been initiated. The objective is to create awareness on nutritional importance on maize, food security and product diversification. It is also expected to provide income opportunities to the farmer.

From the past programs, nine different derivatives of maize were identified. The current program however is focused on products that have shelf-value and can be packaged. These include cookies, doughnuts, cakes and snacks. Since the beginning of 2017, a total of seven trainings have been organised and it was attended by 161 participants consisting of youth, hoteliers, lead farmers and housewives.

Pumpkin, quinoa, tapioca, chestnut, carrot, jackfruit, banana and potato are other agricultural produce that can be used to make snacks, cookies, candies, chips, jams and marmalades. For example, the Japanese variety of pumpkin promoted in the region is now used to make pumpkin cookies. Products such as candies, marmalade and kumquats are sold through queen's project.

As maize products are relatively new in the market, sales volume is currently low. But it has huge potential given the effort centre has put in to promote the product and encourage the farmers.

IFFP and ARDC-Wengkhar targets entrepreneurs, unemployed youth and hoteliers to take up agro-processing as small and medium enterprises. There are already few farmers' group selling chips and candies in local market. IFPP also encourages them to sell their items through the B-Coop Shop and one-gewog-one product initiatives. To help them further, they supply them equipment such as dryer and fryer supported by the National Post Harvest Centre and maize flour mill by National Maize Program in addition to the technical assistance.



SAMCHOLING TEA

The greatest gift to the community

Sangay Dorji, ARDC-Samtenling

Bhutanese are ardent tea connoisseur, but they never grew their own tea. This is changing.

A variety of green tea (*camellia sinensis var. sinensis*) had been growing in Trongsa for decades. Nobody knew it could be grown on a commercial scale. It is believed that His Majesty Jigme Wangchuck brought the tea to Trongsa. The tea was planted around the Samcholing palace and has been the greatest gift to the community from the Second King.

This is because 27 households in Samcholing, Drakten gewog are brewing good income from the sale of green tea. It has become the main cash crop for them. It was initiated in 2009 by then Council for RNR Research of Bhutan with support from the GENTEC University, Republic of South Korea in collaboration with the Department of Agriculture, Trongsa Dzongkhag and the Department of Agricultural Marketing and Cooperatives.

Today, there are about 43 acres of tea owned by the group members who work under a group called *Samdrupcholing Zang Ja Tshongley Detchen*. The hard work is finally bearing fruits. In 2016-2017, the group produced about 15,000 packets (50gm in each packet) of green tea and about 9000 packets (150g in each packet) of butter tea leaves. About 60% of their green tea was sold in Thimphu, 20% in the local markets such as Trongsa and Bumthang and rest 20% to visitors.

The newfound wealth, despite challenges like shortage of labour, high cost of production and limited technical expertise for tea production and manufacturing is changing the living standards of the people. The household's average income ranges from Nu.10,000 to over Nu.200,000. There are more than 160 households in Samcholing mostly depending on agriculture farming such as paddy, maize, wheat, mustard, buckwheat and vegetables as well on livestock rearing. In general, vegetables are the main cash crop of the Samcholing farmers.

Tea plantation is totally based on contour planting in registered marginal and fallow land. The concept of collective farming was initiated due to limited land in a contiguous area which encourages pooling of all their private land for planting tea. Farming is strictly natural without using synthetic insecticides and inorganic fertilisers. The tea bushes are usually maintained at 1m tall by pruning and periodic harvesting of new growth, called flush. Flush is used for the manufacture of finished tea. To maintain high quality tea, importance is given during the time of processing in order to retain its original colour and aroma.

The pilot program has brought tremendous changes in the lives of the tea growers of Samcholing. Their annual income shot up from Nu.10,000 to Nu.150,000 per annum from the sale of green tea and butter tea leaves. This is because tea growers were accessible to the common resources in processing, labelling and packaging. The product outlet and bulk delivery of products to market within country reduced the cost of the group.

Production skills, development of an individual and group saving valued the ownership of enterprise and gear towards development of cooperatives. Following plantation, its annual

production keeps on increasing as its maturity stage is only after seventh year. First green tea harvesting started in 2012 with 700 packets of 50g at rate of Nu.140 a packet. Their overall gross return was about Nu.98,000 in 2012. In 2013, 2014 and 2015, the annual production was over 2000, 5000 and 7000 packets with a gross return of Nu.280,000, Nu.700,000 and Nu.980,000 respectively.

Tea is an environment friendly crop as it has numerous positive impacts on the country's biodiversity, landscape, soil and water conservation. It is also a means to resolve human wildlife conflict as crop encounters very minimal damages by wild and domestic animals.

In the long run, growing tea in the country could reduce the import of tea. Tea seed oil from the same plant is another potential as it is highly edible and equally important as a health-promoting food resource in human diet due to its good antioxidant activity (Wang et al., 2011). To help farmers, the Agriculture Research and Development Centre (ARDC)-Samtenling in Gelephu and the Dzongkhag Agriculture Sector, Trongsa provides technical assistance to the tea growing community in terms of propagation or multiplication of tea seedlings, nursery management practices, layout and plantation and regular orchard management and operations. The technical team also help them during tea plucking, sorting, processing, packaging and marketing.

The sector is planning to emphasise more on value chain and sustainable marketing mechanism of all tea products. It is working towards organic tea certification as a niche product while also diversifying product. It will also focus on development of smallholdings and exploring markets both within and outside the country.

CLIMATE SMART INITIATIVES

The Phakhey Community Forest experience

Lhabchu Tshering and Jigme Tenzin
Divisional Forest Office, Sarpang

In 2013, villagers of Phakhey, Sarpang, unanimously agreed to a plan of starting a Community Forest (CF). One hundred and eighty-two eager men and women from 28 households agreed to the plan. The CF was launched on 25 December 2013 in a simple ceremony.

Four years after the launch, villagers are reaping the benefits of the CF while the climate smart initiative in the community forest is becoming an epitome of sustainable management of forest products and environment conservation.

Before the CF, livestock rearing was the main source of livelihood with off-farm activities during lean season as the main source of cash income. The annual average income/households was about Nu.12,326 insufficient to sustain a family for a year. Unlike other villages, the topography of Phakhey and lack of irrigation water makes Pakhey unsuitable for paddy cultivation. Maize and millet are the only two principle cereal crops grown.

Although electricity was connected long ago, none of the community forest management group (CFMG) members possess any eco-friendlier cooking devices such as rice cooker, curry cooker, bio-gas and gas cylinder. The community relies on conventional cooking and heating system emitting intensive carbon dioxide (CO_2) causing air pollution and bringing various health implications to humans and the environment. Intensive grazing was also found to be a serious issue causing series of land degradation (erosion and landslips cases) in Bjulikhop block.

All these changed with the establishment of the CF. Phakhey CF has a total area of 131.6 acres (53.27 ha) where the CF area is divided into three blocks: Kharshong (61.74 acres), Lhangchenphu (41.88 acres) and Bjulikhop (27.98 acres).

An immediate impact was the land rehabilitation. Members carried out mass plantation covering 20 acres in four years out

of 30 acres (provisional area) that covers all three blocks since 2013. The degraded land (eroded and landslip area) were vegetated with bamboo (*Bambusa nutans*) and broom grass (*Thysanolaena maxima*) since 2013. These vegetation activities have not only controlled land degradation but also significantly contributed the CFMG in generating additional incomes through sale of fallen trees, bamboo culms and broom grasses.

The CF has also revived the community vitality with the people now sharing strong social cohesion. All CFMG members participated in most of the CF activities. This resulted in controlling land degradation in Bjulikhop block (27.98 acres) and management of 20 acres of barren area with broom grass and bamboo plantation which has now become a main revenue sources for Pakhey Community Forest.

Socio-economic status of CF

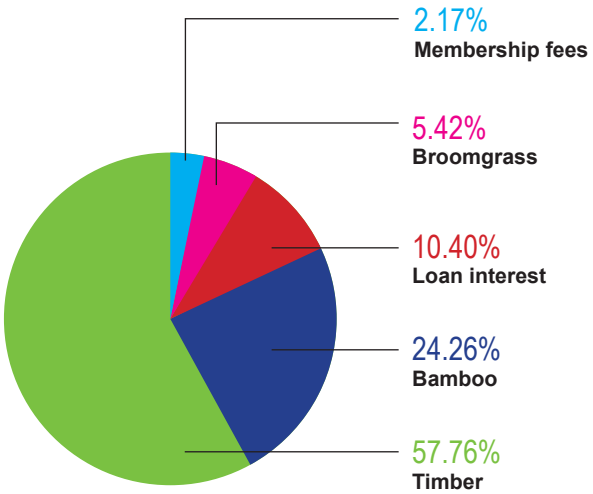
Unlike other CFs, Phakhey has lesser resources in terms of timber. However, there was a good presence of fallen timbers such as Sal (*Shorea robusta*), Gamari (*Gmelia arborea*) and Champ (*Michelia champacca*) which existed prior to CF establishment.

This has become a lucrative source of income for the members. Besides these, the CF has other sources of income. Since 2013 till 2017, the highest revenue, Nu.200,000 was generated from the sale of sawn timbers followed by sale of bamboo culms (Nu.84,000), interests from loan (Nu.36,000) and sale of broom grasses (Nu.18,750). The lowest (Nu.7500) was from membership fees collected from each group members.

In total, within four years of the establishment, Nu.0.346M was generated with an annual average revenue of Nu.86,562.5/year. This indicated that common hard work of members had contributed significantly to the revenue generation of the CF higher than the progress of other CFs in the Dzongkhags.

Overall, sale of sawn timbers has contributed the highest revenue (57.76%) followed by sale of bamboo culm (24.26%), interest from loaning (10.40%), sale of brooms (5.42%) and membership fees collected from respective CFMG was the lowest revenue contributors until now.

Revenue generated percentage for different sources



However, sale of bamboo culm and broom grass will remain a promising revenue contributor during the subsequent year due to available stock within the CF.

Climate Smart Initiatives (CSIs)

In the absence of climate smart devices, fuel wood consumption by Phakhey communities was moderately high. Pollution from fuel wood burning was a concern since burning of wood emit considerable amount of carbon dioxide, a factor triggering global warming and climate change.

The community depended on firewood for cooking, heating and preparing feeds for cattle. It was found that about 28 standing trees were annually felled and allotted as firewood for 28 group members which is equivalent to 224 volumes (m^3) of trees/year to fulfil above residential demand.

Felling 28 standing for firewood was the big challenges to envision sustainable forest management (SFM). Although CFMG will claim their shares as a matter of right, it should not override the principles of SFM.

The CSI which was part of the joint initiative between CFMG, Gewog Forest Office and Divisional Forest Office was initiated in Pakhey CF to reduce the pressure on forests.

The other objective was to minimise environmental hazard such as air pollution through utilisation of eco-friendlier cooking devices. With this initiative, for the first time, about 28 rice cookers, 28 curry cookers, 27 gas stoves and 27 gas cylinders were procured from their CF fund costing Nu.0.156M and distributed to 28 members.

It was initiated by Gewog Forest Officer and launched by the Chief Forestry Officer of Sarpang on 12 September 2017 at Shompangkha gewog.

This initiative replaced the conventional methods of cooking and reduce the health hazards and impact on the environment. CFMG found the program to be an *'Eye-opener'* and '*Fulfilling moment*'.

Firewood allotment is also expected to reduce by more than half (14+ standing trees) which is equivalent to 112 volumes (m^3)/year from the coming year. For instance, retaining one mature tree can store 48lbs of atmospheric CO_2 and in return gives 260lbs of O_2/year. Annually, retaining 14 matured trees can store 672lbs of atmospheric CO_2/year and can give 3640lbs of O_2/year.

The Pakhey CF is a model of a self-financed CSIs undertaken by community forest members of southern Bhutan. This will set a new paradigm for other potential CFs in the Dzongkhag as well as other parts of Bhutan.

Bertipas step into water melon commercial production

Yeshey Dorji and Sonam Jamtsho
ARDSC-Tingtibi
C. M. Dhimal, ARDC-Samtenling

Zhemgang may be known as the poorest Dzongkhag in the country, but Berti farmers are contributing to the national economy in a small, yet important way.

With the government focusing on import substitution to reduce the out flow of scarce Indian Rupee, Berti farmers have taken up commercial farming of watermelons which is imported by the truckload every year.

Containing about 92% water with refreshing soaked nutrients and vitamin A, B6 and C, lycopene, antioxidants and amino acids; Bhutanese consumes watermelons in huge quantities.

With the concern of pesticides residual effect on human health, food security and self-sustainability, the Agriculture Research and Development Sub Centre (ARDSC)-Tingtibi and ARDC-Samtenling in collaboration with Zhemgang Dzongkhag Agriculture Sector and Trong Gewog Agriculture Sector stepped into commercialisation of watermelon in 2017.

Watermelon in Berti was introduced to utilise the wet land during lean season. Berti is also technically and climatically feasible for watermelon cultivation for which 11 households were involved.

An initial trial at Tingtibi centre in 2016 was carried out and information of success trial results was disseminated to the farming community in 2017.

Practical hands on training and crop management were provided periodically to beneficiaries with complete packages for melon cultivation as and when required. The management practices of melon are tedious in nature and need more attention than any other horticulture crops.

Cultivation was carried out in Berti village under Trong gewog located at an altitude of 600 masl with 24 households. About three acres of land is protected with electric fencing and has good access of irrigation out of which an acre was taken for watermelon production.

Farmers worked in a group in a single plot of land with nursery raising in October 2016 and harvesting in April 2017. They were given hands on training and demonstration in nursery raising, field preparation, transplanting, after

care and intercultural operation till harvesting. The activity was further promoted by organising a field day to create awareness and showcase the new initiatives in April 2017. There was good participation from various stakeholders including Dasho Dzongda, other Dzongkhag officials, farmers' group members from various villages, researchers and local government officials.

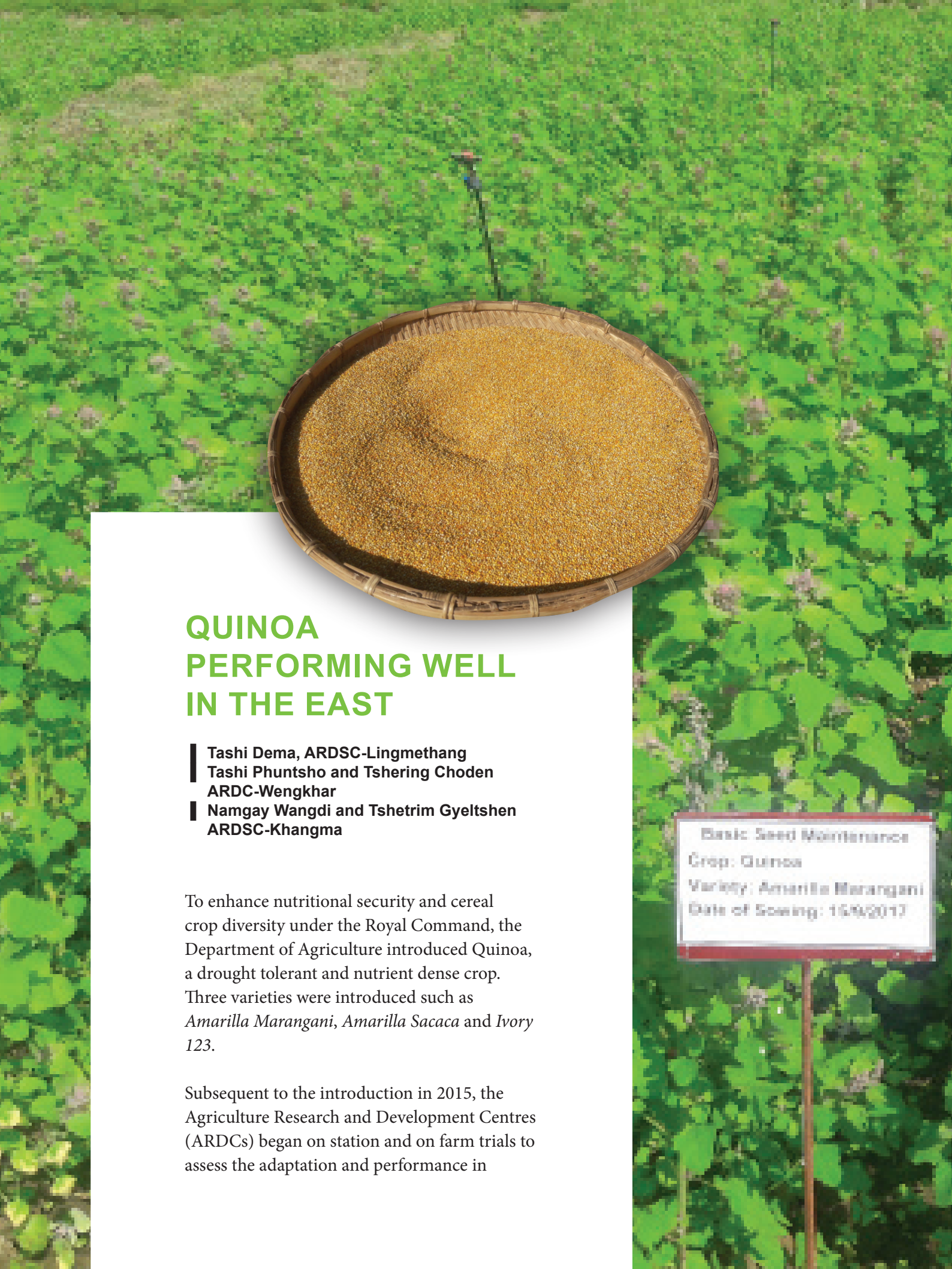
The expected production was about 3 to 5MT in the first year. However the total production exceeded 15MT. It was sold at Nu.30/kg which amounted to Nu.450,000. Out of 15MT watermelons, about 1MT were sold during the field day. Another 7MT was marketed to Thimphu through Khengrig Namsum Cooperative and rest was marketed to Bumthang, Trongsa and Zhemgang.

With the success story, more farmers expressed interest and there is more demand for seedlings in the next season. The Tingtibi and Samtenling centres in collaboration with extension are working on it.

It was noticed that the locally produced melon has more sweetness and water content. The locally produced fruits were bigger in sizes. The only disadvantage is the local melon perishes faster than the imported one.

Currently, about 3-4 acres of land are used for melon cultivation for which labour shortage is big challenge. The sector and sub-centre is planning to expand its cultivation area towards lower Kheng and in other potential areas.

Meanwhile, the same groups of farmers have also ventured into bulb onion production with technical and materials support from agriculture sector and both centres.



QUINOA PERFORMING WELL IN THE EAST

Tashi Dema, ARDSC-Lingmethang
Tashi Phuntsho and Tshering Choden
ARDC-Wengkhar
Namgay Wangdi and Tshetrim Gyeltshen
ARDSC-Khangma

To enhance nutritional security and cereal crop diversity under the Royal Command, the Department of Agriculture introduced Quinoa, a drought tolerant and nutrient dense crop. Three varieties were introduced such as *Amarilla Marangani*, *Amarilla Sacaca* and *Ivory 123*.

Subsequent to the introduction in 2015, the Agriculture Research and Development Centres (ARDCs) began on station and on farm trials to assess the adaptation and performance in

different elevations and also started a seed production program of three varieties.

In the eastern region, the ARDC-Wengkhar began a quinoa program for evaluation and seed production in 2015 starting at Wengkhar, Khangma and Lingmethang and on farm evaluations in Mongar. Using the seeds from the previous year, the crops began spreading out into the farmers' field in 2016 to carry out wider assessment of the crops suitability, adaptability and yield performances in the region. Farmers preferred the Indian variety, Ivory 123 as it suits with maize based farming system common in the east. In addition, Ivory 123 is comparatively shorter and less prone to lodging unlike the other two.

When the program began, seeds were less and could only cover only 13.91 acres. Further with little experience of cultivating the crop, trial harvest coincided with the monsoon which makes seeds germinate before harvest and also cause fungal infections. Average yield of 600kg/acre was harvested. However in 2016, a total of 200kgs of Ivory 123 was distributed in the region expanding the area under cultivation to about 20 acres (46%) cultivated by 130 farmers.

The DoA introduced six more varieties in 2016 namely *Hualhuas, Huancayo, Blanca de Junin, salcedo INIA, Negra Collana* and *Pasankalla* thus increasing the number of varieties introduced to 9. Further evaluations began and resulted in the selection of three varieties namely *Amarilla Marangani, Amarilla Sacaca* and *Ivory 123* found to be suitable in the region at various elevations. From the 2016 harvest, seeds produced by farmers were bought back by the centre and redistributed to the Dzongkhags based on their demand.

By then, few farmers in Mongar have also started to use the seeds from previous harvest as it was planned. Chaskhar gewog is one of the first

gewogs to take up quinoa began to harvest an average production of 667.5kg/ac higher than on station yields at Khangma of about 599.3kg/ac. In 2017, about 188kgs of Ivory 123 and 5kgs of Marangani were distributed in the region targeting cultivation after maize. About 64 acres were put under quinoa by some 200 farmers. By 2017, a total of 3 varieties were identified for the region-Marangani and Sacaca for higher and Ivory 123 for lower elevations.

Since, quinoa cultivation is not common and Bhutanese are unaware of the crop and its potential benefits for nutritional improvement, the centre organised awareness programs and field days and further upscale the crops into the region.

In 2017, more than 400kgs of seeds were secured mostly through research trials and buy back from farmers. These seeds are further distributed to farmers and in collaboration with Dzongkhags and gewog extension centres in the region, the centre is targeting at least 100 acres per gewog in order to upscale and enhance production. The latest data showed that at least 600kgs per acre yield can be harvested and the crop is gaining popularity.

INTEGRATED FISHERY FARM

An inspiring story of Nanong

Sangay Yeshi, RNR-EC, Nanong Pemagatshel

Despite the religious sentiments and stigma that dissuade many farmers from taking up fish farming, three farmers from Nanong gewog in Pemagatshel not only dared to produce fresh table fish but also proved it to be lucrative.

Fishery is not so popular in eastern Bhutan as it is in southern parts of the country. In addition to religious sentiments and social stigma, the geography in the east is not quite suitable for fish farming in most of the eastern Dzongkhags.

In 2013, Pemagatshel got its first and only fishery farm when three farmers Sonam Norbu, Sherab Gyeltshen and Tshongpa from Tshatse village in Nanong came up with one.

If one happens to visit the gewog, 'Fishery Sonam Norbu' is a popular household name and the farm is known for producing and rearing fish species like grass carp, common carp, silver carp, cutla and Raho.

The farm located at Joktari village was established with the technical and financial support from National Research Centre for Aquaculture and Regional Centre for Aquaculture. The Dzongkhag and Gewog Administrations also provided financial support. Currently, there are four small fish ponds constructed in almost two acres of land. The farm practices poly culture fishery.

The first harvest yielded only 420kg of fishes because of lack of proper information and

management in fish farming. The yield almost doubled to around 800kg in the second year. The demand for fresh water fish is ever increasing but land is not adequate enough to accommodate further expansion of the farm. Their production is not able to keep up with the demand in the Dzongkhag itself.

Challenges did not stop the farmers from exploring yet another activity that can go alongside fishery. The three farmers started backyard piggery with support from the gewog. In the first year, the farmers were able to produce 480kg of pork (average wt.120kg/pig). Having expanded their piggery, currently the farm has 24 pigs. The farm also produces fresh pork in the gewog and supplies the surplus to meat vendors in Pemagatshel town.

The farmers have bigger plans for further expansion to harvest 3000kg of fresh pork a year.

The success story of the three farmers is a typical anecdote of how livestock could prove to be lucrative and elevate the living standard in rural pockets. The three farmers earn enough to make a living from livestock activities. For them, it is the main source of income.

AIR LAYERING LITCHI PLANTS

Method to manage and ensuring high quality seedlings

Sangay Rinchen and Deepak Rai
National Seed Centre

Litchi is a sub-tropical evergreen fruit plant known as litchi chinenses of the Sapindaceae family. It is native to China and came to Bhutan from India.

Through research and trial, three cultivars such as Bhur selection, Muzaffarpur and Bedana were released in Bhutan.

Though litchi production is restricted to low altitude, it is slowly gaining popularity. To provide more opportunity to farmers living in the sub-tropical region of Bhutan, local farmers are encouraged to use this technology to produce high quality seedlings for backyard and orchard development besides growing other horticulture crops.

Litchi can be propagated and multiplied successfully by air layering. This is the most common and easiest method adopted worldwide. The air layering is called marcotting in China and gootee in India. As per the experience of the Regional Seed Centre (RSC)-Samtenling; the air-layering was made from April-July for the past three years (2014, 2015 and 2016) with same treatments.

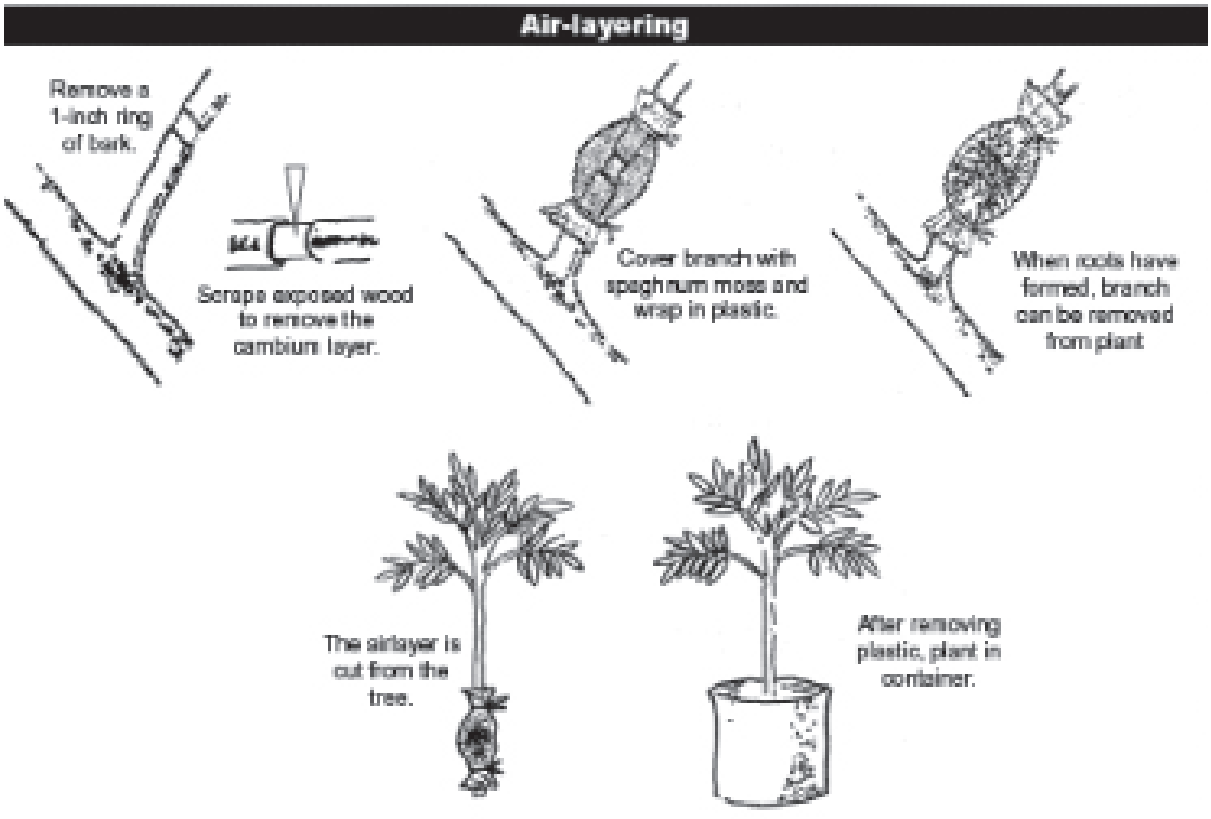
In RSC, annually 15,000 to 20,000 litchi air-layering (marcotts) are done at the centre to meet the growing demand of the Bhutanese farmers. As per the practice in the farm, air layering and rooting have never been a problem but the success rate after detaching and potting had been a problem.

Therefore, RSC conducted simple trials as solution to increase the success rate of air-layered litchi plants.

In 2016, the detached marcotts were maintained with only 50% of leaf cover to keep proper proportion of leaf to root and potted (used only topsoil as media) in poly tube. This method was found promising with 80% successful marcotts than marcotts with full leaf cover and marcotts with complete leaves removed before potting in poly tube.

Method of litchi plants production in Samtenling farm

As proven technology, the RSC practices air layering to multiply and produce litchi plants. It is a vegetative method of plant propagation which involves the rooting of aerial stems while attached to the parent plant. It produces a true to true type and reduces the time it takes to bear fruit. It is done in active growth phase of plant where bark can be easily removed from wood.



Different materials used for air layering litchi

Type of media: Loamy clay soil/sphagnum moss/fresh cow manure/dung
Wrapping/cover: Jute rope/hessian cloth
Tools: Pliers/secateurs/grafting knife
Appropriate time of layering: The best time as per the actual experience of RSC is between April and July when leaves of the previous growth flush have matured.

Procedure

1. Select healthy and vigorous twig about one year old and of not less than pencil size thickness
2. Remove/girdled about 1" across the twig
3. The cut/girdled is surrounded by mud ball (sphagnum mosses, clay soil and fresh cow dung) at 1:1:1 ratio
4. Rapped with hessian cloth and tied up both end with jute rope
5. Watering is done 2-3 days or as when required as per the weather condition

Root initiation and detaching of marcotts

- After about 2-3 months sufficient roots are formed (depends on climatic condition of that location) and it penetrates through the hessian cloth. When the root tips turn brown, the branch is cut below the mud rapped/rooted ball.
- The marcott is detached and soaked in water treat with fungicide. 50% of leaves are removed (including those damaged by pest and insects and disease). Then marcotts are potted in poly tube with only 50% of leaf cover (extra leaves should be removed) and placed in 50% shade house and irrigated immediately.

Among the three methods of management practices tried for detached marcotts, the one with maintaining only 50% leaf cover was found to be the most successful. During the field experiences, following observations were carefully noted and practiced in the farm:

- The survival/success rate of marcotts can be increased and achieved upto 80% success rate with only 50% leaf cover in marcotts and potting.
- Air layering is relatively simple to perform. With a small numbers of plants it can produce more layers with less skill, effort and equipment.
- Larger number of planting materials can be produced from mature plants in short time.
- After detaching, leaving 50% of leaves intake with marcotts, potting and placing in 50% shade house was the most suitable for mass production of marcotted seedlings.
- Never remove all leaves from marcotts after detaching and before potting in poly tube/ pot. Intensive care must be given while shifting and arranging potted marcotts.
- Branches of about one year old, around the outer surface of canopy, exposed to the sun enhance better air layers with more root development than branches taken from shaded position of the tree.

Different type of treatment used

Sl. No.	Year	Qty. marcotted (Nos.)	Media(1:1:1)	Treatment after detaching marcott	% of success after potting
1	2014-2015	20000	Sphagnum mosses, clay soil and fresh cow dung	Complete leaf removed on the marcott	35%
2	2015-2016	20000		Full leaves left in the marcott	50%
3	2016-2017	15000		50% leave removed on the marcott	More than 80%

HIGH ALTITUDE PADDY

A success in Haa

Tandin Wangdi, Samar gewog, Haa

Wetland paddy cultivation is not a new intervention in Haa with two gewogs of Gakiling and Sangbaykha already producing paddy with an estimated area of about 220 acres under cultivation.

However, high altitude paddy cultivation is a new technology for gewogs located at altitude similar to Bumthang. According to the national rice specialist, the high altitude rice constitutes about 20% of the total rice growing areas in Bhutan. The high altitude rice growing areas include Thimphu, Paro and Bumthang which lies in the temperate region with the altitude ranging from 1600-2600 masl.

The paddy variety recommended is Jakar Rey Naab, the only rice variety recommended by researchers for the high altitude rice ecosystem. The crop is cold tolerant, about 90-100cm tall with red grains. The yield potential is 600-2400kgs/acres. The variety was release in 2006 by variety release committee of the Department of Agriculture (DoA) as high altitude rice variety recommended for irrigated conditions for agro-ecology above 2600 masl.

This variety is widely cultivated in Bumthang. Since Bumthang and Haa share the similar agro-ecological zone, the Hon'ble Sanam Lyonpo directed the cultivation in Haa in January 2016. Over the two-year cultivation experiences, it can now be confirmed that Jakar Rey Naab can be easily cultivated in Haa under normal farming condition.

The paddy field is located at Balamnain Samar gewog at an altitude of 2600 masl. The paddy terraces were developed in February 2016 with financial support from DoA and cultivation started in the same year.

During the first year, the Agriculture Research and Development Centre (ARDC)-Yusipang provided full technical support including seedlings. Transplantation was done during the second week of May and it proved to be bit late. Khangma Maap and Jakar Rey Naab were cultivated during the first year and Jakar Rey Naab showed to be performing better despite the late cultivation. The total area is about 0.65 acres. The area is protected with electric fencing.

Researchers from the National Rice Program visited the cultivation site in October 2016 and recommended varietal choice and early transplantation if the Dzongkhag wished to pursue further cultivation of high altitude rice. Researchers said that at high altitudes, if the reproductive phase coincides with the onset of

cold temperatures falling below the critical 17°C, cold injury prevented grain formation. As per the Statistical Year Book of Bhutan 2016, the temperature of Haa drops to around 16.4°C in October which indicates that the reproductive phase should be completed within September when the temperature is about 19.4°C.

As recommended by researchers, transplantation in 2017 commenced in the last week of April, about three weeks earlier than in 2016. Nursery was prepared in green house near the farmstead with technical support from the sector. About 20kgs of Jakar Rey Naab seeds provided by Yusipang centre were sown

on 18 February 2017. Transplantation was carried out on 25 April 2017. By day count, the seedlings were then 2 months and 6 days old. Dzongkhag and RNR officials, gewog and local communities participated in the transplanting awareness program. About 30 baskets of farm yard manure were used during the land preparation.

The paddy crops were treated to the same management inputs that a farmer would normally provide. One time hand weeding was done on 13 and 14 July 2017. Only about 10kgs of urea was applied after weeding. Another issue was irrigation which had to be monitored at frequent interval. Since the household sometimes failed to irrigate the fields properly, water percolation in few terraces was also an issue.

Researchers from the National Rice Program visited the site during the last week of September 2017 and confirmed that the paddy crops were performing well. The team suggested harvesting during the first-second week of October 2017. Subsequently, the Dzongkhag Agriculture Sector conducted the field day on harvesting on 6 October 2017 in collaboration with Yusipang. The maturity from the date of transplanting was 163 days. Use of peddle

thresher was also demonstrated to the farmers. The field day was aimed at promoting high altitude paddy cultivation in Haa. Rice is a staple food commodity for majority of the Bhutanese population with per capita consumption of milled rice compounded at 172kgs/year. Current rice self-sufficiency for Bhutan is about 45% (11th FYP). The Ministry of Agriculture and Forests is targeting to achieve 60% rice self-sufficiency by the end of 12th FYP. This would also mean increasing the wetland form the existing 14,378 acres to 20,286 acres to achieve the 60% rice self-sufficiency target. For this, the Ministry has identified rice self-sufficiency, irrigation and land development as some of the important KPIs during the 12th FYP. In line with the policy guidelines, the Dzongkhag Agriculture Sector will promote high attitude paddy cultivation from the following years based on the interest and capacity of the farmers. As per the crop cut result, the average yield of paddy from

one acre is about 1490kgs, lower than the actual yield potential of about 1600-2400kg/acre. This can be explained from the fact that paddy cultivation was subjected to agronomic practices at farmer's level with naïve experience in paddy cultivation.

The success of the high altitude paddy cultivation in Haa was well received by farmers as a beneficial intervention for communities whose staple food is mainly rice. The credit of the success is attributed to the Lyonpo, Dzongkhag Administration, DoA, ARDC-Yuispang and Gewog Administration, Samar for various administrative, financial and technical support. To promote high altitude paddy cultivation in Haa, the following are some important considerations:

- Promotion of high altitude paddy cultivation should be strictly interest based and for households with adequate land holding and farm labour advantage.
- Nursery should be raised in green house since frost could damage nurseries under poly tunnels.
- Seed sowing is recommended in the second week of February and transplanting not later than the last week of April.
- Jakar Rey Naab is recommended over Khangma Maap for Haa condition since Jakar Rey Naab matures early and is said to have adequate cold tolerant. Khangma Maap is not performing well due to its long growth duration.
- Electric fencing, seeds input and capacity building of farmers on rice cultivation and management are some pre-requisites for a successful crop production.
- Researchers could conduct on-farm trial with the two excellent elite breeding lines
- (YP4-38-4 and YPS7) in Haa since Jakar Rey Naab appeared to be slightly susceptible to rice blast as per 2017 cropping experience.

Computed yield for three crop cuts done

Sl. No.	Crop Cut (3x2m² plot)	Plot Yield (kg)	Average Moisture Content (%)	Moisture Content Adjusted (%)	Yield kg/acre
1	Crop cut 1	2.5	16.47	0.97	1638.22
2	Crop cut 2	1.5	20.5	0.92	935.51
3	Crop cut 3	2.9	16.7	0.97	1895.11
					1489.61

SAVING WILD ANIMALS

SWRRC experience, status and challenges

Jigme Tenzin and Sangay Dorji
Divisional Forest Office, Sarpang

With increasing incidences of human-wildlife conflict in the country, a centre for wild animal, Southern Wildlife Rescue and Rehabilitation Centre (SWRRC) was established in 2016. The 15 acre centre located at Jigmeling above the Sarpang-Gelephu highway is mandated to medicate, rescue, rehabilitate and release injured wild animals back to the wild.

Currently, the centre houses four Crocodiles (*Crocodylus palustris*) and 15 Gharials (*Gravialis gangeticus*) relocated from Phuentsholing in December 2016 on Royal Command. Gharial is categorised as critically endangered and included in CITES Appendice I. Nonetheless, Gharials are reported to be extinct in its original home range such as in Pakistan, Bangladesh, Bhutan and Myanmar.

According to experts, restocking is the only option to bring back the Gharial. Therefore, restocking of these endangered species is initiated as a part of ex-situ conservation program in the centre for revival of their population.

The centre was built at a cost of over Nu.17M supported by the International Development Association under World Bank. While the Nature Conservation Division developed the conservation program, the centre was officially launched in Thimphu on 5 February 2017 coinciding with the Birth Anniversary of His Royal Highness The Gyalsey.

Wild animals sheltered in SWRRC

Sl. No.	Name of species	Quantity (No.)	Source location
1	Barking deer	1	Sarpang
2	Sambar	1	Tsirang
3	Indian Peafowl (male)	2	Punakha
4	Crocodile	4	Phuentsholing
5	Gharial	15	Phuentsholing
6	Indian Peafowl (female)	1	Tsirang
7	Great Hornbill	1	Tsirang
8	Golden Langur	1	Sarpang (Kamikhola)
Total animals		**29**	

It has three ponds cordoned by wire mesh with two ponds for Gharials and one for Crocodiles connected by perennial water supply. Since January till September 2017, the centre housed 29 wild animals including 4 Crocodiles and 15 Gharials.

Wild animals at the centre are undergoing medication and clinical observation due to casualities. Duration of retention in centre depends on the severity of injuries or types of diseases it suffers.

Wild animals retained in the centre are fed with different types of baits for recuperation. Gharials and Crocodiles are fed with table fishes and beefs procured from Gelephu. While barking deer and Indian Pea fowl are fed with milk, cabbage and maize on routine basis. Likewise, hornbills are fed with wild fruits collected from the forests.

Overall, the centre had to feed 29 wildlife casualities since Janaury till end of the November 2017. Above all, feeding of crocodiles and Gharials are cost intensive and challenging with feed shortage especially during the meat ban months. Shortage of manpower further challenges the management in feeding the growing number of injured wild animals at the centre.

From the day it was operationalised till November 2017, the centre had recorded a huge number of wildlife casualities referred from four Dzongkhags of Punakha, Sarpang, Zhemgang and Tsirang.

Among the wildlife casualties referred to the centre, 56.25% are ungulates, followed by avian with 18.75%, Civet 9.38%, primate and lagomorphs with 6.25% each and 3.13% are amphibian. Among them, 31.3% were abandoned by their parents, followed by injuries due to snares (25%), dog bites (15.6%), accidents, dehydration and electrocution (6.3%) while 3.1% had amputed and broken legs.

According to the record, maximum wildlife casualities were reported from Shompangkha and Dekiling gewogs followed by Gelephu, Tsirang,

Singye and Umling. Minimum cases were recorded from Samtenling, Serzhong, Royal Manas National Park and BHSL area. This indicated that probability of anthropogenic threats is higher in Shompangkha and Dekiling.

Around 46.88% of wildlife casualties referred to the centre survived with medication and were released back to the wild. While 53.13% could not survived despites periodic medication and clinical facilitation. Probable reason could be due to inadequate vaccines and equipment for quick responses lack of mobility (vehicles) due to shortage of technical staff and lack of expertise in dealing with wildlife casualities. Unless the above issues are addressed, survival trend is unlikely to improve which might compromise the centre's overall mandates.

Wildlife rescuing concept is new to Bhutan. The centre is newly instituted based on the experiences of Wildlife Rescue Centre, Taba. However, lack of adequate infrastructure coupled with inadequate fund is hampering the rescue and rehabilitation services.

The centre would need separate infrastructures like laboratory with clinical drugs and vaccines, siltation-free water tank for incubation pond and separate species-based rehabilitation compartment within the centre. Good internet facilities are imperatives for systematic functionality of the centre. Meanwhile, the Department of Forests and Park Services must outsource funds or projects until it gets physically stabilised.

Lack of vehicles to lift causalities and reach technical staffs to attend the clinical cases is another challenge. For that, additional technical staffs must be deployed to medicate growing wildlife casualities reported from the south. The centre could then extend the support to other neighbouring Dzongkhags. Construction of fishery ponds within the centre is required to supplement feed and reduce feed costs. These activities will not only contribute in strengthening the centre in the longterm conservation of critically endangered species but also help in ensuring the welfare of wildlife causalities in future.

Hybrid maize making difference in the east

Namgay Wangdi and Tshetrim Gyeltshen
ARDSC-Khangma
Tashi Dema, ARDSC-Lingmethang
Tashi Phuntsho and Tshering Choden
ARDC-Wengkhar

The National Maize Program (NMP) at the Agriculture Research and Development Centre (ARDC)-Wengkhar initiated the spring maize program to enhance maize production in rice fallow system.

With support from the Decentralised Rural Development Project, five hybrid varieties such as P3441, P3377, P1864, P3502 and 31Y45 were introduced from the DuPont Pioneer Seeds Company, Hyderabad in India. On-farm evaluation trials were conducted in the potential pockets under maize production zone I in 2014 in Samtse (Kirney), Chukha (Sadhu Madhu), Sarpang (Pemaling) and Mongar (Thridangbi). The best and promising hybrid varieties were selected through participatory varietal selection (PVS) in all the trial sites.

The constant yield of 2t/ac of P3441 was observed in all locations. Hybrid variety P1864 and 31Y45 are susceptible to gray leaf spot and Turcicum Leaf Blight. Out of five varieties, P3441 and P3377 showed good performance across all the locations. NMP identified two hybrid varieties (P3441 and P3377) based on PVS. Farmers prefer P3441 to P3377 for its uniform cob bearing ability, good grain colour, good husk cover, no lodging and presence of stay-green character.

The NMP started promoting P3441 in large scale from 2015 as a spring cropping the rice fallow system. From the 2015 season, NMP with collaboration with National Seed Centre procured P3441 variety and supplied to potential areas.

The cultivation of hybrid maize (P3441) in the east started from Thridangbi village in Saling gewog with 60 acres by 80 households under cultivation in 2015. The main areas

cultivating hybrid maize in eastern Bhutan are Thridangbi, Yangbari and Redaza in Mongar, Pam-Kheri and Lamtsang, Udzorong gewog in Trashigang, Zangpozor in Trashiyangtse and Pemathang in Samdrupcholing. Pemathang has stopped cultivating hybrid maize despite more production because of organic initiatives in their locality as hybrid maize needs more chemical fertilisers compared to local varieties. Cultivation of hybrid maize as a spring crop has become the source of income for Thridangbi farmers.

Over the year, cultivation of P3441 has increased drastically. With initial start of 90.6 acres under cultivation, it has increased to 216.53 acres in 2017. The total production in 2017 season was 346MT. The total area under hybrid maize cultivation in the last three years has reached 427 acres and produced 693MT of maize.

Case study of Thridangbi and Lamtsang

Among the pocket areas where hybrid was promoted, Thridangbi and Lamtsang have started to intensify cultivation and begun to transform maize into a cash crop than as a food crop.

Tenzinmo, 53 from Menchugang, Saling gewog owns three acres of dry land and cultivates hybrid maize seed supplied by NMP based at ARDC-Wengkhar through 50% cost sharing basis. She earned about Nu.150,000 by selling tengma from a make shift sales point just above her house on the Thimphu-Mongar highway. "What am I today is all because of new hybrid maize," she said.

Hybrid maize matures early than our local variety and enables farmers like Tenzinmo in lower foothills to go for double cropping. Sometimes, farmers also send their produce to Thimphu where the price is better. The income from the sale of tengma has helped her fulfill daily necessities, expenditure for her children and buying seeds for the next season. Like Tenzinmo, most farmers of Thridangbi sell their products processed as *tengma* and earn on average about Nu.30,000-180,000 every year.

In Lamtsang, hybrid maize was introduced in rice fallow system in 2017. The paddy field was left fallow for more than 10 years and now it has been reverted with hybrid maize. Farmers have now started to take upspring maize. Due to the presence of stay-green character (green leaf at maturity) in hybrid maize, farmers have benefited a lot because it can be used as the cattle feed and they sell to a nearby dairy farm. According to records at the Gewog Extension Centre in Udzorong, farmers have started to earn about Nu.240,000 from selling green maize stalk, tengma and grain for feed. Farmers from as far as Bidung come and buy the stalks at the time of harvest.

Hybrid maize is seeing successfull adaptation and acceptance among Bhutanese farmers in the potential sites. The variety P3341 is the most preferred varitey currently grown by farmers mainly for its high yield potentials of about 1800 to 2000kgs/acre. This enables them to produce early *tengma* and *kharang*. Farmers have also started selling the produce to Karma Feed Enterprises and going by the current trend of intensification, NMP could upscale hybrid in potential cultivation sites and link up with appropriate markets such as feed industries.

Area and production of hybrid maize in eastern region

Year	Seed supplied (MT)	Area (ac)	Production (MT)
2015	1.36	90.66	145.06
2016	1.80	120	192
2017	3.25	216.53	346
Total	**6.41**	**427.19**	**683.06**

IMPROVING MUSHROOM CULTIVATION IN WESTERN BHUTAN

Current status and future challenge in mushroom cultivation

Dr. Yoshie Terashima
JICA Partnership Program

Mushrooms are one of the key agricultural products in Bhutan for generating export income and good human nutrition as well as generating private income and raising employment. The production of natively cultivated mushrooms lags behind the demand so mushroom production needs to be increased.

The JICA Partnership Program (JPP), 'Project for improvement in conditions of mushroom cultivation farmers in the western region of Bhutan' started in July 2016 for three years to support and cooperate with the National Mushroom Centre (NMC). The project is formulated by the University of the Ryukyus, Japan and is led by the Program Manager. The project purpose is that NMC staff and agriculture extension officers (AEOs) strengthen technologies and extension systems to improve living conditions of mushroom farmers in the western Bhutan of Paro, Thimphu, Punakha, Wangdue and Chukha. So far, NMC initiated workshops for AEOs in Thimphu, Bajo, Paro and Phuentsholing together with Dr. Watanabe and another Japanese expert Mr. Shuhei Kaneko. In July 2017, a Matsutake expert presented the ecology of this mushroom and how to treat it for good quality sharing Japanese information to Genekha farmers. A classification expert came to identify wild mushrooms and shared the information with NMC and foresters during the Mushroom Festival in August.

White mycelia are visible on logs after wrapped with wet paper for 2-3 days

The JPP invited eight Bhutanese to Japan in February and three in September 2017. The February visit was to learn and experience how different the process of mushroom cultivation is between Bhutan and Japan. The team were introduced laboratory work on spawn production, how to get qualified bed logs for Shiitake, how to treat mushrooms after harvesting without contamination, a system for providing Shitake bags to farmers, Shiitake bag cultivation facilities, other mushrooms such as Flammulina velutipes, Eringi or King oyster mushroom, Hypsizygus marmoreus and

Pholiota nameko and cultivation factories. The visit in September was to collect basic information to establish a future plan for mushroom production in Bhutan targeting the next five-year plan. It was at the Tottori Mycological Institute, one of the leading research and spawn production institutes for Shiitake bed logs in Japan. The institute advised on the importance of sanitary conditions for spawn production. The key message was the importance of constantly monitoring produced spawn by checking its ability to fruit.

The team also met Mr. Shinji Hirai, Governor of Tottori Prefecture. An article about this meeting was published in a Japanese newspaper.

As part of the technical support for mushroom cultivation:

1) The JPP introduced the idea of providing spawn in polypropylene bags. NMC is providing Shiitake sawdust and oyster grain spawns in plastic or glass bottles. Spawns in plastic bags have great merit. NMC does not have to collect empty bottles from farmers after use. High quality bags were not available for purchase in Thimphu but NMC found bags without pinholes as substitutes.

2) The JPP also introduced 'sawdust plug spawn' which can be easily inoculated into holes on bed logs by pushing it in by hand. To make plug spawn, some additional equipment and techniques are needed but the spawn is easily inoculated without waxing. It could be a great indicator of less oxygen conditions for mycelia during the log incubation period. If the mycelia are seen climbing to the mouth of plug spawn holes, this condition indicates that the mycelia inoculated in the logs require more oxygen.

3) The JPP and NMC provided workshops to AEOs and were evaluated to improve contents. Based on the evaluation, the AEOs found the practical learning satisfying and to have improved understanding. The JPP is hoping that NMC and the AEOs will work together to promote an extension service for mushroom cultivation.

Future challenges

1) Breeding commercial Shiitake strains of Bhutanese origin is an urgent goal. The incubation methods in Bhutan are similar in the northern and southern regions although the climate is quite different. Thus, strains that grow at cooler and warmer temperatures have to be provided adequate to the region's climate.

2) Changing the incubation method and techniques are important. The Japanese incubation method of bed logs propped along a wall to stand them upright and wrapped with a plastic sheet to maintain moisture was introduced in Bhutan from Japan during the 1990s. This is the first stage when the mycelia of the spawn grow around the holes of the logs.

   In the second stage, the sheet must be removed for the mycelia to grow deep inside the logs and for the water contents of the logs to decline. a) The change of conditions between the first and the second stage is judged by the water content of the bed logs by measuring the weight of the logs, the right time to proceed to the second stage is known. b) The mycelia running inside the billets can be assessed using a safe chemical, a 5% solution of ferric chloride; in this solution, wood with mycelia running through it remains the yellow colour while the fresh, undecomposed wood is stained dark black. c) Another method to judge the mycelia running inside the logs has been introduced. The cut bed logs are wrapped with wetted newspapers and kept in a plastic bag at room temperature for two or three days. After this treatment, mycelia appear on the decomposed parts.

3) Another mushroom of great commercial interest in Bhutan is the Matsutake which is mainly exported to Japan during July and September. The exported mushrooms have to withstand hot conditions in Thailand or Singapore. When the JPP experimented with packing condition for transporting, the mushrooms that were wrapped and put in a cooler box arrived with big holes. The holes resulted from enzymes produced by snails hiding in the fruit bodies although we could not find any other trace of these snails. Matsutake with holes have no commercial value in Japan. This experiment was done only once. JPP will have to repeat transportation experiments to obtain improvements to export Matsutake.

The JPP is hoping that by working with NMC, solid scientific knowledge of mushrooms and hygiene, lab working techniques and tips for field cultivation will be developed and take root in Bhutan. With support from the Ministry, NMC, extension staff and farmers, JPP will be able to proceed with the projects.

Saving the *Sa-phag*, the indigenous pig from extinction

Phurpa Tshering
Dzongkhag Administration, Trashiyangtse

Once indigenous pigs or *sa-phag* had social, cultural, and economic importance to the livelihood of the rural community. In the early Bhutanese society, pigs were an important medium through which social significance was measured. Pigs also serve as sacrificial animals which still prevail in several remote areas of the country. However, the population of indigenous pigs in Trashiyangtse has declined drastically. This is because less attention has been given to the selection, breeding, and genetic improvement of indigenous pigs by planners as well as by the farmers themselves. Some of the contributing factors which led to the decline in the number of indigenous pigs include religious condemnation of pig breeding and slaughter, increasing purchasing power of people and readily availability of imported pork in the form of packet, canned, dried, smoked and fresh meat.

With time, the concept of breeding had been to focus more on breed improvement resulting in degradation of genetic resources of indigenous pig. The advantage being that exotic breeds fetched more income compared to indigenous pigs which comparatively earn income. Such practices have resulted in quick decline of indigenous pig population and domination of exotic breeds in all pig rearing places. Although indigenous pig are disease resistant and highly adaptable to a broad range of environments with low inputs, our communities still prefer

exotic breeds for many reasons. Despite challenges, it is still possible to prevent drastic erosion of pig genetic resources through conservation and if all relevant stakeholders work together to prevent complete degradation.

As a measure to revive the complete loss of indigenous pig, the Dzongkhag Livestock Sector jointly with the gewog officials visited every part of gewogs in Trashiyangtse. Fortunately, the team managed to locate one household in Zor village in Yallang gewog where Karma Wangdi had reared indigenous pigs without cross breeding. He has been rearing it for more than 20 years as his parents had inherited them.

He owned a female with four piglets (two male and two female). He sold two males and a female to a neighbouring Dzongkhag earning good revenue. As planners, the greatest concern is that there are no males to breed further and there is great risk that inbreeding might occur once the male piglet grows.

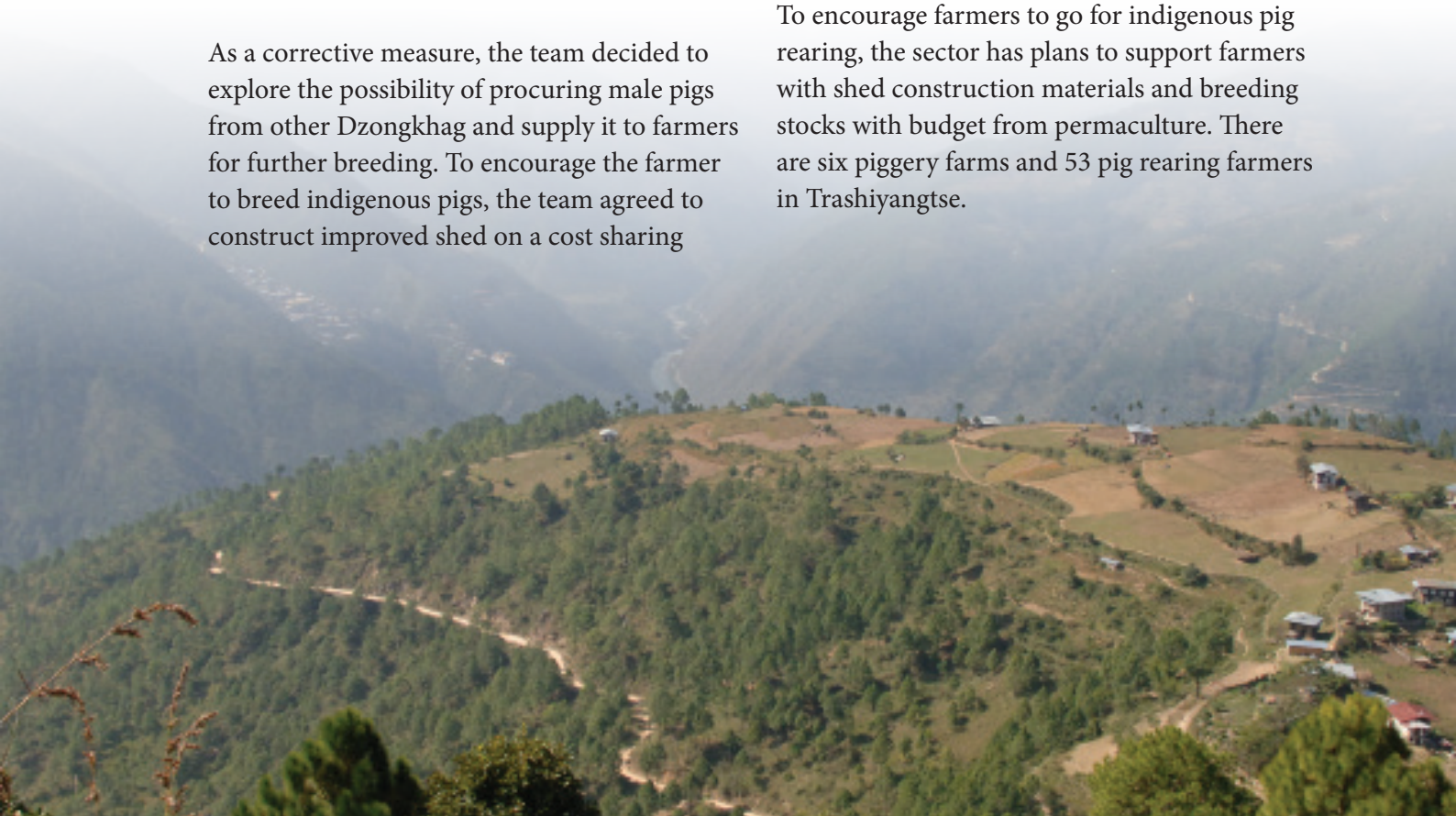
Sa-phag is unique with a small body configuration with small and pricked ears, straight head profile and a long and thin snout.

As a corrective measure, the team decided to explore the possibility of procuring male pigs from other Dzongkhag and supply it to farmers for further breeding. To encourage the farmer to breed indigenous pigs, the team agreed to construct improved shed on a cost sharing basis. The sector will supply CGI sheet and cement and the rest will be borne by farmers including labour. Further, a farmer has been identified to rear indigenous pigs. The sector will procure a male and female indigenous pigs and necessary support would be rendered to encourage him.

Despite strong social stigma to the breeder as well as to the planner, the sector has managed to preserve the last indigenous pig which is no where to be found in the Dzongkhag. The effort to preserve the breed has been quite successful and the sector will try its best to multiply as much as possible. Otherwise, the future generation will not be able to appreciate the indigenous breed besides referring to a story and photographs.

A study conducted by Sangay Chedak, the Dzongkhag Livestock Production Officer revealed the availability of *sa-phag* also in Bongo in Chukha, Chimung in Pemagatshel, Gomdar in Samdrupjongkhar, Bardo in Zhemgang and Wangchutaba Piggery Farm in Thimphu.

To encourage farmers to go for indigenous pig rearing, the sector has plans to support farmers with shed construction materials and breeding stocks with budget from permaculture. There are six piggery farms and 53 pig rearing farmers in Trashiyangtse.



Seed and seedling to enhance farmer's income

Pema Yangdon, ARDSC-Khangma
Lungki, Ugyen Sonam and Ugyen Norbu
ARDC-Wengkhar
Sonam Tashi, ARDSC-Lingmethang

Horticulture development is one of the priorities of the Ministry of Agriculture and Forests in its five year plans to enhance production and contribute to farmers' income. However, insufficient planting materials such as seeds and seedlings of suitable crops have been a major constraint in horticulture development.

In order to help address this constraint especially in the eastern region, the Agriculture Research and Development Centre (ARDC)-Wengkhar initiated the establishment of vegetable seed growers and fruit nursery operators since 2000. In 2004, the Agriculture Research and Extension Project followed by the Horticulture Research and Development Project provided technical and material supports to expand the farmers level planting material production focusing on crops promoted. More than 16 vegetable seed growers and eight fruit nursery operators were established between 2004 and 2015 through hands on practice trainings, demonstrations and applications. These helped in increasing the planting material requirements to a large extent. Currently, supplementary supports to the existing growers and support to establishment of additional growers and operators are supported through the Commercial Agriculture and Resilient Livelihoods Enhancement Program (CARLEP).

With the National Seed centre (NSC) mandated to supply all planting material requirements, these growers were later linked to the NSC where the growers supply planting materials to NSC enabling them to market their planting materials. In order to maintain and regulate their produces, the growers also register them with the Bhutan Agriculture and Food Regulatory Authority through respective Dzongkhags.

An assessment of these farm level planting material producers established so far was carried out with a total of 5 nursery operators and 7 vegetable seed growers to see if the initiative is contributing to their income. It shows that these growers have been making steady increase in income from the particular activity over the last three or more years. Fruit nursery growers annual average income from sale of seedlings ranges from Nu.46,500 to Nu.275,000 and the vegetable seed growers earn annual average ranging from Nu.11,000 to Nu.355,000. Considering the potentials of productivity from a small space occupied under vegetable seeds and fruit nursery, the earnings are significant.

Income (Nu.) from vegetable seeds sold by 7 seed growers

Growers	Ugyen Tenzin	Tsagay	MC Gurung	Chey Dorji	Sherab	Dorji	Samten
Gewog	Ganzoor Lhuentse	Menbi Lhuentse	Orong S/jongkhar	Thrimshing Trashigang	Samkhar Trashigang	Drepong Mongar	Udzorong Trashigang
Crops	Cauliflower Carrot Radish Greens	Cabbage Broccoli	Cabbage Radish Carrot Greens	Cabbage Carrot Radish Greens	Cauliflower Carrot Radish Greens	Radish Broccoli	Asparagus
2010	12,000	60,000	20,000	80,000	140,000	20,000	-
2011	21,000	60,000	13,000	56,000	58,000	15,000	
2012	15,000	16,000	8,000	30,000	27,000	2,000	-
2013	17,000		10,000	60,000	-	13,000	200,000
2014	27,000	12,000	19,000	31,000	19,000	10,000	350,000
2015	32,000	20,000	56,000	60,000	3,000	8,000	400,000
2016	9,000	9,000	28,000	60,000	20,000	10,000	470,000
Total	133,000	177,000	154,000	377,000	267,000	78,000	1,420,000
Average	19,000	25,286	22,000	53,857	38,143	11,143	355,000

While these figures are exclusive of the investment they made, growers are certain that they find it worth continuing especially with an increase in demand for planting materials such as seeds and seedlings. Given the increasing importance given to commercialisation of farming, these micro enterprises could help contribute to increasing grower's income.

Today, there are 11 fruit nursery growers and 21 vegetable seed growers trained and established by ARDC-Wengkhar. Another 14 new seed growers have joined in 2016 and have now started their activity with production input support from CARLEP. They are technically supported by ARDC-Wengkhar .

OKRA
(Lady Finger)
A Wonder Crop

Tanka Maya Pulami, ARDC-Bajo

Okra (*Abelmoschus esculentus*) also known as Lady Finger is a rich medicinal vegetable crop. Raw okra contains about 90% water, 2% protein, 7% carbohydrates and negligible amount of fat. In a 100g amount, raw okra is rich in dietary fibre, vitamin C and vitamin K with moderate contents of thiamin, folate and magnesium. So adding okra to our diet significantly increases our total fibre, mineral and vitamins intake. Okra has multiple health benefits such as anti-cancerous, fights diabetes, constipation, asthma and helps in controlling cholesterol level.

Although it is among the most heat and drought tolerant vegetable species and tolerate soil with heavy clay and intermittent moisture, it is still not as prominent like other vegetables in Bhutan due to the lesser known knowledge of its nutritional value, taste and poor cooking knowledge. In Bhutan, there is negligible pest and disease attack to this crop reported. It is grown in tropical and sub-tropical zones. Sarpang cultivates the highest acres followed by Tsirang and Samdrupjongkhar. In 2016, the crop was cultivated on 43 acres of land producing 42M with 964kg/ac (DoA, 2016).

Although there is less production within the country, the vegetable is imported from India. Okra import in 2016 was 128.8MT (BAFRA). The market price of okra ranges from Nu.120 to Nu.160 in lean period and more than Nu.50 during season. Okra is a health benefiting crop and has potential market in Bhutan.

Okra belongs to Malvaceae family and its origin is still unclear and contrasting research says it originated in West Africa, Ethiopia and South Asia. It is cultivated throughout the tropical and warm temperate regions of the world for its young tender pods as vegetable. It grows to around 2m tall and produces prominent flowers of about 4-8cm in diametre with five white to yellow petals often with a red or purple spot at the base.

The fruit is a capsule up to 18cm long with pentagonal cross-section containing numerous seeds. Okra is available in two varieties, green and red. Red okra carries the same flavour as the more popular green okra and differs only in colour. There are also improved and hybrid varieties of okra.

The growing season for okra in summer is May-July and August-October in winter. It can be grown in most soil types, however sandy-loam and clay loam rich in organic matter are most preferred for its higher yield. It requires soil PH of 6-8 and it is highly susceptible to frost. The land has to be ploughed, weeded and a bed of one metre wide has to be made. It will require well-rotted farm yard manure at 8-10 tonnes per acre and sow the seed keeping 45x30cm. Irrigation is important if there is no rainfall. The crop usually flowers after 40-45 days of planting. Right after flowering, it will start fruiting. It is important to harvest the tender pods 4-5 days after flowering to avoid fibre development in pods and lose tenderness. The field should be harvested every 2-3 days.

Globally, okra is frequently used in dishes and its popularity is increasing particularly because of its various uses. Okra pod can be prepared in many ways as vegetables, soup or chips and also as pickle. One can prepare many dishes from this wonder crop like okra fired crispy, okra datshi, okra fired rice, okra mixed vegetables and okra mixed non-veg etc.

Okra can be used while cooking pulses to give more thickness and stickiness. While frying okra, it has to be washed and the water drained before cutting and frying to avoid the flow of its stickiness due to mucilage present in the plant. One should not add water while frying. When preparing okra datshi or okra soup, one should not touch or strain while cooking.

Many farmers are not aware of its nutritional benefits due to lack of awareness. This paper is an attempt to inform people about the benefits of okra.

DO-NAMKHAI KAW

A Heritage Forest site

Sonam Gyeltshen, Dagana Forest Division Dagapela

Involving the community and giving them the sense of belonging is one of the best ways to manage natural resources in a country like ours. Natural resources are best managed when the community feels the ownership of it.

The Nature Conservation Division and the Dagana Forest Division (DFD) started one such project in the Dzongkhag. The heritage forest at Do-Namkhai Kaw in Kana gewog was started to identify, protect the catchment area and appreciate potential area for protection and empower the people to manage their own resources.

A public consultation meeting was conducted to educate the people on the heritage forest and encourage their participation and support towards the successful implementation of activities.

Recognising the potential and opportunities for conservation, comprehensive demarcation and inventory to access the richness of species for conservation and management at the community level was carried out. The site, located at an altitude of 1,577 masl spreads over an area of 250 acres of forest.

The project also successfully constructed three gazeboos, a dozen waste pits, maintained the 4km trekking route from Nindukha to Dho-Namkhai Kaw, held community meetings on management of natural resources.

Waste pits were constructed to encourage visitor minimise littering and pollution within the heritage site. Since Do-namkhai Kaw is located at the upstream of Dagachu, the focus was on maintaining fresh and clean water recharge.

Major renovation and eco-friendly trekking route was constructed from the main road to Do-Namkhai Kaw measuring little more 4km under a priority list of activities to provide easy and convenient trekking. Providing access road inside the heritage forest in all types of heritage forest around the world is mainly to let visitors enjoy the beauty and appreciate the nature. Similarly, The Nindukha village was included in the plan based on its historical and cultural importance so that the people of this community holds the ownership in the management of heritage forest. As an essential part of culture, the heritage forest contains these visible and tangible traces back dates from olden days of Zhabdrung Chogley Namgyal to the recent past.

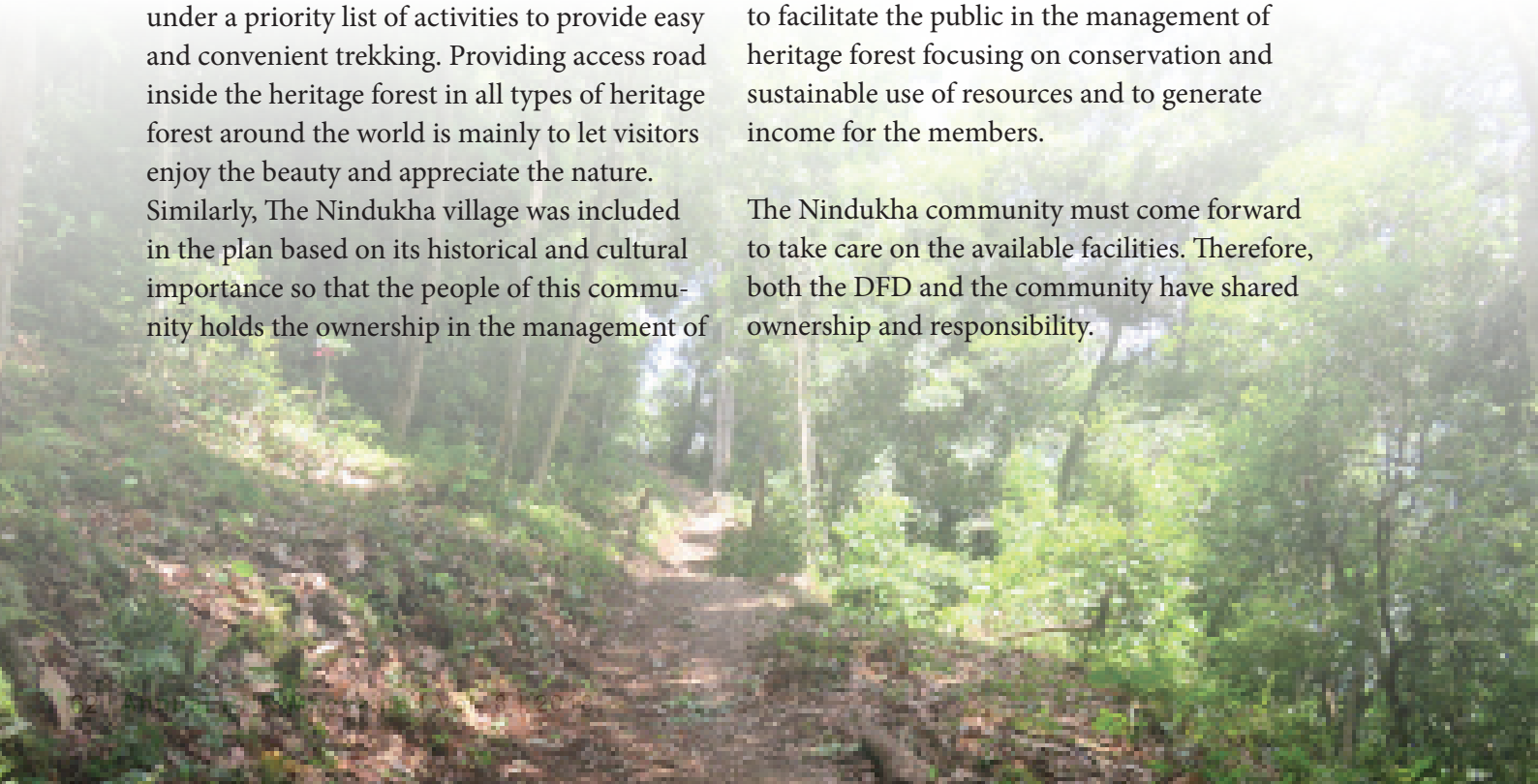
Canopies are essential for resting, watching birds and for recreational purposes. Therefore, construction of canopies was one of the main activities in the field of eco-tourism and heritage forest. Eventually, 3 canopies were constructed.

For the further development of the heritage site, a list of activities was planned. The project will supply piped water at the site, construct two unit toilets, construct a Choekhang and supply waste bins. Committee will also be formed and trainings will be given to forest user groups.

However, there remain challenges. The Dagana Territorial Division is out of protected area system of the country and is in the non-project area, the biggest challenge that we have is the lack of budget to fully develop the heritage forest.

Since the activity is first of its kind in the Dzongkhag, the heritage site requires frequent monitoring from the Territorial Forest Division to facilitate the public in the management of heritage forest focusing on conservation and sustainable use of resources and to generate income for the members.

The Nindukha community must come forward to take care on the available facilities. Therefore, both the DFD and the community have shared ownership and responsibility.

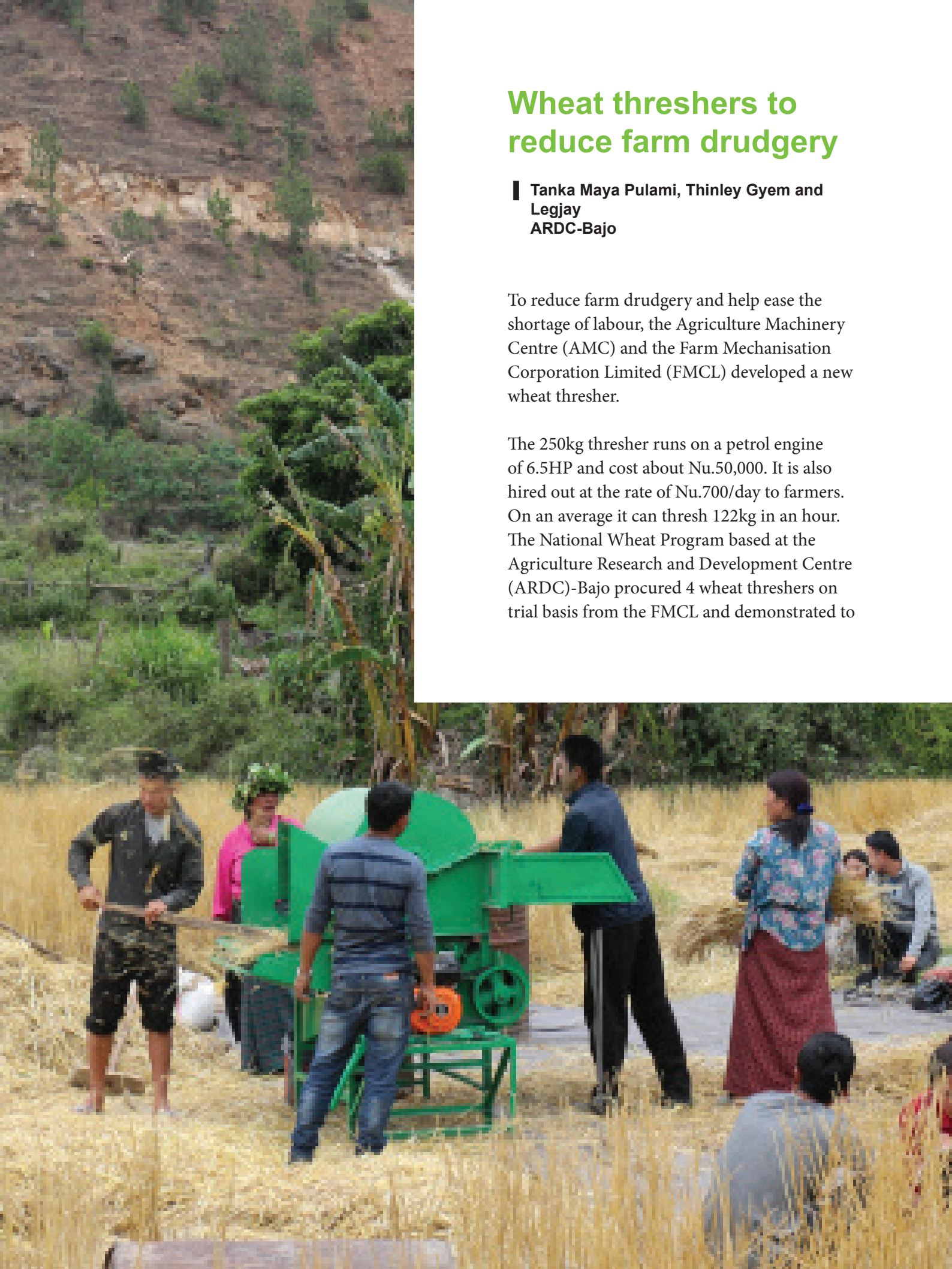


Wheat threshers to reduce farm drudgery

Tanka Maya Pulami, Thinley Gyem and Legjay
ARDC-Bajo

To reduce farm drudgery and help ease the shortage of labour, the Agriculture Machinery Centre (AMC) and the Farm Mechanisation Corporation Limited (FMCL) developed a new wheat thresher.

The 250kg thresher runs on a petrol engine of 6.5HP and cost about Nu.50,000. It is also hired out at the rate of Nu.700/day to farmers. On an average it can thresh 122kg in an hour. The National Wheat Program based at the Agriculture Research and Development Centre (ARDC)-Bajo procured 4 wheat threshers on trial basis from the FMCL and demonstrated to



Wangdue and Punakha wheat growers. There were mixed responses with some farmers appreciating the labour saving device while some felt that the machines were no better than manual threshing. The major drawback with the thresher was its size which was difficult to transport and the frequent breakdown observed.

However, when the machines were put to test during demonstrations at Punakha and Wangdue, it indicated that the cost incurred for wheat threshing using wheat thresher was the lowest. This was found after simple comparative analysis was carried out to compute the benefit of wheat thresher with manual harvesting and using power tiller rotavator. Data for wheat thresher was collected from the demonstration and from FMCL resource persons. The manual threshing and power tiller renovator data were collected from farmers. The prevailing labour and inputs rates were used for computing the cost involved for one acre of wheat threshing.

The cost incurred using the thresher was computed at Nu.2696.80 which is the lowest compared with the other two methods. Although using the new thresher takes more man-days (four) compared to using power tiller (three), the total cost of wheat threshing with power tiller rotovator amounts to Nu.2996.80

per acre. Manual threshing does not involve any other input cost but it is tedious and takes more man-days (16) incurring the highest cost at Nu.6400/acre. The analysis shows that the new thresher saves cost and time compared to manual threshing and using power tiller. Moreover, power tiller is not meant for threshing and there could be negative impact in the long run.

Most of the extension officials and farmers who attended the field days felt that it is labour saving and easy to use with less energy required as threshing can be done simultaneously with harvesting. The crop will not be damaged by rain as harvesting coincide with rainy season (mid May-June). Fully matured standing crop takes shorter time to thresh and is more efficient.

The field crops researchers observed that the input spout is too small so it leads to intensive work in feeding small quantities which is not efficient. Shorter straw results in more efficient threshing so harvesting should be done accordingly. It was recommended that the input spout should be bigger and placed at slanting position.

The machine is approximately 250kg which is heavy and not appropriate for individual household. Participants suggested fixing wheels for easy transportation. The machine required at least four people to function so it may not be suitable for households with limited labour.

Using power tiller rotavator for threshing requires only two persons. Participants suggested reducing the weight of the machine for easy transport and use. They also suggested to increase the intake capacity and make it slanted for easy feeding of the harvested wheat plants.

Thangu farmers in Wangdue said that they harvest only the head and use power tiller for threshing. They felt that the wheat thresher is better or more efficient for dwarf varieties. Their other suggestion was to adjust the reaper so that the harvested plants are short and suitable for the new thresher.

The concrete data through a systematic study on different uses of wheat is currently lacking. The general consensus, however is that majority of wheat is used for brewing, food and animal feed.

Protected agriculture and compost production to aid commercial farming

Lhap Dorji, Karma Tenzin, Birkha B Tamang and Thinlay Dorji
ARDC-Wengkhar

With growing emphasis on home production, developing crop resilience to climate change, engaging youth in farming and promoting commercialisation of farming, research and development services have become important to provide alternatives for entrepreneurship development in farming particularly for youth and enterprising farmers.

The Agriculture Research and Development Centre (ARDC)-Wengkhar is responsible to initiate innovative approaches in promoting commercial farming and provide agriculture development services. The ARDC is also responsible for assisting the implementation of the programs designed to promote commercial farming in the region with thematic focus on climate change, gender, youth and commercialisation. This is supported by the Commercial Agriculture and Resilient Livelihoods Program (CARLEP) and the Ministry.

To engage youth and young entrepreneurs in farming, initiate options in view of climate change and commercialise agriculture, the ARDC-Wengkhar in 2016-2017 began working on the development of 'Protected agriculture and compost production'. This is done by firstly developing prototypes on station for research and demonstration and then initiating promotion and scaling of the prototypes.

These options either on its own or in combination could be promoted for commercial farming. With the centre currently leading the promotion of lead farmer development for wider dissemination of agriculture farming practices through changing extension approaches, these models have provided options in enhancing the lead farmers demonstration model in the region.

This paper is written to take account of the major features of these models, costing and suggest ways to further promote or upscale this from the research stations to the villages.

Protected agriculture and bio-composting: Option as a farming enterprise

Protected Agriculture (PA) is not a new innovation but its practice in Bhutan is limited to only few. An innovative practice of cultivating crops under protected structures and modified environment to enhance growth, PA is a technology that can help address impacts of climate change on food self-sufficiency. Considering the practice confined into a smaller enclosed space, green house and the ability to have control over the crop more than conventional farming practices, it provides a new way of farming. This perhaps could be a way forward to attract youth in Bhutan to farm in a different way and promote entrepreneurship.

Bio-composting is an essential component in PA. It is simply recycling of farm wastes, farmyard manures, soil and water through controlled decomposing. The combination of PA and composting results in products that can initiate commercialisation i.e. fresh farm products of superior quality and organic fertiliser. In our efforts to promote organic farming, compost is an important product to maintain a healthy soil. The combination of these two on semi-commercial and commercial scale or as a separate product line can be promoted as a commercial farming enterprise.

Established in 2016-2017 with support from CARLEP mainly as a research and demonstration site for innovative approaches in farming, it is currently used as a training model for lead farmers training program. It is also a technology for demonstration to visiting farmers at the centre and to initiate a proper production economics study of protected agriculture and composting.
Although PA on large commercial scale is done under bigger structures, the use of available green houses is also suitable for semi-commercial scale. Manufactured green houses purchased from local suppliers were set up on properly developed land and fitted with proper paths between crop cultivation beds. It is fitted with an automated drip irrigation system to grow a selected few crops like tomatoes, cucumbers, chilli, lettuce and brinjals.

The current PA model developed at Wengkhar covers an area of about 450m2 including exterior space fitted with two 5x20m poly house. This is expanded to make three poly houses joined by altering the space between the frames from the standard 1 to about 3m. This is done to expand the area and reduce cost. Manufactured drip irrigation accessories were connected to the automated irrigation system developed by the centre for irrigation.

The composting model is developed by transforming the centre's compost yard by providing structures for decomposing materials, establishing a mechanised sieving machine and a poly house to solarise or dry compost

products. Appropriate small machines such as wood chippers and chaff cutters were installed to help material preparation particularly fruit tree branches, bushes and wild grasses collected from the farm.

With abundant farm residues, poultry manures, soils and saw dust in the locality, raw materials for composting is not in short. The model is currently used to prepare potting mix and compost for the on-going research demonstration plots for vegetables and other crops.

To generate cost of establishment, based on the current works, a maximum and a minimum cost is worked out by considering cost reduction features in the models so that a choice is available for promising entrepreneurs.

Promotion of PA and composting model in the region

While detailed production economics study should be taken up parallel to the use of the models for demonstration purpose, these could also be promoted in the region as a combined option for enterpriser separately.

In doing so, interested entrepreneurs could be taken on board to replicate these as an outreach with support for initial set up. To start with, eight lead farmers from the batch of lead farmers for 2017-2018 has come forward to replicate these.

The centre targets to promote these with youth farmers. Five youth expressed their interest to take up these practices. More than 40 credit officials from the region visited the sites and expressed interest and support to fund any proponent coming forward. The centre and the Bhutan Development Bank Ltd. are looking for potential clients preferably youth entrepreneurs. The ARDC-Wengkhar plans with support of CARLEP to promote these as an outreach in the beginning unless keen entrepreneurs come forward. Based on the experiences and having demonstrated the potentials to enhance income through cultivation and marketing, young entrepreneurs who take up the practice could be linked to credit supports for up scaling.

To cut cost, use of local materials will be encouraged in the initial stages. Options for establishment of these models on a cost-sharing basis, right from the initial stages with beneficiary contributions either made from their savings or linking them with credit support programs is also kept open. Commercial farming targeting youth may need appropriate transformation in farming practices

that suit them. The PA and composting as a business model could be an option to promote commercial farming.

The promotion of PA practices can also contribute towards enhancing farmers' resilience to climate change impacts and food production. With current emphasis being on promotion of organic farming, composting could be promoted both as a supplement or as an enterprise on its own to provide better potentials for its up scaling.

While protected agriculture practice has not gained its popularity, research and development in this practice should be initiated and its production economics and various options of crops studied. However, its promotion as an outreach could begin parallel to the research and demonstration and make a start in promoting the practice in the region.

The up scaling of these practices which depends mainly on the capacity of entrepreneurs to invest. Alternatives to cut down cost will have to be explored and wherever possible, the practices should continue to be introduced to credit support agencies, projects and other development support programs for its wider adoption and promotion in the region.

Composting model at ARDC-Wengkhar and process

HIGHLIGHTS OF 2017

Green Bhutan Corporation Limited

January 3, Thimphu: To promote the clean and green environment, the Green Bhutan Corporation Limited (GBCL) was inaugurated in Semtokha.

GBCL is mandated for landscaping, urban greening, consultancy and floriculture besides the tree planting works. It will promote tourism and help generate clean energy through hydropower constructions. It will also help agriculture sectors by providing uninterrupted water supply for irrigation and livestock sector through mass plantation of fodder species

It has a budget of Nu.33M for its first year during which it will recruit 298 more staff.

Nationwide Water-Birds Census

January 22: The fourth annual nationwide Water-Birds census captured different species of water-birds including the globally threatened species like White-bellied Heron, Black-necked Crane and Palla's Fish Eagle. It was carried out in all the major water bodies and wetlands across the country.

The survey was initiated by the Ugyen Wangchuck Institute for Conservation and Environmental Research in 2014 to generate data for long term monitoring of habitat change and species response to the climate change. It will contribute in understanding and sharing data with the International Wetlands.

First World Wetlands Day

February 2, Wangdue: The first World Wetlands Day on disaster risk reduction was celebrated in Gangtey-Phobji Ramsar site.

The wetlands covers a range of ecosystem types such as lakes, rivers, floodplains and coastal mangroves and they provide a range of important services for both people and the environment. It acts as natural safeguards against disasters protecting communities most at risk and vulnerable to the devastating effects of floods, droughts and storm surges. They provide multiple benefits and act as buffers against the effects of extreme weather events.

MoAF celebrated the first Birth Anniversary of HRH The Gyalsey

February 5, Thimphu: The Ministry joined the nation in celebrating the first Birth Anniversary of HRH The Gyalsey. During the event, the Ministry launched various centres and reports such as Integrated Yak Conservation and Breeding Centre, Park Office for Jomotsangkha Wildlife Sanctuary, Regional Centre of Tiger and Cats Research, Wildlife Rescue and Rehabilitation Centre, National Forest Inventory Report and A Century of Orchid Records in Bhutan among many others.

A newly discovered Dragonfly species was named as Gyalsey Emerald Spreadwing in honour of HRH The Gyalsey.

Cattle show at Sirigang

February 14, Punakha: The Dzongkhag Livestock Sector, Punakha and Regional Livestock Development Centre (RLDC)-Wangdue organised a cattle show at Sirigang under Kabisa gewog.

It was aimed at encouraging farmers to rear quality animal breeds for better milk production and take up improved cattle breeds. It also served as an information sharing platform through posters and quiz competition among the participants.

Officials from RLDC evaluated around 145 jersey cattle and awarded prizes under the categories of milking and dry cows, heifer and female and male calves.

Highland Biogas Technology in Gasa

February 20, Gasa: The highland biogas technology was inaugurated at Damji, Khamoed gewog. A total of seven biogas plants, 6 in Khamoed and 1 in Khatoed were installed.

The lowest biogas plant was constructed at an altitude of 1900 masl and the highest at the range of 2569 masl. In both locations, the plants were successfully installed and are fully operational. Each plant cost Nu.36410, out of which Nu.11700 were supported by Bhutan Biogas Project, Nu.13260 by Dzongkhag Livestock Sector and the beneficiary households contributed Nu.11450.

Groundbreaking ceremony for Regional Centre for Tiger and Cats Research

March 12, Gelephu: The ground breaking ceremony for the Regional Centre for Tiger and Cats Research was held. The centre will provide critical information on tigers and cats conservation. It will be also helpful for other tiger range countries in Asia.

Most of the tiger population in the country is found in the southern foothills and the establishment of centre will be the best place to reach all those places. It will be supported by World Wildlife Fund, Bhutan Foundation and other donor agencies.

The Dragonfly named in Honour of The Gyalsey

March 24: Scientists from Sherubtse College, Kanglung; National Biodiversity Centre and the Dutch Naturalis Biodiversity Centre have named a new species of dragonfly in honour of The Crown Prince of Bhutan, The Gyalsey as a symbol of appreciation and gratitude for the extraordinary leadership of Bhutan in biodiversity and environmental conservation.

Honouring The Gyalsey, the dragonfly Megalestes gyalsey (Odonata: Synlestidae). Megalestes gyalsey spec. nov. is described from a single male from Trongsa. It was discovered during the field work conducted in 2015 for the Bhutan invertebrate biodiversity project.

The National Flower of Bhutan found to be a New Species!

March 27, Thimphu: The national flower of Bhutan commonly known as Blue Poppy and scientifically known as Meconopsis grandis subsp. orientalis has been upgraded to a species rank with a distinctly Bhutanese name Meconopsis gakyidiana.

The species though previously considered to be a sub-species of Meconopsis grandis was found to be different from the typical Meconopsis grandis in several important characters such as plant life form, leaf arrangement, leaf and petal colour and shape thereby warranting a separate identity of species rank.

Rural Development and Climate Change Response Programme

April 13, Thimphu: Bhutan and the EU launched a new Euro 21.5M Rural Development and Climate Change Response Programme to support sustainable agricultural development and climate change adaptation in Bhutan.

The project will assist Bhutan to implement reforms that will make rural communities more resilient to climate change. Key actions under the project include construction of rural roads and irrigation facilities, increased use of resilient seeds and livestock breeds and improved natural resource management. It will also address environmental issues like deforestation and loss of biodiversity.

Fifth Rhododendron Festival

April 14-16, Lampelri: The fifth Rhododendron Festival was organised by Lampelri Rhododendron Tshogpa, a community based organisation comprising members from Chang, Dagala, Kawang and Toep gewogs; Dechentsemo Central School, Hongtsho Primary School and Department of Forests and Park Services.

The event aims to preserve the unique culture and tradition of the country for future generations. The communities displayed and shared their knowledge about forest and the surrounding environment. Local cuisines and beverages, traditional dances by schools and environmental skits including Tiger and Bear dances were the festival attractions.

Chief Veterinary Officers from SAARC meets

May 9-10, Thimphu: The Chief Veterinary Officers from the SAARC member countries gathered to discuss control of infectious animal diseases in the SAARC region as there exists free movement and informal trade. The member countries share long borders with many other countries.

One of the main aims of the meeting was to find ways for early issuing of alerts and information sharing for trans-boundary animal diseases (TADs) so that the member countries can take adequate preventative steps. It also discussed on a progressive control program for TADs.

NPPC website on Pests of Bhutan

May 12, Thimphu: The National Plant Protection Centre (NPPC) lunched the website, http://pestsofbhutan.nppc.gov.bt. It relates three interconnected products such as document retention, National Plant Pest Database and Pests of Bhutan. It provides the public access to the latest information on identification and management of the most important pests such as insects, pathogens, weeds, vertebrate pests in Bhutan.

Some of the most damaging pests among the invertebrates are Chinese fruitfly, citrus psyllid, PTM and among the pathogens are apple scab, chilli blight, ginger rhizome rot, citrus greening and foorkey disease.


Ministry of Information & Communications
Thimphu : Bhutan

National Website Competition (2016-17)
(Evaluated from August 31st, 2016- April 28th, 2017)

This certificate is awarded to

Information and Communications Technology Division(MoAF)

in recognition of their website www.moaf.gov.bt

which was voted as the Most Popular out of 118 websites evaluated

(Lyonpo D.N. Dhungyel)
Minister, MoIC

Date: 17th May 2017

MoAF website gets Most Popular Website award

May 17, Thimphu: The Ministry of Agriculture and Forests' website won the Most Popular Website award (2016-17) out of 118 websites evaluated. The Ministry's website provides regular updates of news, events, tender and other announcements related to the RNR Sector.

The evaluation of the websites is carried out to encourage the agencies to use their websites as one of the main channels for information dissemination, improve public service delivery and prioritise ICT and its usage in government agencies. The website competition was initiated by the Hon'ble Prime Minister in 2014.

Bhutan and World Bank signed 8M US$ grant

May 18, Thimphu: Bhutan and the World Bank signed a 8M US$ Global Agriculture Food Security Program grant to increase agricultural productivity and enhance farmers' access to markets. The World Bank will be the supervising entity while the FAO will provide technical assistance to the project.

The project will be implemented in Chukha, Dagana, Haa, Samtse and Sarpang. It represents an opportunity to significantly reduce pockets of extreme poverty in Bhutan and build the capacity of smallholder farmers to move from subsistence to commercial agriculture.

Livestock Conference

June 12-17, Bumthang: The Livestock Conference was held with a theme 'Innovations for Sustainable and Resilient Livestock Enterprise Development in 12th FYP' in Bumthang. It was a step to address the emerging and pragmatic issues which affects the rural livelihood.

Over 150 officials attended it to reconcile the lessons learnt from 11th FYP, align different stakeholders towards 12th FYP in setting the key result areas and indicators to synchronise the plans from gewog to Dzongkhag to central level. It also discussed new innovations, strategies and policy requirement to enhanced livestock sector.

Agriculture Land Development Guidelines

June 17: Coinciding with the World Day to Combat Desertification, the Hon'ble Sanam Lyonpo launched the Agriculture Land Development Guidelines (ALDG) to ensure sustainable management of agriculture land by adopting proper processes, procedures and technologies.

The ALDG is developed by a technical working group of eight members from within and outside the Ministry with varying backgrounds and experiences. With the guidelines in place, the interventions will be more focused and effective in combating land degradation, increasing crop production, mitigating climate change and enhancing agro-ecosystems in the country.

Bhutan Journal of Animal Science

June 20: The Bhutan Journal of Animal Science is a tribute to the recent organisational development exercise initiated by the Royal Civil Service Commission of Bhutan wherein Research and Extension Division was conceived and therefore a rejuvenation of livestock research in Bhutan.

The research findings reported in the journal add to the previous state of knowledge forming a basis for new thinking and interpretation of new implications in the field of livestock sector in Bhutan.

Ministry and REDCL signed MoU

June 22, Thimphu: A memorandum of understanding (MoU) was signed between the Ministry and the Rural Enterprise Development Corporation Limited (REDCL).

As per the MoU, the Ministry will oversee development of the RNR sector including agriculture, livestock, forestry and the marketing of RNR products while the REDCL will be responsible for the promotion and development of cottage and small industries and non-formal rural activities in the country by providing them financial support. Both parties will work as partners to realise the common goal of fulfilling self-sufficiency of the economy.

SAARC Regional Expert meeting on Water-Energy-Food Nexus

July 3-5, Thimphu: The Ministry in collaboration with SAARC Agriculture Centre, SAARC Energy Centre and International Centre for Integrated Mountain Development organised a SAARC Regional Expert consultation meeting on Water-Energy-Food Nexus: A Basis for Sustainable Agricultural Development.

The meeting was aspire to prepare a policy brief on water-energy-food nexus which can be put up to the both national and regional forum for implementation. It also provided the opportunity for professional interactions among the participants. The overall scenario of water-energy-food nexus in SAARC region was also shared.

World Ranger Day

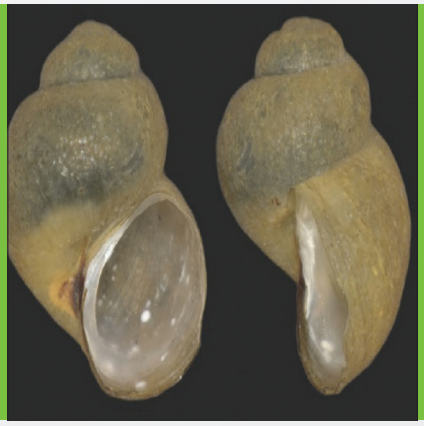
July 31, Thimphu: Bhutan celebrated the World Ranger Day for the first time to recognise the role that the rangers play in the conservation of Bhutan's natural heritage and public service delivery. It also celebrated the membership of its Society of Bhutanese Foresters to the International Rangers Federation and paid a tribute to rangers who have lost their lives in the line of duty.

Commemorating the day, the Ministry awarded seven categories of certificates in recognition of the outstanding services and to encourage environmental stewardship in all.

Bhutan Livestock Development Corporation Limited

August 3, Thimphu: To complement the development needs of livestock sector in the country and create job opportunities for youths and farmers in livestock enterprises, the Bhutan Livestock Development Corporation Limited (BLDCL) was launched.

BLDCL will support the Department of Livestock (DoL) in production and supply of quality livestock inputs especially those which are imported and help produce products that are not produced enough by the Department. It will also help DoL to export livestock products and other value added items such as sausages, ham and bacon.



New species of snails and plants described from Bhutan

August 4: Three species of snails, new to science namely, Rahula kleini , Rahula trongsaensis and Erhaia wangchuki were discovered and described from Bhutan by researchers from the National Biodiversity Centre, Naturalis Biodiversity Centre, Netherlands and Ugyen Wangchuck Institute for Conservation and Environmental Research. With these discoveries, the total snails and slugs of Bhutan stands at 120 species.

Another interesting discovery is the new floral species named as Roscoea megalantha. It is white in colour with purple markings in the middle and corolla tube clearly exerted from calyx.

Agriculture Ministry receives farm road construction machineries

August 7, Bumthang: His Excellency, the Ambassador Kenji Hiramatsu handed over a heavy fleet of earth moving machineries to the Hon'ble Sanam Lyonpo, Yeshey Dorji. The machineries included 30 excavators, 20 backhoes and other important equipment worth of about Nu.445M. This support is largest in the history of Ministry.

With these fleet of machineries, the Ministry aims to construct 457km of farm roads in this fiscal year alone and comfortably meet the target of the 11th FYP. It will contribute in promoting accessibility, enhancing food security and reducing poverty.

Third Mushroom Festival

August 15-16, Thimphu: The third Mushroom Festival was held in Geney gewog. It celebrated the importance of mushroom particularly Matsutake which play an important role in the socio-economic development of the Geney community. The major export destination of Matsutake are Japan followed by South Korea, India, Singapore, Hongkong and Thailand.

The festival showcased the different mushrooms for sale, food stalls, local handicrafts, livestock products, farm tools and cultural programs. The event was also aimed to help promote the culture and tradition and improve the livelihood of the community.

Lhuentse inaugurates Kurichu Capture Fishery

August 17, Lhuentse: A Kurichu Capture Fishery covering 13.5km was inaugurated in Lhuentse and handed over to the community of Gangzur, Lingabi, Magar and Nimshong villages.

The community as a whole is expected to benefit from the fishery. It will serve to secure a nutritional status of the community by providing them with much needed animal protein. People will now have access to a completely different variety of food fish that is both organic and fresh. The fishery is also expected to benefit the community as a source of income.

Experts meet for community based NWFPs

August 24-26, Thimphu: Participants from the SAARC member states of Afghanistan, Bangladesh, India, Maldives, Nepal, Pakistan and Bhutan along with participants from Fiji, Myanmar, Philippines and Laos gathered for a consultative meeting on Development of SAARC Regional Project on Community based Non-Wood Forest Products enterprise: A Sustainable business model.

The meeting aimed at documenting the best community based enterprise on non-wood forest products (NWFPs) for up scaling in the member countries and develop its sustainable business model. It also documented lessons both successful and unsuccessful on NWFPs.

An excavator and a backhoe loader for 20 Dzongkhags

August 30, Bumthang: The Hon'ble Sanam Lyonpo, Yeshey Dorji handed over a Hydraulic excavator and a backhoe loader each to all the representatives from 20 Dzongkhags. Operators trained at the Central Machinery Unit were also provided for each machinery.

The machineries are part of the aid provided by JICA to the Ministry under the project, 'Improvement of Machinery and Equipment for construction of Rural Agriculture Road in the Kingdom of Bhutan' for construction of farm roads in the 11th FYP and beyond.

Pemachoeling Heritage Forest in Tsirang

September 16, Tsirang: Pemachoeling Heritage Forest was established at Tsirangtoe gewog to protect the natural forests and rehabilitate degraded forest ecosystems around the archeological sites (ruin Dzong and Nye) and preserve the cultural and spiritual values attached including protection of Rajapani springsheds. It covers an area of 45 acres.

Various activities such as maintenance of existing footpath from Dzong to Nye, fencing with entry gate, installation of signboard, construction of gazeboo, development of picnic spot and bird watching view and waste management activities will be carried out among others.

World Bank partners with Bhutan for FSAPP

September 21, Thimphu: Bhutan and the World Bank launched the $8M Food Security and Agriculture Productivity Project (FSAPP) to reduce rural poverty, food insecurity and malnutrition to benefit the Bhutanese people.

The project is designed to reduce the county's reliance on food imports and help combat malnutrition in children while improving the productivity of agricultural which employs 60% of Bhutan's people. It will benefit over 10,000 households with 30% of the beneficiaries being women. It will help increase productivity of crops such as rice, vegetables, pulses, potatoes, cardamom, ginger and citrus.

Dragon tour raises Nu.0.63M towards Tiger conservation

September 27, Thimphu: The Amankora Resort and the Bhutan Foundation handed over Nu.0.63M to the Regional Centre for Tiger and Cats Research to strengthen tiger conservation efforts in Bhutan. The fund was raised through an online campaign during the 8th Dragon tour mountain-bike race from Bumthang to Thimphu.

The centre aims to fill critical gaps in scientific understanding of wildcat conservation in the mountains, conduct its cutting-edge science and research, influence tiger and wildcat conservation policy and practices and facilitate awareness programs.

Presence of Snow Leopard in JSWNP confirmed

October 10: The presence of one of the most enchanting, yet elusive species, Snow Leopard (Panthera uncia) in the Jigme Singye Wangchuck National Park (JSWNP) was confirmed through the camera traps at Argutsela (before reaching Black Mountain).

It is yet to be confirmed whether these are already included in the list of 96 individuals recorded by National Snow Leopard Survey or new ones.

Snow Leopards are perfectly adapted to the cold, barren landscape of their high-altitude home. IUCN has now moved its status from endangered to vulnerable.

Fifth Jomolhari Mountain Festival

October 14-15, Soe: The fifth Jomolhari Mountain Festival with a theme, 'Celebrating the life in the mountains' was held in Damgochong near Jomolhari base camp under Soe Park Range of Jigme Dorji National Park.

The festival is one of the unique occasions where by members of the whole Jomolhari community gather together to enjoy and celebrate their cultural heritage and also learn about ecotourism opportunities in the region. It also raised awareness on snow leopard conservation by improving local community members' perception and attitude towards the endangered species.

World Food Day

October 16, Tsirang: With a theme, 'Change the future of migration: Invest in food security and rural development,' the World Food Day was celebrated in Damphu Central School. It is observed every year across the world to mark the foundation day of FAO which works against hunger, malnutrition and poverty.

As a part of the celebration, the importance of consuming fortified rice, meat and the right amount of salt intake were shared. The theme related awareness programs were also organised including a Dzongkha skit and farmers quiz along with cultural dances.

Highlanders attends the first ever consultative workshop

October 19, Thimphu: More than 353 yak herders from 10 Dzongkhags gathered in Thimphu for the first ever consultative workshop with the government.

During the meeting, highlanders raised issues related to schools, basic health units, compensation, cordyceps, light and dairy equipment among others to help reduce urban migration. They expressed concerns over the lack of hostel facilities, experienced teachers and declining cordyceps areas.

Considering the richness and environmental importance of highland, the highland development is proposed as one of the flagship programs in the 12th FYP.

Global Snow Leopard Day

October 23, Bumthang: To mark the Global Snow Leopard Day with a theme 'Save the Ghost of mountain', over 1200 students from schools under the area of Wangchuck Centennial National Park gathered at Wangduechhoeling Lower Secondary School.

The event highlighted the livelihood of herders, herder-snow leopard conflicts and measures to mitigate such problems. The students participated in a different competitive programs such as quiz, debate and skit based on theme.

As per the National Snow Leopard Survey, the park has around 17 snow leopards out of 96 in the country.

Second Royal Highland Festival

October 23-24, Gasa: Highlanders from Wangdue, Thimphu, Paro, Haa, Trongsa, Bumthang, Trashigang, Lhuentse, Trashiyangtse and Gasa along with officials and tourists gathered for the 2nd Royal Highland Festival at Langothang, Laya. His Majesty The King graced the opening of the festival with a theme, Highlands-The Pride of the Nation.

The festival celebrated the unique cultural heritage and legacy of the highland communities. It also provided an opportunity for visitors to experience highland life and culture. One of the festival attractions was the Laya run from Ponjothang, the nearest road point.

Field guide for fishes of western region

November 15, Thimphu: A field guide listing 104 freshwater fish species of western Bhutan was launched. Among others, it covers the detailed taxonomic position, quality photographs, present conservation status and local names of species belonging to 16 families and 47 genera.

Out of 104 species, 57 are new species recorded in Bhutan while 11 are non-native fish species introduced in the country for commercial purposes.

The National Research Centre for Riverine and Lake Fisheries, Haa developed the guide covering the river basins of Amochhu, Punatsangchhu and Wangchhu.

Ministry signs MoU with IRRI

November 24, Thimphu: The Ministry signed a memorandum of understanding (MoU) with the International Rice Research Institute (IRRI), Los Banos, Philippines for research, development and training in rice and rice based systems.

As per the MoU, the priority will be given to high yielding and stress tolerant varieties including traditional ones. It will promote mechanisation, post-harvest and nutrient management technologies. It will further develop staff's capacity building and strengthen seed systems. All the research materials used in the collaboration will be transferred using the material transfer agreement.

RNR Professional Development Programme for extension staff

December 1, Thimphu: 23 officials who had been invited to Thimphu from the remote parts of the country completed a month long RNR Professional Development Programme.

Officials were placed at their respective departments to learn about the functioning of their head offices. During their attachment, they attended various meetings and fields visits which helped to further enhance their knowledge. They expressed their gratitude to the Ministry for initiating such program. During interaction, issues related to attachment duration and lodging among others were discussed.

DoL recognised for Institutionalising Compassion

December 2-5: The Department of Livestock (DoL) was awarded the prestigious award for Institutionalising Compassion at the 10th Asia for Animals Conference that was held in Kathmandu, Nepal.

The award was bestowed for its contribution in improving the animal welfare in the country and implementing the nationwide dog population management campaign. DoL and HSI embarked on a joint project to reduce and address increasing free-roaming dogs in Bhutan. During the nine years of successful collaboration since 2009, more than 70,000 dogs have been sterilised and vaccinated against rabies.

FROM UNIVERSITY GRADUATE TO SUCCESSFUL PIG BREEDER

Anand Rai is today running the largest private pig breeding farm in the country

Pema Sherab, NPiRDC, Gelephu

When in college, 30-year-old Anand Rai never thought that he would venture into business, that too into piggery.

The Bachelor of Arts graduate from Shillong University in India aspired to become a public servant like everyone else. That changed in 2011, soon after his graduation. Fresh out of college, Anand tried his luck in dairy but somehow it didn't work. Few more years were wasted trying his luck in the construction sector. He tried politics too but in vain.

He tried rearing pigs at Shechamthang (Ranibagan), Sarpang. There were hurdles. He was asked to move. His interest didn't die and in 2014 considering his interest, the then National Piggery Development Centre supported him in establishing 20 sow breeding farm at Kagatey village. The semi-commercial piggery breeding farm in Kagatey, Gakidling gewog was perfect. The orange trees were dying and that gave him a good location.

The pig shed design and construction materials were provided as per the piggery stimulus support of the Department of Livestock (DoL). More luck was in store. One year later, his village was connected by a farm road and a bridge built over the river. He added another shed making his breeding farm to 30 sow-level capacity.

Anand Rai is today running the largest private pig-breeding farm in the country. With 30 breeding sows and few heads of fatteners, he is now a happy educated farmer with a good income. There is a ready market. The National Piggery Research and Development Centre (NPiRDC) buys all the piglets at Nu.3500 a piglet. The procured piglets are then sold back to other fattening farms in the country at a subsidised rate of Nu.2000 a piglet.

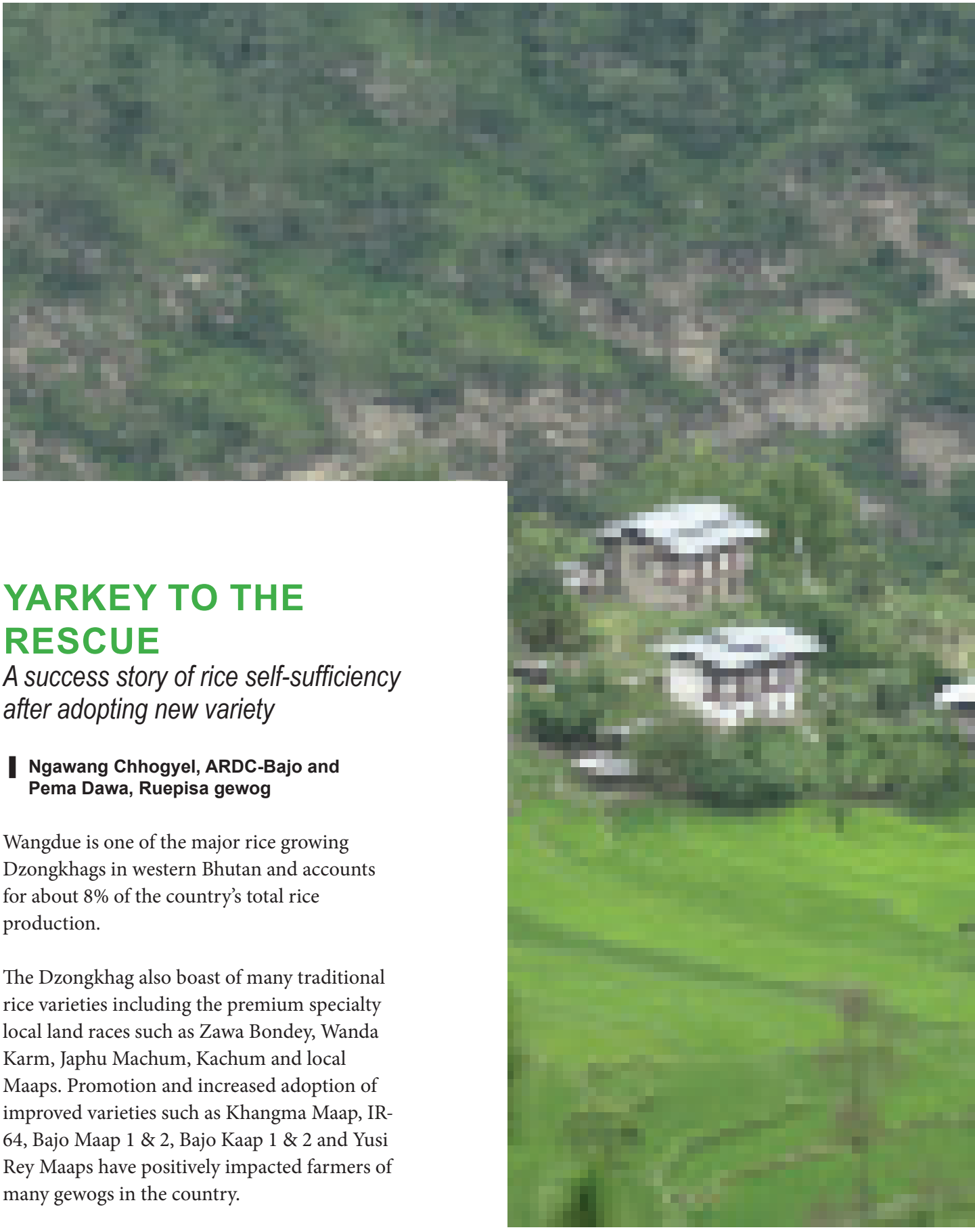
Within two and half years, Anand has sold 595 piglets earning him Nu.2,082,500. This excludes the income he got from the sale of fatteners and pork. His wife helps him in running the farm. Now he is driving his own utility vehicle (Bolero). He also sells pork. He is happy that he made the right choice by venturing into piggery farming.

His only worry is if he could sell all his piglets in the 12th FYP if the government stops the piglet buyback subsidy support. This will affect his business and plans. He is planning of having separate fattening units to create jobs for the educated youth in his village.

Anand had also spearheaded the formation of a first ever piggery cooperative, Sarpang Yarkey Piggery Cooperative. The cooperative was formed for systematic production and marketing of piglets and pork with 57 members from Sarpang. The DoL also provided them a cold chain equipment for sale counter.

But the successful functioning of pork marketing was disrupted when the Sarpang Chu washed away the Sarpang town. Currently, the Dzongkhag Livestock Sector allows them to utilise the meat sale counter available at Sarpang vegetable market on temporary basis.

When our villages are getting empty and youth rushing towards city, Anand believes with some extra effort, life in the village is not difficult. He feels it is one place where life is comfortable. Meanwhile, lack of sale counter and chilling storage room is the biggest challenge for farmers like Anand as pork is a perishable product.



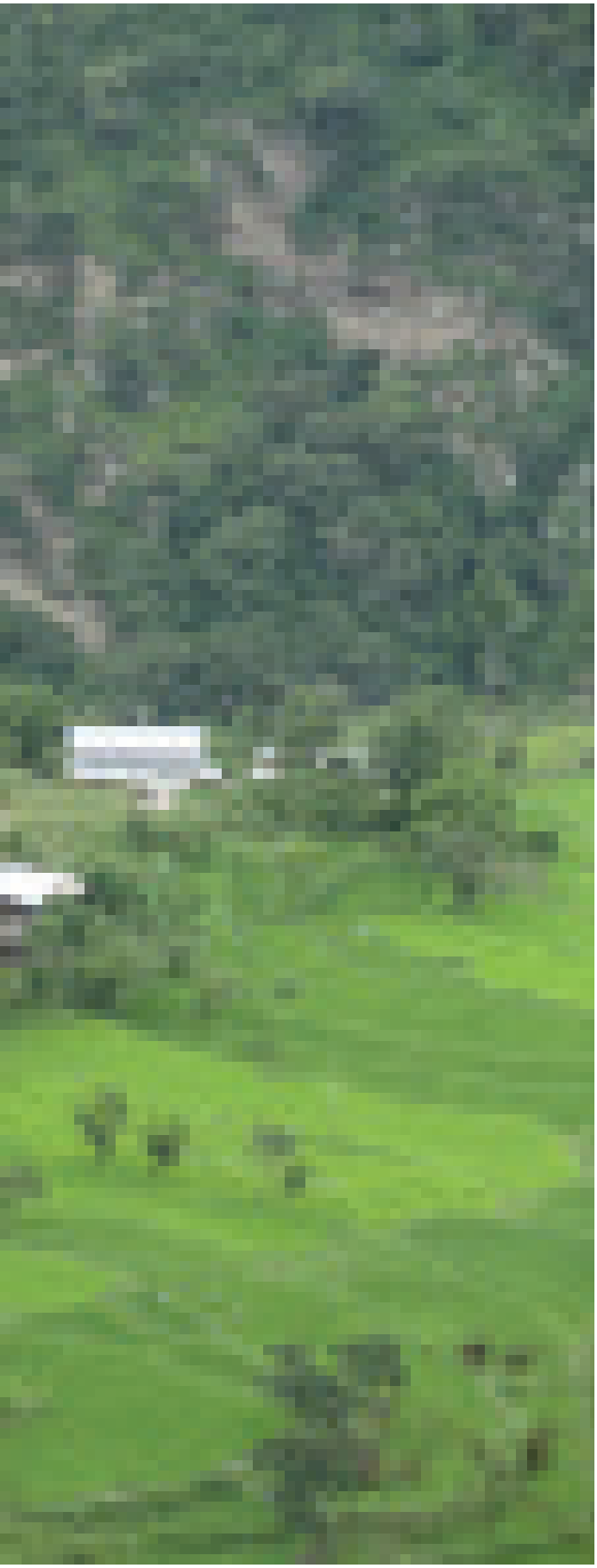
YARKEY TO THE RESCUE

A success story of rice self-sufficiency after adopting new variety

Ngawang Chhogyel, ARDC-Bajo and Pema Dawa, Ruepisa gewog

Wangdue is one of the major rice growing Dzongkhags in western Bhutan and accounts for about 8% of the country's total rice production.

The Dzongkhag also boast of many traditional rice varieties including the premium specialty local land races such as Zawa Bondey, Wanda Karm, Japhu Machum, Kachum and local Maaps. Promotion and increased adoption of improved varieties such as Khangma Maap, IR-64, Bajo Maap 1 & 2, Bajo Kaap 1 & 2 and Yusi Rey Maaps have positively impacted farmers of many gewogs in the country.



The success story of 100% Yarkey variety adoption by the farmers of Jala village, Ruepisa in Wangdue is a case in point. It is located on a hillock at 2200 masl with 45 farming households.

In some cases, improved varietal adoption has also completely replaced low yielding local varieties, thus calling for efforts to conserve local genetic materials. Yarkey rice variety has totally changed the rice self-sufficiency status of Jala farmers who were once never rice self-sufficient. The other improved variety grown by the farmers is Khangma Maap which is known by the name 'Kashi maru'.

Rice is the mainstay of the farmers with 100% adoption of a higher yielding variety called Yarkey. The word Yarkey literally means 'improvement or enhancement'. Thus, meaning improving food security or rice self-sufficiency of the Jala community and hence, the variety was called as Yarkey rice. It was learnt that the cultivation of this variety has changed the rice self-sufficiency status of Jala village.

In order to confirm and ascertain the exact name of the improved variety that the Department of Agriculture promoted, a visit was made to village where the Tshogpa and some elderly people were informally consulted. The origin of Yarkey was traced to Goenshari in Punakha. Delving deep into the references on high altitude rice varietal trials spearheaded by the research centre Yusipang then and consultations of experts at Bajo and Yusipang, the team were closer to variety identification. The plant characteristics and grains were examined and preliminary investigation indicated that the variety could be YP/K-Y/B-20, an advance line that was developed and promoted in some high altitude places of Paro, Thimphu, and Punakha post blast epidemic of 1995.

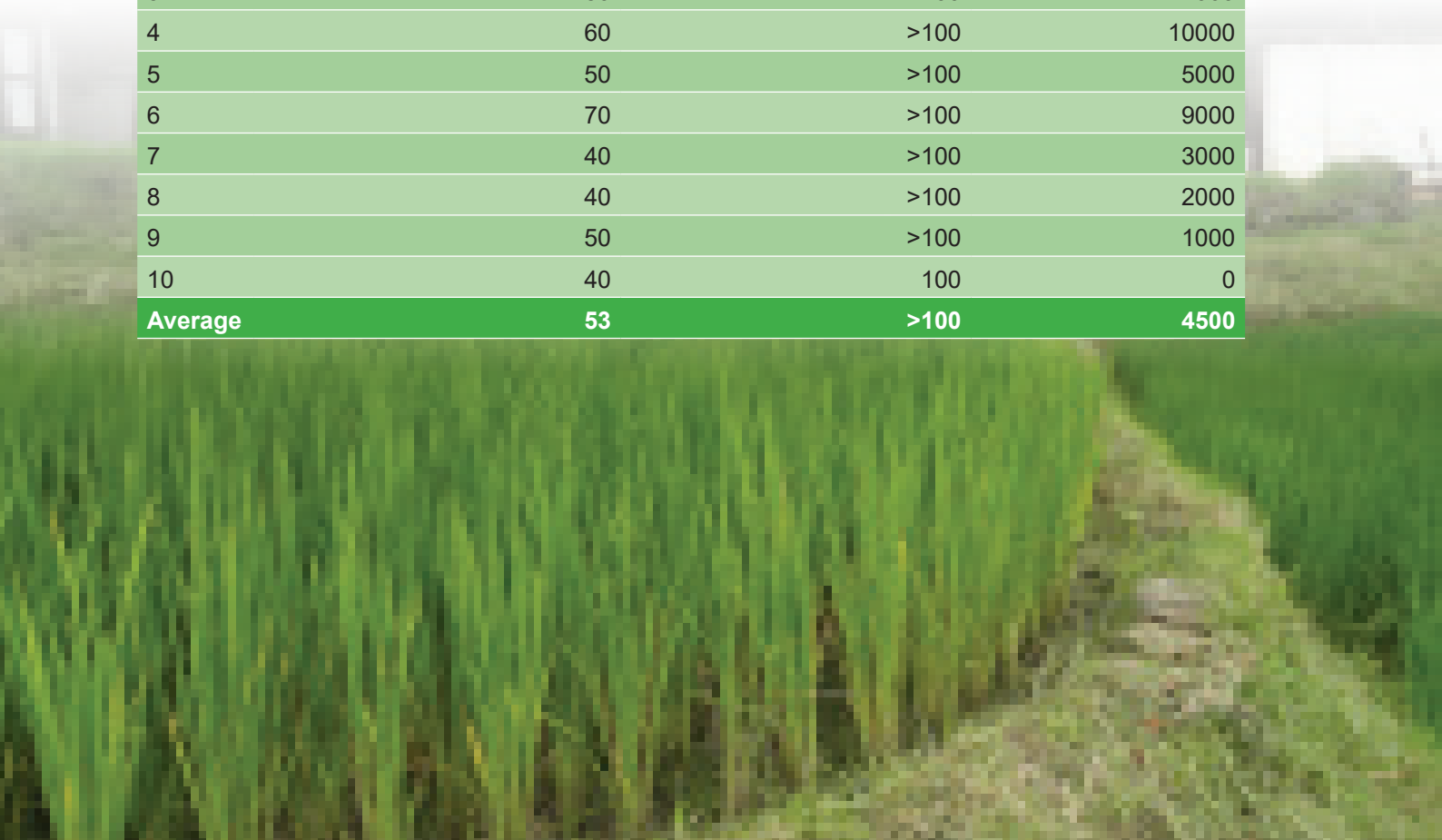
YP/K-Y/B-20 is one of the red rice varieties that are easy to thresh and was promoted a decade ago. However, detailed study through site visits at different crop stages and in-depth review of the promotional programs/reports has to be done to ascertain the variety. In the past, the Agriculture Research and Development Centres in Yusipang and Bajo attempted to promote several selections from its breeding program and due to re-structuring processes undertaken by the Ministry, the rice-breeding program has suffered a slow death.

Therefore, there is urgency on the part of the national rice program at Bajo to revive rice breeding programme and also work towards enhancing the overall rice self-sufficiency in the 12th FYP. Yarkey rice was able to revolutionise rice production of Jala village and there is no reason that we cannot replicate it in other places.

A random sample survey of 10 farmers showed that Yarkey is the main rice variety grown by the farmers both for self-consumption and sale. It is also synonymous to cash crop in the past since the remote village of Jala was not accessible by roads and there was no market for the crop that is currently becoming popular (potato). The survey data showed that besides attaining rice self-sufficiency, Yarkey rice gave them cash income ranging from about 2000-10000 per household. The villagers unequivocally mention that their village was not rice self-sufficient a decade ago but currently, the farmers could even earn some cash from the sale of surplus rice.

Rice self-sufficiency status of Jala farmers

Sl. No.	Rice self-sufficiency of Jala farmers		Cash income from surplus rice sale (Nu.)
	Before adoption of Yarkey (%)	After adoption of Yarkey (%)	
1	50	>100	2000
2	50	>100	6000
3	80	>100	7000
4	60	>100	10000
5	50	>100	5000
6	70	>100	9000
7	40	>100	3000
8	40	>100	2000
9	50	>100	1000
10	40	100	0
Average	**53**	**>100**	**4500**



New crops released for food self-sufficiency, climate resilience and commercialisation

Sangay Jamtsho, Lhap Dorji, Loday Phuntsho, Sonam Gyeltshen and Tashi Phuntsho
ARDC-Wengkhar

In line with the themes of 11th FYP to enhance food self-sufficiency, mitigate climate change and enhance commercialisation of farming, the Agriculture Research and Development Centre (ARDC)-Wengkhar released the following four new crop varieties that can also serve as sources of income.

Dragon Fruit: Dragon fruit was released as Wengkhar Gewa-Ring-Nga in 2016 contributing to the diversity of fruit crops for the low to mid altitude areas. It has a wider adaptability compared to other sub-tropical fruit crops and suitable for dry arid areas. The centre is currently promoting this variety as a crop mix with other sub-tropical fruits such as avocado and mango.

Upland Paddy: Upland paddy traditionally known as Pangbara, Kambara or Kambja and cultivated in most of the eastern Bhutan in the past. Although its contribution is small, its cultivation and research is considered important mainly from household food security and climate change perspectives. Two new upland rice varieties namely Wengkhar Kambja-1 and Wengkhar Kambja-2 were released in 2017.

Both varieties are promoted in the region through research outreach program as an option to enhance household food security and climate resilience.

Maize: Maize is the second most important cereal crop grown in the country. A new variety "Arun-4" is short duration crop with tolerance to gray leaf spots and turcicum leaf blight. This new variety was released as Bhur Ashom-4 in 2015 by ARDC-Samtenling with coordination from the National Maize Coordination Centre.

Released name: Wengkhar Gewa-Ring-Nga
Botanical name: *Hylocereusundatus*
Cultivar name: Dragon Fruit
Source of germplasm: Thailand
Year of introduction: 2008
Recommended elevation: 300-1600 masl
Average yield per tree: 5-8t/acre
TSS: 12.1%

Released name: Wengkhar Kambja-1
Botanical name: *Oryza sativa*
Cultivar name: Machhapuchhre-3
Source of germplasm: Nepal
Year of introduction: 1998
Recommended elevation: 600-2300 masl
Seed rate: 15-25kg/acre
Average yield per tree: 1-1.38t/acre

Released name: Wengkhar Kambja-2
Botanical name: *Oryza sativa*
Cultivar name: Zangthi-2
Source of germplasm: Zangthi village, Lauri gewog, Samdrupjongkhar
Year of Introduction: 2005
Recommended elevation: 600-2300 masl
Seed rate: 15-25kg/acre
Average yield per tree: 1-1.38t/acre

Released name: Bhur Ashom-1
Botanical name: *Zea mays*
Cultivar name: Arun-4
Source of germplasm: Nepal
Year of introduction: 2005
Recommended elevation: ≤1200 masl
Seed rate: 15-20kg/acre
Average yield per tree: 1.0-1.3t/acre

Effect of decentralising Pig Breeding Program

Pema Sherab and Gyembo Tsheten
NPiRDC, Gelephu

Despite various challenges in meat development in the country, steady progress has been made in pork production by the Department of Livestock under its nodal agency, the National Piggery Research and Development Centre (NPiRDC) in Gelephu.

The pork production in 2016 reached 740MT compared to 350MT in 2013. Such increase in domestic pork production in the recent years is attributed to promotion of Contract Piglets Breeders (CPB) under the piggery stimulus subsidy scheme in 11th FYP.

CBP produces piglet and supply to private fattening farms to supplement government pig breeding farms in piglet supply. It was started in 2014 to produce enough piglets in the country. Before 2014 piglet production was centralised under governments' farms.

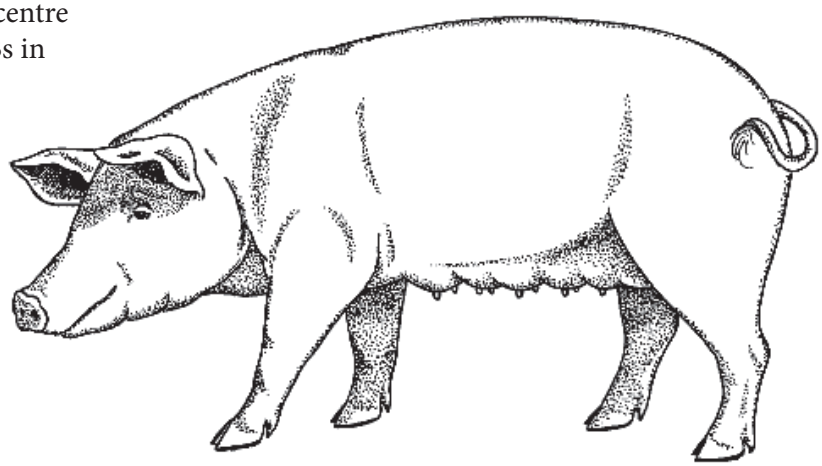
Piglet buyback packages include CPB sale piglet @ Nu.2000/piglet to fattening farm owners. CBP received another Nu.1500/piglet from government as price support or subsidy to encourage more piglet production. This is the piglet buyback package.

With the limited infrastructure (pig shed) at government breeding farms, the centre has been promoting numerous CPBs in potential Dzongkhags. The subsidy packages were initially supported through Royal Government of Bhutan (RGoB) and thereafter by Government of India (GoI) project. All the government subsidy beneficiaries are CPBs except for few fattening farms. In total, 58 piggery farms-breeding and fattening were established with total expenditure of Nu.10.213M. Majority of the farms (n=31) were established during 2014-2015 fiscal year.

The majority (65.5%) of these farms are located under Sarpang followed by 18.96% in Tsirang. These CPBs comprise of 5 to 10 sows whereas semi-commercial or commercial fattening farms comprise of 10 to 100 fatteners.

As of September 2017, CPBs produced more than 7000 piglets of which the centre procured 6986 piglets under buyback package and supplied to fattening farms across the country). Piglets were procured at the rate of Nu.3500 per piglet. Under this buyback package, the CPBs across the country generated the cash income of Nu.24.241M from the sale of piglets.

Overall, government had invested Nu.34.454M from RGoB and GoI funding-Nu.10.213M for shed construction materials and Nu.24.241M for piglet buyback. With initiation of CPBs, the issue of piglet shortage in the piggery development has been solved.



Moreover, this initiative enhanced domestic pork production. Exclusive of the piglets retained by CPBs themselves as replacement stock, the pork production from supply of 6986 piglets is estimated about 530.96MT after deducting 5% as mortality rate following their distribution.

Furthermore, import substitution of 530.96MT of pork have save the country of about Nu.90.26M at farm gate price of Nu.170/kg. Thus, the governmental subsidy support and piglet buyback packages are certainly the best intervention by centre. Despite of various challenges, this initiative proved to be a successful story in the history of piggery sector development in the country.

With the target of producing 2200MT of domestic pork during the 12th FYP period and with only about 4% of households engaged in piggery farm, the focus on pork production program at selected Dzongkhag needs to be explored. Some remarks from piggery clients proves how farmers are benefited from the piggery farm business.

The innovative Turnkey pork project looks a viable solution where all the initial establishment cost is borne by the government including land, structure, equipment, etc. and handed over to interested party to operate the establishment on lease basis.

There are some school leavers willing to take up piggery related business but they do not have enough land and money to start business. However, some youth are very sensitive to risk who are not interested to do this business.

According to one of the piggery farmers, Bifa Maya Rai, present 10 breeding sows and 50 fatteners is too less for her two sons. She is hopeful of receiving additional support to increase her farm to 150 fatteners size as she have her land lying vacant.

Jamyang Thinley, a Class XII graduate after visiting the centre shared that he is interested in piggery enterprise but land and cash for initial investment is a challenge for him. He feels that if government could provide readymade piggery shed on lease, many educated youths would take up piggery business.

Therefore, if government would deliver a complete set of infrastructure built on government land and lease to interested youth, they could carry out farm operation activities without having to build any infrastructures-land and huge investment not required. This would reduce infrastructural and investment burden on individual who are willing to take up the piggery business.

Moreover, one can reap great economic profits from the project as complete set of infrastructure will be ready for immediate operation. This strategy is intended to spur further growth in piggery sector in the country.

NPiRDC/Government has already included piggery farming in the Priority Sector Landing (PSL) scheme of RMA to support school leavers. The scheme will take care of land and money.

There are 30 farms with permanent pig shed constructions rearing from 10-100 pigs in semi-commercial and commercial level. The piggery business in south Bhutan is expected to do well.

Social and religious pressure is slowly pushing pig rearing to extinct in eastern, northern and western Bhutan. In the south, it is on the rise. With the establishment of the Bhutan Livestock Development Corporation, pork production in the country is expected to increase. Further with the launch of the scheme, more commercial piggery farms are expected to come.

NPiRDC piggery target in the 11th FYP was 900MT. As of December 2016, it has achieved around 740MT.

Meanwhile, the centre during the 12th FYP will focus on Pig Artificial Insemination technology for effective pig breeding.

Spring Rice for food security and rural livelihood

Ngawang Chhogyel, ARDC-Bajo

Spring rice in Bhutan is identical with rice double cropping as it permits rice production twice a year. It has the potential to improve the rice self-sufficiency of Bhutanese farmers and contribute to offsetting rice import. It is one of the Ministry's strategies to enhance total production in the 11th FYP and beyond. One of the spring rice growing regions in Bhutan is Rinchengang village in Wangdue.

The spring rice was introduced to enhance rice production for self-sufficiency and ensure better utilisation of farm land for food security.

Production Technology

- Feasible in the mid and low altitude areas with assured irrigation.
- Produced from February to July. (mid-altitude) and February to June (south).
- Nursery raised under poly tunnels since spring season is quite cold.
- Cold tolerant higher yielding short duration varieties are available for spring rice.
- Crop has to be harvested at 80-85% maturity and dried immediate to avoid viviparity especially in the south.

Experience with spring rice production in 2017

In 2017 season, the Farm Mechanisation Corporation Limited (FMCL) has undertaken large scale cultivation in south covering three Dzongkhags. The short duration varieties (90-100 days) introduced from India took about 150-160 days to mature. A total of 77.127 tonnes of spring rice was produced (37.926 from Sarpang, 6.181 from Samtse and 33.02 from Samdrupjongkhar. With such experience, FMCL is all set to double the production in 2018.

Spring rice has potential to enhance Bhutan's rice self-sufficiency. It is one of the best ways to better utilise our scare land resource and intensify crop cultivation for food security. The 2017 season has given an immense experience to the newly created FMCL and field colleagues. Despite the field issues, it was noticed that spring rice could also provide employment opportunities to our rural people.

Spring rice varieties available

Sl. No.	Agro-ecological condition	Varieties	Remarks
1	Mid-altitude region	No.11	Cold tolerant Japonica rice grown in Paro
2	Southern region	BRRI dhan26	Introduced from Bangladesh and evaluated at ARDC-Bhur
		BRRI dhan 28	

DOCs rearing farm thrives in Trashiyangtse

Dawa Dema, Dzongkhag Administration Trashiyangtse

Poultry is raised all over the world for various reasons. It is one of the cheapest sources of meat and can be raised by anyone even in their backyards. Milk and egg production are the most important commodities that the livestock sector under Trashiyangtse has proposed to achieve in the 11th FYP.

However, the egg production has dropped in 2014 due to the outbreak of IBD and some poultry farms have closed due to increased feed costs. Further, it was challenging to get quality pullets from other Dzongkhags due to high demand.

To solve the issue, day old chicks (DOCs) rearing farm was established in 2014 to supply farmers with good quality pullets at reasonable prices avoiding transportation charges to reduce the cost of production. The idea was also to prevent the entering of new diseases, ensure safety, achieve the Dzongkhag targets and serve as a model farm.

The farm in 35 decimal of areas was started with 1000 numbers of DOCs that were procured from Lingmethang and Sarpang poultry farms. It was located at Tshaling village under Boomdeling gewog. Initially, the cost of DOC was Nu.38 which later was reduced to Nu.30. The DOCs were reared in the farm for 45 days and were supplied to the farmers at Nu.190 each which later increased to Nu.200 due to the increased cost of feed and production. The farm adopted proper management practices to ensure quality and healthy pullets and avoid future complications.

The rearing of pullets was done till mid 2017 during which it supplied 30,000 pullets. They were marketed to Boomdeling, Yangtse, Ramjar, Jamkhar, Tongshang, Khamdang, Toedtsho and Yallang gewogs. The income earned by owner was approximately Nu.2M between 2014 and 2017.

The farm is now run by Sangay Jamtsho, one of the graduates from Sherubtse College. His farm covers 40 decimal of areas. He has 1500 DOCs which is sold for Nu.190 each including the transportation cost. He also has 10 cattle and sells fresh milk to the milk collection centre in Yangtse.

Sangay is managing both dairy and poultry very sustainably following a routine time for both poultry and dairy farms. His family members also help him look after the farm activities.

Some of the challenges he faced include difficulty in getting farm labour, improvise the high tech farming method, feeds and expensive to mechanise the farm.

The DOCs demand for every gewog under Trashiyangtse has been met through the farm helping Dzongkhag to achieve more than the targeted egg production of Nu.3.141M. The Dzongkhag produced eggs of Nu.3.662M at the end of the 11th FYP.

To help Sangay market his DOCs, the Dzongkhag Livestock Sector has restricted the DOCs procurement from outside Dzongkhag unless there is an urgent need. The sector is also exploring for the best feed supplier to meet the demand of poultry farmers. The Dzongkhag has supported farmers with poultry shed construction materials.

There are 40 farms (more than 100 birds) and 150 small backyard farms (less than 100 birds) in Trashiyangtse. The Dzongkhag's plan to supply DOCs to poor farmers has been almost achieved. The sector is also planning to support the interested farmers to set up the farm at commercial level which will serve as a model farm for community in future.

Technical assessment of rice research and development

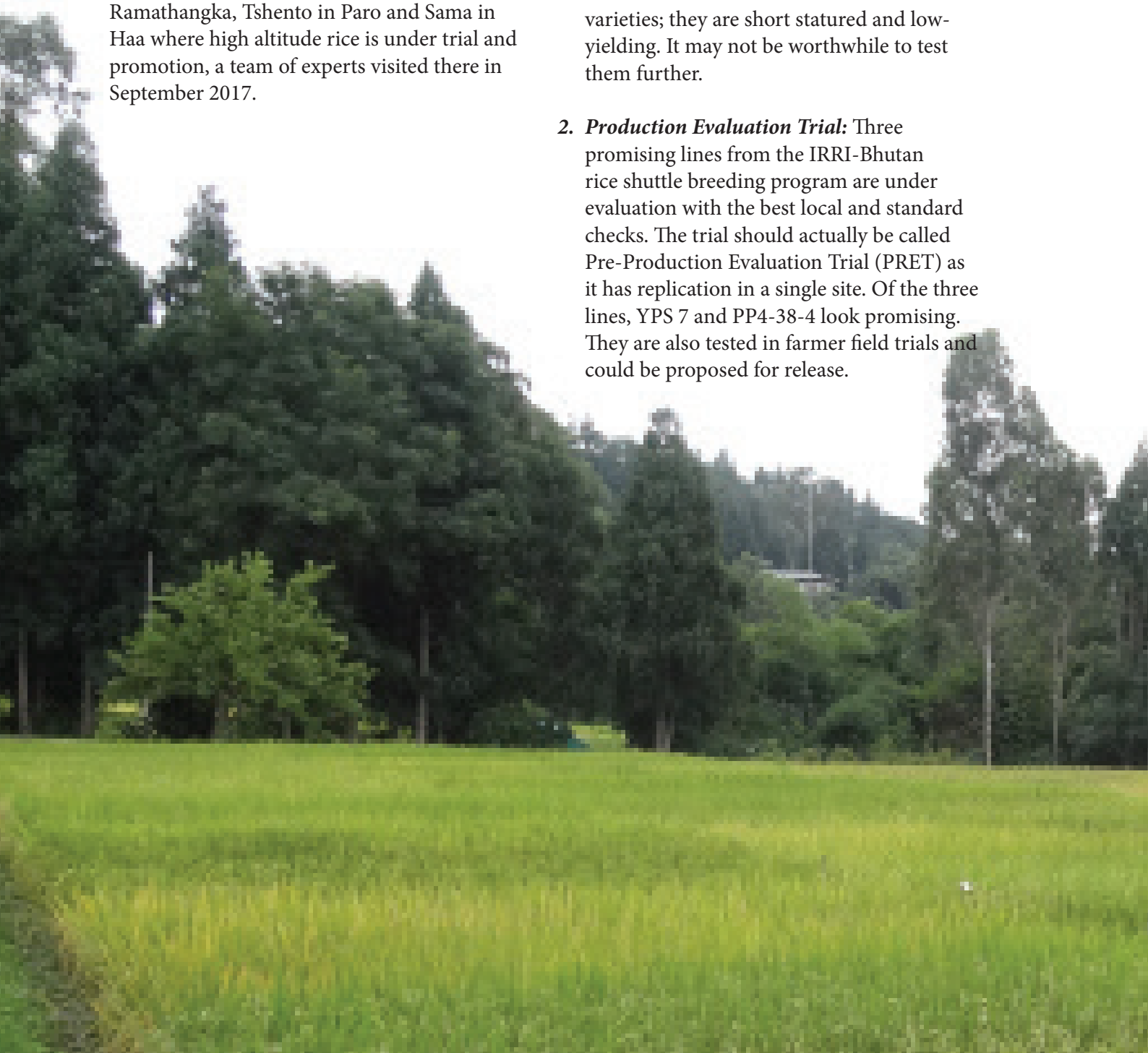
Mahesh Ghimiray and Ngawang Chhogyel
ARDC-Bajo

On the request of the Agriculture Research and Development Centre (ARDC)-Yusipang for a technical assessment of the rice trials established in the new sub-centre at Ramathangka, Tshento in Paro and Sama in Haa where high altitude rice is under trial and promotion, a team of experts visited there in September 2017.

Ramathangka sub-centre at an altitude of 2500 masl is sub-leased from Farm Mechanisation Corporation Limited (FMCL). FMCL has 2.84 acres of wetland. It is appropriate for high altitude rice testing and evaluation. The wetland was left unused for several years and ARDC-Yusipang has cleared the land and set up experiments. The following experiments are ongoing:

1. ***Advance Evaluation Trial:*** Three Japanese varieties are under comparison with local and standard checks. The Japanese varieties do not seem better than the released check varieties; they are short statured and low-yielding. It may not be worthwhile to test them further.

2. ***Production Evaluation Trial:*** Three promising lines from the IRRI-Bhutan rice shuttle breeding program are under evaluation with the best local and standard checks. The trial should actually be called Pre-Production Evaluation Trial (PRET) as it has replication in a single site. Of the three lines, YPS 7 and PP4-38-4 look promising. They are also tested in farmer field trials and could be proposed for release.



3. ***Rehabilitation of traditional varieties:*** Six traditional varieties namely, Janam, Zhuchum, Dumja, Hungri Maap, Shaba Kuchum and Themja are grown for genetic purification and rehabilitation as these varieties have been abandoned by farmers for higher yielding HYVs. Although transplanted in the first week of June, the age of seedlings must have affected their growth and reproduction; except for Hungery Maap (which looks very much like an improved variety with short height and early maturity) all other varieties are in heading and early flowering stages. They were affected by cold and may not produce matured grains.

   A total of 13 elite lines and released varieties are grown for seed production. The seeds will be used for further research and promotion purposes.

4. ***Bulk 20:*** There is a plot of an interesting breeding line (segregating population) named Bulk 20. The bulk is not fully homozygous or uniform. Further selection can be done to obtain early and late plant types.

Overall, the fields are maintained well. However, some land developments to make wide and uniform terraces for laying out experiments are recommended.

In collaboration with the National Biodiversity Centre (NBC), two farmers in Zukha village, Shari were provided with seeds of their local varieties (Thembja and Zechum) after rehabilitation by ARDC-Yusipang. Farmers used to grow this variety but now they have switched to an assortment of high yielding, tight shattering rice varieties collectively known as 'Sata'. It also includes four varieties released from ARDC-Yusipang namely Yusirey Maap1 and 2, and Yusirey Kaap 1 and 2.

The purpose of the program was to revive the cultivation of traditional rice varieties in Paro that has seen an almost entire replacement of local cultivars. The idea in fact is *in situ* conservation and utilisation of traditional varieties and crop genetic resources for future crop improvement programs. The intent is undoubtedly noble but the two local varieties have not performed well.

In Aum Gyem's plot of about 50m^2, variety Thembja looks miserable with plants of varying maturity (plants in the middle are late and will not form grains, some plants bordering the plot have formed grains). Overall, the performance is very poor and is almost a total loss for the farmer. In a plot (about 7mx5m), Zechum is grown. More than half the plot is severely affected by node and neck blast. This is in stark contrast to the neighbouring fields where Sata varieties are laden with golden grains without a trace of blast disease.

It may be noted here that all the traditional rice varieties are highly susceptible to blast, a fungal disease which is difficult to control. This was proven in the blast epidemic of 1995. Resistant varieties is one of the answers to blast problem hence the rice breeding program was started with IRRI and ARDC have developed several blast resistant varieties (in addition to high yield) such as the Yusirey Maap and Kaap series.

These varieties are now grown by farmers. Asking farmers to grow the susceptible and low yielding traditional varieties for the sake of conservation may not be the right approach or a sustainable option. Farmers need to be incentivised (will require discussion on what form and how much) if they are to grow the traditional varieties *in situ*. In fact, from crop breeding and improvement point of view, farmers have not totally lost their traditional varieties as the newly developed Sata varieties have genes from the local varieties (Naam, Rey Maap, Thimphu Maap were crossed with blast resistant Japanese and Korean varieties to produce Yusirey Kaap/Maap series).

For the second year, rice is cultivated in Sama gewog in Haa at an altitude of about 2700 masl. The area has been expanded to about three-fourth of an acre from the small plot cultivated in 2016. Rice seedlings were grown under polyhouse in February and transplanted in April. The variety used was Jakar Rey Naab, the same variety that Bumthang farmers grow. Weeding was done in July and 10kg urea was top dressed.

The majority of the crop was matured and ready for harvest in October. Plants near the terraces where cold water comes directly in contact are affected by cold and will not produce grains. In at least two plots where soil fertility is high; there are distinct blast patches with visible symptoms of node and neck blast. It may be noted that Jakar Rey Naab is highly susceptible to rice blast under favourable conditions excessive nitrogen being one. Some sheath blight and sheath rot were also recorded. The terraces were still being irrigated leading plants to lodge in several fields. The extension staff and farmers were asked to stop water completely.

The team observed several plants of a distinct phenotype which has clean white grains than the intended Jakar Rey Naab variety. It may be a nature's wonder that mutation has occurred but most probably a mixture of another variety which is early maturing and cold tolerant like Jaka Rey Naab. One can select this plant type and develop into a new variety. This has been brought to the attention of Yusipang researchers.

Recommendations

- ARDC-Yusipang is establishing the new research site in Tshento. It needs to be supported with budget provision for land development, small and winding terraces required to be leveled and straightened into standard plots for experimental layout. The owner should not have a problem if his/her land is developed this way.

- Percolation rate is reportedly high (the field is close to the river with possibility of sand deposits). It can be improved through addition of organic matter. Funds to purchase farm yard manure, compost, leaf litters etc. should be made available.

- Bulk 20 is a very promising genetic stock from which segregates with appropriate maturity, plant height, grain type, shattering etc. can be made. These phenotypes (and genotypes) can be distinct varieties after attaining uniformity.

- Further work on Japanese varieties is not recommended as they exhibit no better traits than the existing varieties. Their seeds can be conserved in the national gene bank.

- Two breeding lines, YPS 7 and PP4-38-4 are already adopted and grown by Paro farmers. The lines are genetically better than the existing varieties in terms of grain yield, cold tolerance and blast resistance. They should be proposed for release and seeds made available to high altitude farmers.

- The two farmers who volunteered to grow Thembja and Zechum varieties in Shari probably deserve some form of compensation for the yield loss due to very poor performance of local varieties. NBC may be consulted on this.

- The rice in Haa is much better than last year. The site will act as demonstration for farmers interested in rice cultivation. Crop management can be improved. Blast management will be crucial if area expansion is to occur.

- Prior to harvest, researchers from ARDC-Yusipang should collect all the plants which are not Jakar Rey Naab but have matured grains. This can be bulked, tested further and possibly develop into a new variety.

Maize Drying and Harvesting

Maize drying is a vital operation which involves removal of moisture from the cobs/grains. It is carried out because high moisture grain will deteriorate rapidly due to grain respiration and heating, germination of grains, mould (fungal) growth and subsequent incidence of my cotoxins (e.g. Aflatoxin) and increase insect multiplication and damage. The optimum moisture content of maize should be 14% or less.

Types of drying

1. **Sun drying:** It is a popular method of drying grains where spread grain is exposed to direct sunlight until the desired grain moisture content is achieved. It is low energy cost. The good practices that have to be followed in sun drying are as follows:

    - Clean the drying surface properly before spreading the grain to prevent contamination with impurities.
    - De-husked cobs should be spread on a ground cover such as a plastic sheet or any other suitable material to prevent seepage moisture from the ground reaching the cobs.
    - Start the drying operation in the morning to get maximum sun shine hours of the day.
    - Spread the cobs as thinly as possible on the drying floor but not more than 5cm thick to achieve faster.

- Grains absorb moisture during night when the relative humidity of the air increases. In order to minimise this phenomenon, heap the cobs on the drying floor and cover the heaps with plastic sheet or any other protective material such as straw bags until the grains are spread on the following day. During sudden rains, heap the cobs or grains on the drying floor and cover the heaps with plastic sheet or any other moisture barrier.

2. **Smoking:** The insect infestation is reduced when hung above the fire as the heat reduces the moisture content and the chemicals in smoke deters insect from laying eggs.

3. **Air Drying:** The maize cobs are hung along the roof of the house to expose it to air and hence the moisture content is minimised.

The correct stage of maturity for harvesting of maize is:

- When silks of ears have dried to a golden brown.
- Kernels should be well filled and plump milk stage.
- 90-115 days after planting.
- Cobs should be at least 5" long.
- 20 days after the appearance of the first silk strands.

Early harvesting results in:

- High level of immature, unfilled and partly filled cobs.
- Low field yield.
- High grain moisture.

Late harvesting results in:

- Low field yield due to damage by insects, mould, birds, rodents and wild animals.

Storage: Maize can be stored either in cobs or shelled in various storage structures or containers for different lengths of time. The period can be short-term (4-5 months), season-long (6-9 months) and long term (>9months).

Good practices for storage of maize cobs/ grains:

- Cobs or grains should be dry, clean, undamaged, free from infestation and matured.
- No rain water or seepage water should touch the stored maize.
- Clean storage area, store, bags or sack sand clean surroundings.
- Adopt the practice of 'First in first out' that is cobs or grains stored first should be removed first.
- On dry, sunny days provide adequate ventilation and on humid, wet days keep the storage closed.

When using sacks for storage, the grain sacks should be stacked on palates so that they will not touch the ground for seepage water to reach the grains:

- Adopt insect control practices.
- Adopt rodent control practices.
- Prevent and control mould growth in stored grains.

Source: National Plant Protection Centre Semtokha

Organic third-party certification by BAFRA

Organic certification is a process where in a certification body (CB) gives a written assurance (to the buyer and seller) that a clearly identified process has been methodically assessed to provide adequate confidence for the specified products with specific requirements. Bhutan Agriculture and Food Regulatory Authority (BAFRA) under the Ministry is the CB that provides organic third-party certification in the country. Currently, organic certification by BAFRA is based on the Bhutan Organic Certification System (BOCS) Guidelines.

The process involved for organic certification by BAFRA are as follows:

Application: The farmers group or cooperatives or individual farmer (> 2 acres of cropped area) will register with National Organic Program (NOP)/Department of Agricultural Marketing and Cooperatives (DAMC). Such registered farmer/farmers group/cooperatives will apply to BAFRA for assessment with recommendation from NOP. If the applicant complies with the basic requirements of the BOCS Guidelines such as registration, undergone training on organic agriculture by NOP and book keeping for cooperatives by DAMC, an inspection schedule will be developed by BAFRA.

Undertaking of compliance: The farmer/farmers group/cooperative will sign an '*undertaking of compliance*' to honour the principles of the BOCS Guidelines prior to inspection. The undertaking states that the farmer/farmers group/cooperatives will adhere to the organic agriculture principles mentioned in the organic standards. The original copy of the undertaking is handed over to BAFRA and a copy of the same will be forwarded to NOP for their records.

Assessment: Assessment will be done by the organic inspectors of BAFRA. Looking into the compliance of the farmer/farmers group/cooperatives by the inspectors, recommendations will be sent for endorsement to the Organic Certification Committee (OCC) of BAFRA. In case of non-compliance with the requirements, certification will be suspended until corrective actions are implemented within the timeframe sanctioned by the organic inspectors. The OCC is established within BAFRA comprising of relevant officials.

Certificate: The inspection report will be assessed by the OCC and a decision will be taken on the status of certification. If the farmer/farmers group/cooperatives comply with the requirements, organic certificate will be issued to the farmer or farmers group. The certificate is valid for one year from the date of issue. Renewal of certificate will be based on successful fulfillment of annual on-site inspection.

Logo: The certified farmers/farmers group/cooperatives will be allowed to use the 'Bhutan Organic' logo on their products or banners or farms or packaging/promotional materials.

Till date, BAFRA has certified '*Rangshin Sonam Detshen*', organic farmers group of Khatoed gewog, Gasa for vegetables such as potato, garlic and carrot.

Source: BAFRA

What is Clean Milk?

Clean milk is generally defined as 'milk drawn from the udder of healthy animals which is collected in clean dry milking pails and free from extraneous matters like dust, dirt, flies, hay, manure etc. It has normal composition, possesses a natural flavour with low bacterial count and is safe for human consumption.

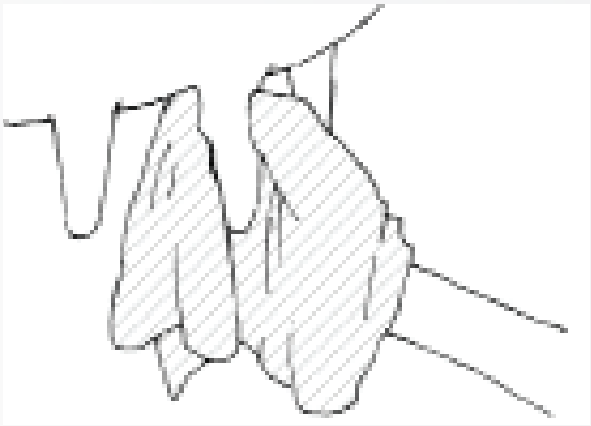
Milk is an ideal medium for bacterial growth such as spoilage and pathogenic bacteria and when contaminated lead to much faster spoilage of milk. It is therefore essential to ensure clean handling of milk to prevent rapid bacterial growth and milk spoilage.

Contamination can occur from:

- **Udder infection** of cows such as mastitis will raise the bacterial count of milk to more than 50,000cfu per ml of milk.

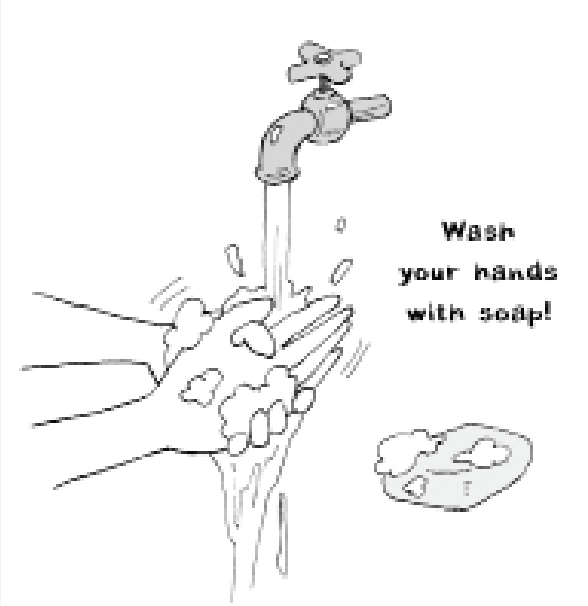
  Contaminated milk such as this will be unfit for human consumption and if mixed with milk from other healthy cows will also contaminate it thereby causing the whole lot to be declared unfit for human consumption.

- **Dirty udders and teats** contaminate milk due to the presence of bacteria on them. Even though the udder and teats may appear clean, bacteria will always be present and are not visible due to their microscopic nature.



It is therefore very important to wash and dry the udders and teats of all cows prior to milking. You can also reduce the risk of udder and teat contamination by providing good cow housing and grazing management.

- **Dirty hands and udder cloths** are a source of contamination. The udder cloths used must be clean and one cloth should be used only for one cow. Individual milking the cow must be clean and if possible should have a clean set of clothes used only during milking. They should wash their hands using soap and have short fingernails as long fingernails may hurt the cow.



- **Dirty milking equipment** is a source of contamination and should be kept very clean. All equipment used during the milking process such as the buckets, udder cloths, filters etc. should be washed using detergents in hot water, rinsed and sterilised.

The milking environment should be:

- Clean and free from dirt and odour.
- Cleaning and sweeping of all areas must be finished before you begin milking.
- Well ventilated with proper drainage.
- Well lighted.
- Free from cow dung and urine.

Animal health should be:

- Healthy and disease free.
- Vaccination should be done as per vaccination schedule and if the animal is suspected to be sick, refer to your nearest veterinary health worker.
- If the animal is treated with antibiotics, milk from this animal shouldn't be consumed till the recommended withdrawal period is over.

The milking personnel should be:

- Free from contagious diseases.
- Have good personal hygiene.
- Wear clean clothes.
- Wash hands before milking.
- Not have long finger nails.
- Not smoke or cough and sneeze during milking.
- If the milk handler is suffering from communicable disease, the person shouldn't milk the animal as the disease can get transferred to the milk.

Milking procedure

- Bushing away dirt and loose hair from the sides and back legs of the cow.
- Do not wet wash your cows' body as this could increase the risk of contamination.
- Wet, wash only the teats and lower udder of the cow and wipe dry.
- Massage the back, front part of the udder and the teats to help in the let down of milk.
- Start milking soon after the above-mentioned steps.
- Milk first from all four teats into a cup and check for any abnormalities such as lumps or odd colour. If the milk looks abnormal your cow could have mastitis and should be treated as soon as possible. Such milk is unfit for consumption.
- Close the canal between the teats and udder using two fingers and squeeze the milk out by closing the rest of the fingers firmly around the teat. Strip milking should be avoided as this could harm the insides of the teats that are easily infected and lead to mastitis.
- Continue milking until the udder is completely empty.
- Never dip your fingers in the milk, water or spit to moisten them as this can contaminate the milk.
- Filter the milk using a clean straining cloth and if it contains dirt, investigate the origin of the contaminant and keep it out of the milk in the future.
- Store milk in a bucket with a lid protected from sunlight and deliver to the collection centre as soon as possible.
- Handle the milk carefully as rough handling can cause rancid tastes.
- Isolate sick animals and milk them last (Their milk should not be mixed with good milk). Seek nearby medical and clinical medical advice.
- Follow proper milking techniques to avoid damage to teat. Dip teats in teat disinfectant to avoid infection of teats. Avoid feeding cows during milking.

Milking utensils: Use seamless utensils preferably aluminum or stainless steel. The utensils and equipment should not have any joints or open seam and should be free from dents, rust etc.

Cleaning

- Rinse excess milk with cold and clean water.
- Scrub with a brush using hot water mixed with a detergent.
- Rinse again with plenty of clean water.
- Finally sterilise using very hot water.
- Dry in clean tidy place preferably in sunlight upside down during the day ground to facilitate drainage of wash water.

Storage: Utensils should be stored at night in a safe and clean place which is well ventilated.

Filtering: Use a white filter cloth and filter immediately after milking. Disinfectant, wash and dry the filter cloth after use.

Storage and transport: Milk should be stored in clean containers with a lid and kept in a cool and shady place. Milk should be delivered to the collection point or market as soon as possible.

Source: National Dairy Development Centre Yusipang

Methods for measuring crop yields

Monitoring crop yield is not only basic but also a fundamental piece of information. Crop yields vary with seasons, inputs and location and therefore regular monitoring is important. Normally yield monitoring is done through crop cuts. Crop cut is a technique used to estimate crop yields from a unit area. The methodology for taking crop cuts varies with the type of crop. The primary objective of the crop cut is to measure the crop yield in that season.

Important points to consider while taking crop cuts

- Make sure that the crop is ready for harvest.
- Area for crop cut should be representative of the gewog.
- As a rule of thumb, 30% of the total gewog area should be covered.
- Stratify the gewog into high, mid and low altitudes.
- Select 50% of the villages representing the three altitude zones.
- From the selected villages take crop cuts from a minimum of 10% of the households.
- The crop cut area should be selected at random to avoid biases of selecting either poor or very good plant stands.
- Record the name of the variety of the crop cut taken.
- Moisture should be recorded with a moisture metre and adjusted to safe moisture content, wherever possible. Moisture metre may however not be available in all the extension centres. In absence of this, proper drying before weighing the sample is suggested. In any case, record whether the sample was weighed fresh after harvest or air/sun drying was done.

Materials Required

1. Measuring tape
2. Weighing balance
3. Rope
4. Wooden pegs
5. Basket, container, sacks, winnowers, tarpaulin
6. Data recording sheet/note book

Crop cut procedures

1. Maize: Normally maize crop will be ready for harvest when the grains are nearly dry and contain less than 20% moisture. Farmers are expert and can tell whether or not the crop is ready for harvest. Once the crop is ready for harvest, identify a representative plot. Fix a 2m tall wooden peg in the selected spot. Tie the nylon rope on the peg and make a sliding knot. The length of the rope from the centre of the peg to the other end should measure 1.5m. Walk in circular fashion holding the end of the string in the field.

Chop and pile all the plants that fall within the string length as you walk. The area of the plot harvested will be $7m^2$. Detach the cobs. Dehusk the cobs and record the fresh weight using a weighing balance. Ideally moisture should be recorded with a moisture meter but it may not always be available.

Field experiences under our conditions have shown that the grain moisture content usually ranges from 20 to 25%. As a rule of thumb, the moisture content may be taken in the range of 20-25%. Record the data and compute the grain yield (t/ha) using the formula as shown below.

Sample area (m^2) $= 3.14 \times (1.5m)^2 = 7m^2$

Field weight of dehusked cobs from $7m^2$ = kg

Actual field moisture content ($MC_{(a)}$) = %

Adjusted moisture content ($MC_{(ad)}$) $= \frac{(100 - MC_{(a)})}{85}$

Grain yield (t/ha) at 15% MC $= \frac{\text{Mean yield/plot (kg)} \times 10{,}000m^2 \times MC_{(ad)} \times 0.8}{7m^2 \times 1000}$

Note: Average shelling recovery of maize is 80%. Moisture content is adjusted at 15%, hence divided by 85.

2. Rice: Normally rice is ready for harvest when more than 85% of grains in panicle turn golden yellow. With the help of wooden pegs and measuring tape, measure an area of $6m^2$ (3.0m x 2.0m). As a rule of thumb, the moisture content of freshly harvested rice varies from 20-24% which needs to be brought down to a standard of 14% after drying. The grains usually crack when you bite at this moisture level.
Sample area = 3m x 2.0 = $6m^2$.

Harvest the crop that falls in the demarcated area. Thresh it. Clean the grains by removing husks, chaff, damaged and unfilled grains. Record the weight of the grain with a weighing balance. Record the moisture content using a moisture metre, if available; otherwise indicate whether fresh or dried sample was weighed. Use this data to compute the yield in t/ha using the formula below:

Brown rice grain yield (t/ha) at 14% MC $= \frac{\text{Yield/plot} \times 10000m^2 \times MC_{(ad)}}{\text{Plot size } (6m^2) \times 1000}$

Adjusted moisture content ($Mc_{(ad)}$) $= \frac{(100 - MC_{(a)})}{86}$

Important Terms (Adapted from Poehlman and Borthakur, 1969)

- Rough rice: The unhusked rice grain is known as the rough rice or paddy.
- Brown rice: The rough rice is converted to brown rice by removing the hulls (called dehulling or dehusking).
- Milled Rice: The brown rice is converted to milled rice by removing the outer bran layers (called milling or polishing).
- Head rice: Refers to the whole grains and the large broken pieces of (three-quarters sizes or larger) of rice.
- Total Rice: Refers to all the rice recovered after the milling process, both whole and broken kernels.
- In general, rice hulls form 20-22% of the rough rice, and rice bran+embryos form 8-10%. Head rice recovery can vary from as low as 25% to as high as 65%.

3. Potato: In Bhutan, it has been observed that farmers follow three distinct ways of potato cultivation such as ridge planting, flat bed planting and mound/heap planting. The first two planting methods are the most common while the last one is practised in a few places. Depending upon the type of cultivation the following procedures are suggested for taking crop cuts.

- **Ridge Planting**

  Take four rows each with five metre length for one crop cut.

  Area per crop cut = 4 rows x average distance between rows x length of row (5m). Use pegs and string to demarcate the plot. Record the crop cut area. Harvest the area and record the fresh tuber yield in kg.

$$\text{Yield (t/ha)} = \frac{\text{Yield/plot (kg)} \times 10{,}000\text{m}^2}{\text{Crop cut area (m}^2\text{)} \times 1000}$$

- **Flat Bed Planting**

  Measure an area of 4m x 4m = 16sqm.
  Use pegs and string to demarcate the area.
  Harvest and record the fresh tuber yield in kg.

$$\text{Yield (t/ha)} = \frac{\text{Yield/plot (kg)} \times 10{,}000\text{m}^2}{\text{Crop cut area (m}^2\text{)} \times 1000}$$

- **Mound/heap planting**

  Harvest 20 heaps.
  To calculate the crop cut area measure the average distance between heaps in m and compute as: No. of heaps harvested x average distance between heaps (m).
  Record the fresh tuber yield in kg.

$$\text{Yield (t/ha)} = \frac{\text{Yield/plot (kg) X } 10{,}000\text{m}^2}{\text{Crop cut area (m}^2\text{)} \times 1000}$$

Desired Moisture content for storage: Maize 15%, rice 14%, wheat 12%, mustard 8%, soybean 12%, groundnut 7% and millet 16%.

Other Crops (Wheat, Barley, Millet, Mustard, Buckwheat and Grain Legumes)

The crop cut procedure is not very different from that for rice. The minimum area for crop cut should be $5m^2$ but for convenience $6m^2$ is suggested. When the crop is ready for harvest identify a representative area for crop cut with the help of wooden pegs and measuring tape measure an area of $6m^2$ (3m x 2m). Harvest the crop that falls in the demarcated area. Thresh it. The method of threshing varies from crop to crop. Clean the grains to a standard level. Remove husks, damaged and unfilled grains. Record the weight of the grain with a weighing balance. Since it will be difficult record and adjust the moisture content, proper drying is very important.

$$\text{Grain yield (t/ha)} = \frac{\text{Yield/plot (kg) X } 10{,}000\text{m}^2}{6\text{m}^2 \times 1000}$$

Source: ARDC-Bajo

NISM on plant genetic resources for food and agriculture

Plant genetic resources for food and agriculture (PGRFA) are crucial in feeding the world's increasing population. They are the raw materials that farmers and plant breeders use to improve the quality and productivity of crops. The sustainable use of plant genetic resources is vital for national agricultural development because they are required to increase in agricultural productivity and sustainability; thereby contributing to enhanced global food security and reducing poverty.

At the fourth international technical conference on Plant Genetic Resources (Liepzig, June 1996), 150 countries adopted the Global Plan of Action (GPA) on PGRFA. They agreed that its implementation would be monitored and guided by the national governments and other members of FAO and recommended the establishment of a transparent and effective monitoring system.

The National Information Sharing Mechanism (NISM) on implementation of GPA-PGRFA is one such tool for transparent and effective monitoring of the implementation of GPA. Its objective is also to improve countries' capacity in exchanging and analysing PGRFA information for future planning.

The National Biodiversity Centre is the national focal point for the NISM in Bhutan and is coordinating the participation of other national stakeholders in the country. All the information compiled under the NISM on GPA implementation can be accessed at http://www.fao.org/pgrfa-gpa-archive/btn/advancedsearch.jspx. Other countries' mechanism can be accessed in several languages from the World Information Sharing Mechanism (www.pgrfa.org).

What instruments does the mechanism use?

A set of tools agreed by the FAO commission on genetic resources for food and agriculture:

- A list of internationally agreed indicators related to the 20 GPA priority activity areas and a reporting format to monitor the implementation of the Global Plan of Action and an information system including a database and a search engine (NISM-GPA database).

How does it operate?

Through the voluntary contribution of data and information by national institutions, private institutions, non-governmental organisations, coordinated by the GPA national focal point and under the supervision of national committee.

Who can participate into the mechanism and how?

All stakeholders including government, non-governmental and private institutions, organisations, enterprises who contribute to the conservation and sustainable utilisation of plant genetic resources for food and agriculture in the country can be part of the mechanism by contacting the national focal point.

Source: National Biodiversity Centre Serbithang