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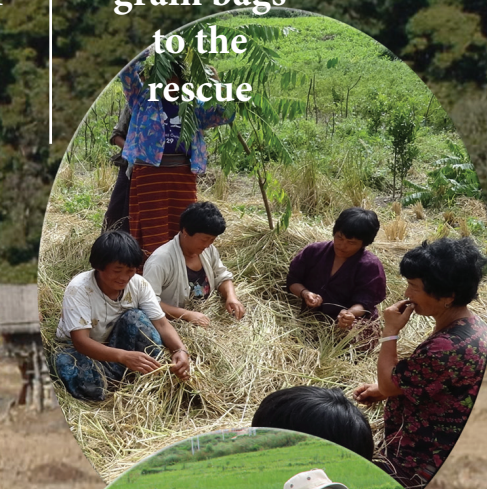
February 2016

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grain bags
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Losar Trashi Delek!



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Story from Dzedokha village: “Access to Genetic Resources and Benefit Sharing in Bhutan”



Linking communities to the Global Market for Traditional Knowledge Conservation

Phib Raini Limbu is all smiles and has every reason to be. She lives in a small village of Dzedokha devoted to growing a little cardamom and ginger as cash crops with maize, paddy and millet offering subsistence supplemented by a few livestock, mainly cattle and goats. Dzedokha (pop 2,672), has only one access farm road, mostly impassable during the monsoon season but Phib is all smiles. Why? It is because the world is now beating a path to Dzedokha's door and with it a world of opportunities has arrived.



Among its assets the Dzedokha area boasts a wealth of natural resources most noteworthy being plant. Using the Traditional Knowledge (TK), plants are made into powders, decoctions, syrups and pastes to treat a variety of ailments in the village, such as jaundice, food poisoning, bone fracture and dislocation, typhoid, diabetes, snakebites, cuts, etc. Of the many plant species used for treatment, Zingiber cassumunar is particularly favoured locally for alleviating joint pain.



Recognising the presence of such an important TK in the locality, Bhutan's National Biodiversity Centre (NBC) has identified Lokchina administrative district which includes the village as one of the pilot sites under the project on “Implementing the Nagoya Protocol on Access to Genetic Resources and Benefit sharing in Bhutan”,

supported by Japan's Nagoya Protocol Implementation Fund (NPIF), Global Environment Facility (GEF) and United Nations Development Programme (UNDP).

The project aims to ensure that TK holder like Phib and her fellow villagers can benefit from use of their TK related to use of the genetic resources which the plants have, when they are used for commercial product development. The project also supports establishment of a National Access and Benefit Sharing (ABS) framework, to facilitate the discovery of nature-based products and demonstrate best practices of ABS processes by engaging communities and seeking their prior informed consent. For locals to benefit and have a voice, local involvement is, of course, essential- which brings us back to Phib and her smiles.

Phib has just been elected the Secretary of the village farmer's group comprising 21 women and 17 men. The farmers' group was registered formally through a bylaw on 30th April 2015. As the Secretary, Phib has to play an important role in group management and decision making and in the process of equitable collaboration with multinational pharmaceutical interests and other partners.



Farmers were trained on Zingiber cassumunar cultivation techniques and given hands on training in field preparation, irrigation, manure application, weeding, harvesting and post-harvest techniques. “I was extremely impressed by farmers' enthusiasm in the entire training process,” says Leki Wangchuk, Biodiversity Supervisor of NBC.

NBC will partner with the Swiss based Quantum Pharmaceuticals Limited for collaborative research aimed at confirming TK claims of relieving joint pains using extracts from the plant. The research will involve bio-activity tests and evaluations of

the safety, quality and efficacy of the target bio-product with a view to trial product development and ultimately international distribution.

Based on the results of the collaborative research, the initiative will lead to a community-private-government tri-partite ABS agreement involving the local communities from where the TK and genetic resources are sourced, the international collaborator and NBC. The ABS agreements will articulate the objectives of the collaboration, roles, rights and responsibilities of all the parties, mutually agreed terms for access to genetic resources and benefit sharing between providers and users of the genetic resources and associated traditional knowledge.



Through such initiative, farmers like Phib will have better opportunities to prosper from their traditional knowledge of biological resources and the capacity enhancement through the project will prepare them for better negotiation of associated benefits from government and private companies. Through such intervention, they will also participate proactively in conservation and sustainable use of Bhutan's rich biological and genetic resources. Remote? Yes. Small? Yes? But this initiative places Dzedokha very definitely on the map. And that is something for us all to smile about.



Source: NBC



Foreword



**MESSAGE FROM THE HON'BLE MINISTER
MINISTRY OF AGRICULTURE AND FORESTS**



Losar Trashi Delek and Best Wishes for 2016!

I am delighted to introduce the 6th edition of *Sanam Drupdrey*, 2016. This edition features a wide range of success stories in the areas of food and nutrition security and natural resource management contributed by field colleagues from across the country. I visited 112 geogs and am very happy to note that the RNR sector continues to make substantive improvements in the lives and livelihoods of communities living near and far away from the service centres.

The farmers are growing a diversified food basket using both improved as well as traditional crop varieties; almost every household has accessed improved livestock and families in general have access to extension services. The discussions within the community meetings are mostly dominated by concerns on water security, human-wildlife conflict and erratic weather patterns. It was a pleasure to see the consumption of a good mix of all the food groups among many rural communities compared to the last decade.

2015 was a great year for the RNR family members. In addition to these successful stories, the institutes and agencies under the Ministry launched a number of eco-friendly projects and

activities to celebrate the 60th Birth Anniversary of our beloved 4th Druk Gyalpo. Some of these projects are likely to help combat climate change impacts in the near future such as Golden Floriculture, Green Thimphu projects and Multi-Purpose Bike Trail around Thimphu valley. A brief write up on each theme was compiled in a magazine-'Celebrating the Glorious Reign of the Fourth Druk Gyalpo' and if you do not have a copy, it is worth getting one as a reference. On this note, I want to thank everyone who had contributed to our RNR events to celebrate 60th Birth Anniversary.

The agriculture sector contributes close to 16.8% of the GDP according to 2015 National Statistic Bureau statistics. We also witnessed frequent occurrences of erratic weather patterns in a number of localised areas in 2015. These events are likely to increase in the near future. One of the adaptation mechanisms we have introduced is the promotion of smart agriculture practices. Likewise, one of the articles in this edition examines the possibilities of using wild citrus genes from the local area to fight citrus greening, a disease responsible for citrus decline in the country. Another article looks at improving efficiency of irrigation through local innovations when the local water sources are drying up. In light of the changing climate, these

localised solutions are likely to yield better adaptive results. I urge our colleagues to explore, and tap into the potentials of our rich biodiversity and traditional knowledge, innovate and take up local solutions to build community resilience in combating climate change.

The programs and projects under the Ministry continue to add to the knowledge base through surveys and studies in the areas of the socio-economic fields. One important area is the study of farm economics where the cost of inputs and outputs for a specific commodity is studied. Experiences and lessons learnt from such studies are essential and would contribute to interest and attract our younger generation to take up farming. I challenge my RNR colleagues to come up such articles in our next edition.

Enjoy reading, and promote and share the success stories presented in this edition. Good luck.

Yeshey Dorji
Minister

Acknowledgement



MESSAGE FROM THE HON'BLE SECRETARY
MINISTRY OF AGRICULTURE AND FORESTS



Dear Readers,

Another successful year has passed and I am delighted to present the sixth edition of *Sanam Drupdrey*.

This year's achievements and successes including several new initiatives and innovations owes to the determination and hard work invested by everyone in the RNR sector from the Geog extension offices, Dzongkhags, Research and Development Centres, and various Departments and Agencies.

Such an accomplishment would not have materialised if it was not for the resolute and generous support of our development partners. I would like to acknowledge the continuous support granted by the Government of India, the Japan International Cooperation Agency, the European Union, International Fund for Agricultural Development, Global Environment Facility, World Bank, Helvetas, World Wildlife Fund, Business and Technology Education Council, Food and Agriculture Organisation, World Food Programme and CSE, among others.

Research and development, mechanisation and commercialisation of the agriculture sector in the country are well on track. The Food Corporation of Bhutan and the Department of Agricultural

Marketing and Cooperatives are working hand in hand to open more markets and thus ensure that our farmers' work are rewarded justly and thereby better living standards ensured for our farmers.

Farming by the educated lot has been encouraged as we try to reverse the rural-urban migration and have more efficient farmers who use scientific methods to enhance the production and productivity of our agricultural produces. As we grow more self-sustainable we are gradually advancing towards the attainment of the national goal of food self-sufficiency and the Ministry is also facilitating all possible supports to this end. I would therefore like to acknowledge our farmers, both existing and newcomers for their efforts.

I would like to commend Information and Communication Services for the laudable job with this issue.

I would like to call for your continued support for the RNR Sector and wish you all the very best.

Trashhi Delek !

**Tenzin Dhendup
Secretary**

**“
Research and
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commercialisation
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country are well on
track.
”**

Editorial

Singye Wangmo
Program Director
ICS

“

This year's edition of the Sanam Drupdrey highlights the success stories told through our field staff, extension agents and researchers. They capture the real picture of the numerous activities initiated by the sector in the 11th Five Year Plan.

”

From cultivating rice in water-scarce Taraythang to growing Kiwis in Lhuentse to watermelons in Mongar, 2015 has been a busy year for the RNR sector.

Guided by the key strategy of transforming agriculture into a commercially viable sector to ensure better returns to farmers, improve livelihood, reduce import and youth towards farming, the sector saw numerous activities geared towards achieving the vision of food security. An equally important and long-term aim of the sector has been to protect and expand arable agriculture land acreage in the country.

This year's edition of *Sanam Drupdrey* highlights the success stories as seen through the eyes of our field staff, extension agents and researchers. They capture the real picture of the numerous activities initiated by the sector in the 11th Five Year Plan.

This issue highlights the successes of the sector in the field of rice, no pun intended, whether it is the introduction of new varieties or the intensifying of production through simple technologies. The System of Rice Intensification in Samdrup Jongkhar, introduction of upland rice in Bumthang and restoration of irrigation channel in Pemaling are some of the activities that will change the lives of the farmers.

A by-product of the change in the macro-economics, pressure on the agriculture sector has increased with the mandate of reducing import while enhancing export. The introduction and

enhancement of new cash crops like Kiwis and watermelons or cultivating spring maize for animal feed industries will not only provide a new source of cash income to farmers, but will also help fulfil the objective of import reduction.

Sanam Drupdrey captures the stories of farmers who are already into growing new crops. Besides cash crops, high yielding variety or new varieties of crops introduced in previously water scarce regions and climatically not suitable places will help farmers and the sector to come closer to achieving the vision of food self-sufficiency.

This edition also captures the new strategies our researchers are adopting to maximise yield from the same plot of land by introducing and encouraging crop maximisation through the use of simple technology and farm mechanisation.

These are more than success stories in *Sanam Drupdrey*. The stories come with suggestions, recommendations and advice to farmers and those interested in being farmers. It also highlights challenges and solutions.

However, we are optimistic that we will move one more step closer to achieving our objectives and the noble vision. We also hope that in doing so we will fulfil the aspirations of our farmers through on-going and future research and collaborations.

Trashy Delek and happy reading!



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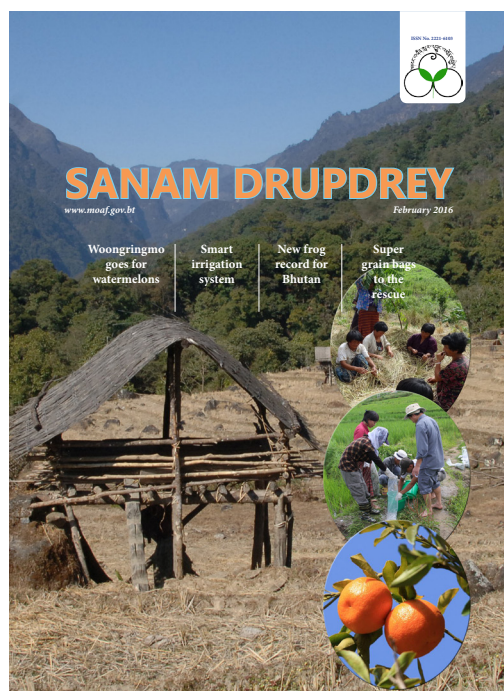
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“New Generation” herbicides found effective against rice weed

Sulfonylurea herbicides were tested against the broadleaf weed, Potamogeton distinctus growing among transplanted rice in Bhutan

Kezang Tobgye, Kiran Mahat, Lhendup Dorji and Phuntsho Loday, NPPC

Potamogeton distinctus, an aquatic broadleaf weed, locally known as Shochum is the most serious type of weed assailing transplanted rice fields in Bhutan. It is found in mid-altitude rice growing areas.

Controlling P. distinctus weed is labourious and costly; farmers hand-weed it at least two to three times per season. Herbicides to control this weed were tested in the past but they were found to be uneconomical and not readily available.

M e a n w h i l e , the DuPont, an American company has developed a range of herbicides falling under the class Sulfonylurea such as Orthosulfamuron 50% WG, Metsulfuron Methyl 10% plus Chlorimuron Ehtyl 10% WP and Ethoxysulfuron 15% WDG.

These herbicides were procured from India to conduct field evaluation for the control of weeds in transplanted rice field. These new generation herbicides

have a low application rate and mammalian toxicity. They are supposed to be effective on broadleaf weeds and a wide range of grasses. Sulfonylurea herbicides were particularly chosen to be tested against P.distinctus in transplanted rice field.

Field evaluations were conducted from June to November 2014 to study the efficacy of Sulfonylurea





herbicides for controlling *P. distinctus* on transplanted rice at three locations: Kabesa, Genekha and Tendrelthang in Thimphu. The fields were treated with the herbicides for three to five days after transplanting (DAT). The herbicide dosage applied in an acre were 70g in 200 litres of water for Orthosulfamuron 50% WG, 8g in 120 litres of water for Metsulfuron Methyl 10% + Chlorimuron Ethyl 10% WP and 40g in 200 litres of water for Ethoxysulfuron 15% WDG.

Weed samples were collected from the trial field using 1m x 1m quadrant at 25 and 40 DAT. Collected weed samples were rinsed and dried in an oven at 70 degree Celsius for about 24 hours. Data was collected for dry weight of weeds and rice yield at harvest and data analysis was carried out using SPSS software. Weed control efficiency (WCE) was determined for all the treatments using the formula: $WCE = \frac{\text{Dry weight of weeds in control fields} - \text{Dry weight of weeds in treated fields}}{\text{Dry weight of weeds in control fields}} \times 100$.

- Dry weight of weeds in treated fields/Dry weight of weeds in control x 100.

These test results concluded that all three herbicides were equally effective in controlling *P. distinctus*. The highest percentage of WCE was showed by the herbicide Ethoxysulfuron 15% WDG with an average of 93.15% WCE, followed by Orthosulfamuron 50 % WG with an average of 87.31% WCE and 74.79% of WCE on an average for Metsulfuron Methyl 10% + Chlorimuron Ethyl 10% WP. However, there was no significant difference among the herbicides tested. Therefore, these herbicides hold promise and potential as effective control agents of *P. distinctus* in transplanted rice field.

Table for weed dry matter, weed control efficiency and grain yield difference obtained with different herbicides across three locations

Location	Treatment	Mean weed dry matter \pm s.e (g/m ²)	Weed control efficiency (%)	Grain yield (t/ha)
1	Orthosulfamuron 50 % WG	5.06 \pm 1.35a	94.87	4.56a
	Ethoxysulfuron 15% WDG	6.87 \pm 1.40a	93.04	3.91a
	Control	86.23 \pm 17.59b	00.00	2.66b
2	Metsulfuron Methyl 10% + Chlorimuron Ethyl 10% WP	4.97 \pm 1.43a	75.63	4.26a
	Orthosulfamuron 50 % WG	4.47 \pm 0.96a	78.08	3.15a
	Control	20.41 \pm 4.83b	00.00	1.66b
3	Metsulfuron Methyl 10% + Chlorimuron Ethyl 10% WP	31.26 \pm 9.91a	73.95	4.38a
	Orthosulfamuron 50 % WG	20.50 \pm 5.36a	88.99	4.88a
	Ethoxysulfuron 15% WDG	11.47 \pm 3.78a	93.17	4.97a
	Control	113.71 \pm 23.20b	00.00	2.99b



Dorji Wangchuk, RDC Wengkhari and Namgay Wangdi, RDSC Khangma

Flattened, pounded, milled or cooked as it is, maize is one food crop that is grown and consumed all over the country. While it is the staple diet of the people of Eastern Bhutan, the importance of the grain plant is largely not understood.

It is an important crop in Bhutan and its role in achieving food security paramount. However, the

use of maize for food needs to be diversified and made acceptable as rice or other food crops to suit to the changing economy and food habits.

In fact, maize has been termed as *nutricereal* due to presence of carbohydrates, fats, minerals and vitamins. The presence of a mixture of carotenoids (β -carotene, cryptoxanthins and β -zeacarotene having Pro Vit A activity) provides maize a specific place among cereals.



The high protein quality of maize in quality protein maize (QPM) varieties is another attraction catching the eyes of scientists, planners, policy makers and extension workers to tackle the problem of protein malnutrition prevalent in the world.

In its baby corn stage, it is highly suitable for infants, old, and patients under stress condition. Hence, there is an urgent need to exploit the potential of maize for the promotion of the health of people, especially the vulnerable segment of the society.

This will be possible only when maize is utilised in a more diversified ways by converting them into a variety of products by grinding, alkali processing, boiling, cooking, fermentation and processing it into infant food, health foods/beverages.

The outcome of maize processing and value addition will enhance economic security which will ensure food and nutritional security of the nation.

Thus, in order to upscale diversification of maize products and value addition, the maize programme in collaboration with the National Post Harvest Centre initiated the technical capacity building of field staff through fielding a maize product development specialist from India.

National counterparts were also trained. Hands-on training for field staff was organised in which several products were developed and a study on post harvest processing, products and machines currently available was conducted.

More than nine different products were developed including value addition to existing products through the hands-on training which was later replicated with farmers of Udari, Kengkhar.

Kaa Drukchu- the new winter wheat variety

The new variety yields 30 percent more grain than the local variety

Sangay Tshewang, RDSC Tsirang; Lobzang Chopel and Rabgyel Drukpa, RDC Jakar

If wheat is the staple food for the Bumthaps, they are in for a grand treat.

Kaa Drukchu is the first ever improved variety released for winter/facultative ecosystem in the country. The wheat program in collaboration with National Seed Centre is in the process of mass seed production so that the varietal diffusion of this new cultivar is fastened for higher grain yields.

With the spring wheat receiving maximum research and development focus, winter wheat has largely been ignored. However, the Research Development Centre (RDC) Jakar has been conducting the Winter Wheat Varietal Improvement Program

in collaboration with RDC Bajo (Wheat Coordinating Centre) and International Maize and Wheat Improvement Centre (CIMMYT) with the aim to identify potential improved varieties in order to broaden the genetic base in the winter wheat ecosystem and to provide variety choice to the high altitude farmers.

Two lines from Nepal (NL 1064 and WK 1204) and one (Gumasokha Ka) originally from Mexico but released by RDC Bajo were evaluated at two sites (Tang and Chumey) under farmers' management conditions.

Of the three cultivars, majority of the farmers in both sites preferred NL 1064 given its big and compact spike, bold grains, medium plant

height and optimum maturity. Kaa Drukchu also had higher yielding potential with a yield of 950 kgs/acre. This was 30 percent more grain than the local cultivar, 730 kgs/acre.

Further, the local variety had small spike and prone to lodging due to tall stature. Most importantly, varietal deterioration in local cultivar was observed as manifested through admixture and non-uniform plant stand in the field.

Considering the yield attributes and farmers' preference, the 18th Technology Release Committee had approved the release of NL 1064 as Bumthang Kaa Drukchu.



SRI should set the trend in Rice cultivation

The method is increasing yield from the same area of land

Sonam Dorji, Langchenphu Extension Centre, Samdrup Jongkhar

Fifty-five year-old Sangay Wangdi was a worried farmer when he deviated from traditional practice of cultivating rice in 2014. The farmer, like most Bhutanese rice growers was used to the old practice.

Identified and convinced as a trial farmer, Sangay Wangdi followed the 'System of Rice Intensification' (SRI) method. SRI is a system to boost rice production and required farmers to use a singly spaced young paddy seedling when transplanting.

"The field looked odd after the transplantation and we weren't sure if we did the right thing," Sangay Wangdi once told Kuensel, the national newspaper. By September 2014, his field looked different, standing out from the others. He was a happy farmer without regrets.

SRI is highly sensitive crop production process and method of good returns. It is a simple existing method, but largely unknown to rice growers. In SRI, a single tender seedling is planted right after 7-10 days from

the greenhouse either form tray or ground nursery with a stand of two to three leaves. Immature seedlings (10-15cm) are planted in well-pulverised semi-water field in line plantation by manually or using transplanters to ease management.

It is being tried to maximize yield from small unit area with low cost of production. This is more relevant to Bhutan. The population is increasing while the cultivable land area remains same or decrease through land fragmentation or development activities.

As SRI method require lesser water, it is also appropriate as the scarcity of irrigation water is becoming a common problem.

In collaboration with the Samdrup Jongkhar Initiative (SJI), SRI was tried in Langchenphu geog. Initially only five farmers were selected as lead role farmers. The geog later trained around 50 farmers.

SRI trial was conducted on Khamtey, a favoured local rice

variety. The SRI yield was impressive with around 0.6MT higher yield than non-SRI. SRI trial produce yielded 1.9 Mt/acre, whereas non-SRI yielded 1.3 MT/acre.

Farmers were recommended to go for SRI keeping in mind the small land holding and the higher yield from the new method of cultivating rice.

Farmers were impressed with the SRI production right after the field day and crop cut result analysis. Aware of the difference, more farmers are interested in the new method of rice cultivation.

The simple method of improved rice cultivation, given its effectiveness could provide an answer to the food security issue in the country.





ELECTRIC FENCE: A MITIGATION BOON FOR HUMAN-WILDLIFE CONFLICT

Electric fencing systems are currently helping the Bhutanese farming community ward off wildlife than any other measures

While human-wildlife conflict (HWC) is becoming increasingly rampant in Bhutan causing huge losses of crop and livestock to farmers, the introduction of locally fabricated electric fencing has proved a boon in dealing with this issue.

Over the years, wild animals have ravaged about 7,542 metric tonnes of cereal crops, preyed on 493 livestock and killed 23 people making HWC an issue for policy makers, conservationists and the farming communities alike.

Recognising the gravity of the situation, many mitigation measures and strategies were developed in the past by the Ministry of Agriculture and Forests but the electric fencing has surpassed all of them in terms of effectiveness.

With its initial success and overwhelming feedback from the farmers, the National Plant Protection Centre (NPPC) in collaboration with the Regional Development Centres (RDCs) have up-scaled the electric fencing and made it easily accessible to

more farmers.

Tshering Penjor who initially developed the electric fence system (EFS) using a self-built energiser is credited for making electric fencing available in the country today.

However, Bhutan Power Corporation (BPC) did not permit the use of the EFS using a self-built energiser in the country because his products were not certified and the safety aspects came into question. This led the NPPC to import certified energisers from China and demonstrate the fence system and safety aspects to the BPC, Bhutan Electricity Authority and Bhutan Standard Bureau in April 2013.

After a series of demonstrations and discussions, the three agencies finally approved the use of EFS to ward off wild animals. Since then, the NPPC in collaboration with RDCs promoted and popularised the EFS in the country. An audio-visual was developed and aired on the national news channel, technical manuals and guidelines were produced and trainings were conducted to popularise its use. After the use of EFS in agriculture

was legalised, the first of its kind was used in Trashigang Dzongkhag and subsequently taken to other eastern Dzongkhags.

The authorities ensured that at least one electric fence was established in each eastern Dzongkhag so that each served as a demonstration site to the communities for creating awareness and popularising it.

In the western region, Haa was the



first Dzongkhag to receive EFS. Since the demo-electric fence in Haa was used, it has given rise to demand from other neighbouring Dzongkhags as well.

Given the threats posed by HWC both on conservation and livelihood of the rural population, the Ministry's 11th five year plan recognises HWC as one of the most important issues to be addressed for the well-being of both wildlife and farming communities.

Since the legalisation of EFS in the country, many agencies and Dzongkhags have individually established the EFS. However, the Department of Agriculture (DoA) and Department of Forests and Park Services (DoFPS) have been the main agencies establishing the EFS in the country. Since April 2013 to September 2015, EFS covered 572.9 kms benefitting 3,224 households. The total area

covered is 6,369.61 acres. Mongar has the highest length of EFS established with 95.42 kms while Gasa has the lowest with 3 kms. In terms of issues, DoA addresses it from the crop protection standpoint while DoFPS addresses from the wildlife conservation standpoint. The former bases the EFS on a cost sharing basis where beneficiaries contribute labour and fencing poles, the latter establishes EFS totally free of cost. The latter also uses imported

fence materials and accessories which are costlier than the locally fabricated ones. However, the EFS established by DoFPS so far have been all project-tied and donor-dependent thus determining the use of fence materials and accessories.

At the field, once the electric fence has been established the fence is handed over to the beneficiaries who formulate a by-law for monitoring and maintenance of



EFS. The fence requires regular monitoring and maintenance because wires are sometimes tampered by wild animals or weeds grow along the fence lines and leak the current, rendering the fence ineffective.

Sometimes beneficiaries see the regular monitoring and maintenance of EFS as cumbersome due to which they tend to neglect and leave the fence unattended. In such cases, the electric fence remains defunct and ineffective to prevent wildlife entry into the agriculture fields. To address such issues, better cooperation among the beneficiaries is required and an effective system needs to be developed to ensure that the fences are utilised optimally.

Working principle of an electric fencing system:

An electric fencing system works on the principle of flow of current in the wire. However, unlike the conventional flow of electricity in the wire which is very dangerous, the current flow in the EFS is in the form of a pulse. The energiser which is the main component of the EFS converts the current flow into a pulse and makes the system very safe and non-lethal for both animals and human beings. The fence just provides a shock and drives the animal away. The experience of shock by the animals creates a psychological barrier that prevents animals from developing resistance unlike the sound and light repellent. In areas where electricity is not available, solar panels are used to drive the fence which gives

the same strength as ordinary electricity.

Components of an electric fencing system:

Other than the imported energiser, an electric fencing system consists of locally fabricated or locally available materials. Insulators are created out of high-density polyethylene pipes, wires strands are made out of galvanised wires, earthing plates and nails are available locally so are wooden poles and other accessories.

Human-wildlife conflict is recognised as one of the challenges to successful conservation and

uplifting farming communities from food insecurity. Of all the mitigation measures developed to address the issue, locally fabricated electric fencing holds a greater promise for our farming community and wildlife. Up-scaling locally fabricated EFS and reaching more rural communities would provide a better solution to seemingly intractable HWC in the country. However, there is still a need for a better coordination at the national level for effective management of information and resources in the country. At the ground level, cooperation among beneficiaries is required to maintain the efficacy and function of the electric fencing system.

Status of EFS as of November 2015

Dzongkhag	Fence length (km)	Beneficiaries (No)	Dryland (ac)	Wetland (ac)	Total area covered (ac)
Bumthang	47.75	84	146.10	0.0	146.10
Chukha	5.87	53	340	206.2	546.2
Dagana	62.5	235	103	205.8	308.8
Gasa	18	6	12.61	0	12.61
Haa	23	228	322.6		322.6
Lhuentse	15.88	152	178.45	53.34	231.79
Mongar	32.48	208	120.12	5	125.12
Paro	8	60	64	70	134
Pemagatshel	39.55	307			575.00
Punakha	18.5	52	37.92	183.75	221.67
Samdrup Jongkhar	28.4	311	216	270	486
Samtse	19.5	221	160	32	192
Sarpang	112.36	279			593.0
Trashigang	40.75	470	902.1	214.92	1170.32
Trashiyangtse	70.3	625	1262.2	108.1	1801.7
Thimphu	39.49	207	231.71	0.00	231.71
Trongsa	8.9	40	61.16	60.2	121.36
Tsirang	13	7			20
Wangdue	19.15	71	24.17	132.85	157.01
Zhemgang	27	128	164.2	137.0	301.2
Bhutan	650.38	3,744.00	4346.34	1679.2	7698.19

Zambhala-

Leading the way of commercial farming in the East

Kinga Dechen, Dzongkhag Livestock Sector, Trashigang

When Kinzang Namgyal, a renowned Trashigang businessman quit his business and started buying cows, his friends thought he was out of his mind.

Kinzang Namgyal knew what he was doing. He was still in the business, but this time it was a bit different. Realising that there is a growing demand of dairy products, he switched to rearing cows. He is a happy man with his cash cows.

His Zambhala Dairy Centre, the first in the Dzongkhag produces around 100-200 litres of milk every morning. The milk is sent to the 4,000-litre capacity Chenary Dairy Plant. The one that is milked in the evening is churned into dairy products.

Dealing with 60 cows is a massive task, but Kinzang Namgyal loves what he is doing. Visitors to Lungtenzampa, on the banks

of Gamrichu where the farm is located, will never miss the farm. If it is not the sound of cows, it is the sound of the electric chaff cutter and other processing equipment that adds to the rushing sound of the river below. And Kinzang Namgyal is always seen with the cows.

There are 30 Holstein Fresian cows imported from India and another 30 crossbred jerseys. Kinzang Namgyal is not content with that. He wants to expand his business. His plan is to supply heifers and bulls to the farmers, mechanise the farm besides looking for product diversification.

Zambhala was made possible with the support of the Dzongkhag Livestock Sector and has become an example for farmers not only from Trashigang. The farm is viewed as a model for commercial dairying in the east and many farmers' groups from all over the country have visited it.



Foresters' Familia

Ugyen Tshering, ICS

Winter is already here and more than anyone else, the season is dreaded by the foresters. This is because winter to all the foresters around the country means only one thing that they should remain ever alert of forest fire. Be it early in the morning or late into the night, the handset or their mobile phones could buzz any moment. Then there is no excuses to be made rather have to rush to the forest from where emits the plumes of smokes. There is forest and other natural resources to protect from the forest fire.

Winter for any other people is time to stay within the confinement of warm and cozy room, be it at home or in office. Outside, it is terribly cold, hence many try to stay within the reach of heating appliances to keep themselves warm. Venturing into the forest at odd hours to battle the fire is far from being even in anyone's wish-list.

But for the foresters, this is the time when they have to keep their antennae all time raised, all senses alive, ever alert for any report of forest fire outbreak. A small plume of smokes from far end of the ridge would send chill up the spine, for fear of it being the potential start of

ferociously raging forest fire.

Forest of all categories, be it the vast extent of broadleaved in lower altitudes to the conifer forest up in the north, all becomes critically vulnerable and susceptible to fire. This is mainly because; in winter the forest floor is filled with blankets of thick dry biomass. Bullied by the plummeted temperatures, the trees and plants shed leaves, the twigs and small branches are rendered dry, while the annual and biennial shrubs and herbs becomes highly inflammable.

Hence, it just takes a small flicker of fire to ignite into a full-fledged forest fire. It is either the small kid playing with the matches and other sources of fire, a farmer or orchard caretaker burning agriculture debris, an undoused cigarette butt flying from the whizzing SUVs in the highway, campfire left unattended etc. Although many do not care to think twice before they do either of above, most of the time, they are the major causes of forest fire in Bhutan.

You are on your way driving south to a warmer part of the country. On the way, it is cold and you decide to light a cigarette to warm up yourselves. Once you are done, it could have been way wiser to properly douse before you discard the butt, but you are speeding high or you feel so lazy

rather open a window glass just enough to send the undoused cigarette butt riding the gushing air.

A cigarette butt is too small of a fire source to produce a flame big enough to blow up to major forest fire, but at the roadside, the grasses are so dry. The butt comes in contact with a small dry leaves and soon it catches the fire. The fire slowly spreads and grows bigger and bigger gaining momentum. Just within an hour, the whole ridge is on flame.

Karma, a forester was sipping a hot steaming Suja (Bhutanese butter tea) near a warm Bukhari in his residence. He was just back from doing round of his area to see if there is any potential forest fire outbreak. While doing so, he has cautioned all the community people to not to engage in anything that would spark the fire. All of them were advised to do everything to avert outbreak of forest fire.

Karma was counting days of winter.

He was about to call a day without forest fire, a day less of winter without a fire when the handset tucked in his uniform belt buzzed, "Charlie report," "Charlie report," "Reporting," he instantly responded, "There is a forest fire" came the

Fire Battle

voice,

"You get ready, asap," directed the man from the other end.

"We're on our way," the man added, and ended, "Over and out."

A minute ago, Karma was about to settle for the dinner with his families. His wife had cooked a delicious supper and he intended to have a sumptuous dinner and go to bed to remain curled up in the thickets of blanket. But nothing this is going to happen for tonight he got to hurriedly put on his clothes and head to battle the fire.

Once at the fire spot, the fire has gained momentum. It has become so large that there is least a handful of foresters can do. But they first need to do the reconnaissance survey of the area and try to assess if there is any properties or lives the fire poses risk to. If there is one, they need to divert all their attention in saving it. Their reconnaissance assessment reveals that right at the fire direction is an old lhakhang, perched at the top of the hill.

Given the speed of the fire fanned by strong winter wind, they have less than couple of hours in their hands before the fire engulf the lhakhang and raze it down to rubble. They instantly spring into action and create a fire break some metres wide circumambulating the lhakhang. The fire break which entails clearing bushes

and rendering the ground bare a metre and half wide is expected to act as a barrier for the fire, which upon reaching the break, the fire be deprived of the fuel and slowly get doused.

By the time they are done with constructing the fire break, the dawn cracks. The darkness gives way slowly to the daylight. Karma and the group of foresters have not eaten anything for hours now despite working aggressively.

But this is not the current concern. They now have the public from the nearby community to mobilise to help them contain the fire. Although the century-old temple has been saved, the fire is raging ferociously. It has crossed the mountain and is on its way to another as indicated by the flames shooting way above the tree canopy.

Led by the geog gup, a big group of fire fighters from the locality joins them. Foresters happily greet them and in the midst of sharing few gulps of water, the foresters appearing all charred with black paints on their face and hands are engaged in mobilising the public. The public are segregated into groups and each of them led by a forester each battles the fire from all possible angles.

By the time they were able to contain the fire in its sixth day, it has already burnt hectares of flora and fauna. All thanks to the dedicated and committed team of the foresters, with the help of the public, the fire was suppressed finally. Otherwise, it could have been even worst annihilating and

obliterating large extent of forests.

All spent, Karma and his friends are finally relieved that they were able to bring down the fire. But this was in November. The fire season stretches till March. With more months to go, this is not their first and last time, battling the fire. They only pray that the number of incidences be the minimum.

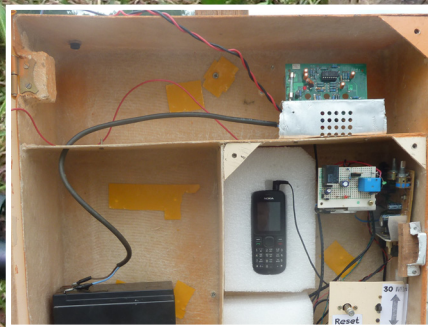
Meanwhile, a man in SUVs had reached his destination long time back. He is relaxing at his home with nothing much to worry about with least idea that his carelessness has resulted in more than he could have imagined.



Smart Irrigation System

A solution to the irrigation water problem

RDC Wengkhar is attempting to develop a technology for efficient water utilisation



Tshering Penjor, Lhap Dorji and Choki Nima, RDC Wengkhar

Scarcity of water for irrigation is a common problem among Bhutanese farmers. Irrigation in Bhutan is mainly rain fed and in situations of erratic rainfall, the problem is aggravated.

However, the little we have could last throughout the cultivation season if proper water management systems are put in place. And this is possible with simple technology and know-how. Today, the irrigation system is predominantly conventional channel based system and confined mostly to rice cultivation without using any technology.

Faced with the same realities of limited water and labour for irrigation, the Research Development Centre (RDC) Wengkhar began working on developing an irrigation system for our own research block at the Indigenous citrus block in 2013. The system aimed at improving effective utilisation of water using a drip and micro-sprinkler irrigation system.

It began with the first prototype (TP 2013)-low cost drip system, a simple way of connecting all trees with pipelines connected to a reservoir tank. By making small

hole (0.8mm diameter) in the pipe near each tree, water is made to drip to the root area. Irrigation is scheduled based on the soil moisture content determined by 3 soil tensiometres installed at 30 cm, 60cm and 100cm soil depth. The number of hours required for irrigation is determined by using the flow rate of water through the drip hole and the readings from the tensiometres. Compared to conventional method like flooding and hand watering with hose-pipe, this method has greatly improved the efficiency of water as well as labour usage in irrigation.

Except for variable flow rate of

ystem: lem



drippers due to the gravitational water pressure in the pipes, the prototype worked well. This was later modified using pressure compensated emitters/

micro-sprayer heads, which are commercially available at Nu.5.5/ emitter and helped solve the problems of variable flow rates. However, the system requires



manual operation for which an automated control system to start and stop the irrigation was required to make it more effective. A second prototype (TP 2014) was designed to incorporate features of automation. An irrigation control system was designed using a cheap mobile phone hand set. Using this system, the irrigation was made to activate automatically by sending a “missed call” or a SMS to the mobile phone or using the mobile phone’s inbuilt features such as clock timer and alarms.

Although this new feature helped to replace manual operations of the first prototype by not having to have physical presence at the site, it still faced several drawbacks such as:

- The system is not users interactive. There are no means to verify for the user if the system is actually irrigating the field or not
- The system cannot control multi-stations. One controller can control only one station
- Cannot make multi-irrigation schedule which is necessary sometimes to maximise water usage in certain orchards
- System does not have capacity to change irrigation schedule or scale water time up and down through interference of weather and soil moisture data

This led to the latest and recent prototype (TP 2015) to solve the above drawbacks. It is based on open-source hardware and software called Open sprinkler



which connects the irrigation system to internet and mobile apps interface. By doing this, the system could be access through standard HTTP web interface from anywhere on the planet. It also incorporate local weather conditions such as rainfall, temperature, humidity and soil moisture which will alter the irrigation schedules and water amount automatically which will reduce the water wastage.

Local climate data was connected to the system through establishing automatic weather stations at Wengkhhar and the data is uploaded to famous online weather website www.wnderground.com.

This system under trial at the Indigenous citrus research block at Wengkhhar attempts to put in place an efficient irrigation system that can help us save water, a precious resource. Designed mainly for large commercial farms and research centers, the technology comes at a time when the Ministry of Agriculture and Forests is emphasising on commercialisation of agriculture.

The system could also help in municipal and rural water scheme to manage water distribution and scheduling system more effectively and economically. One such trial is also set up at Kidheykhhar village under Mongar geog testing to see solving water shortages by providing effective water scheduling. If all goes well, this technology could provide a way forward for effective management and utilisation of water and increase productivity of farming.

Upland rice, a solution to Taraythang's water woes

Farmers are thriving on the three improved varieties introduced

Ugyen Dendup, RDC Bhur; Ugyen Gyeltshen, Taraythang Agriculture Extension Centre; Tirtha Bdr. Katwal, RDC Yusipang and Rinchen Dorji, National Biodiversity Centre

Farmers of remote Taraythang became landowners overnight in 2007. His Majesty the Fourth Druk Gyalpo granted a kidu of five acres of land to each household.

But the farmers had a problem. There was no water and they couldn't put their new found wealth to use. The National Biodiversity Centre and Research Development Centre (RDC), Bhur, in partnership with the Geog Agriculture Extension Centre came with a solution. They initiated an upland rice cultivation demonstration in 2011.

The work on upland rice was first initiated with support of the Biodiversity Use and Conservation in Asia Program (BUCAP) project that aimed to enhance the on-farm conservation, development and utilisation of arable crops mainly cereals.

The demonstration became a success and farmers never looked back. Area under rice cultivation increased from two acres to 50 acres in just three years (2011-2015).

Unfortunately, a devastating forest fire from Assam that escaped into Taraythang severely damaged the main irrigation channel, which further heightened the shortage of irrigation water for rice cultivation. Farmers of Pemacholing and Dorjitse villages were in a dilemma. They didn't have the means to restore the irrigation channel.

However, there was a cheap and reliable alternative. The upland rice production technology came to the rescue once again. The technology had already been proven a success in the geog. It came as the best solution.



The Extension Officer advised the farmers on upland rice technology and provided seeds of proven upland rice varieties with support of the BUCAP project.

The Senior Rice Researcher from RDC Bhur, Mr. Neelam Pradhan recommended the promotion of two improved rain-fed rice varieties Bhur Kamja 1 and Bhur Kamja 2 initially. Now RDC Bhur has identified and recommended another high yielding rain-fed rice variety Sukhadhan 2 introduced from Nepal.

The problem of water actually came as a boon as farmers now have a choice of three high yielding upland rice varieties. Depending on the variety, productivity of upland rice in Taraythang ranges from 1,400 Kg/acre to 1,893 Kg/acre.

The success of upland rice in Taraythang is a direct output of the suitable upland rice technology developed by RDC Bhur and the Participatory Variety Selection (PVS) trials and demonstration supported by the BUCAP project which was further complimented by the active participation of the farmers.

The initiative on upland rice has greatly enhanced the food security of the farmers as well as the conservation, development and utilisation of rice. Apart from augmenting the household food security of Taraythang farmers, upland rice is substantially contributing towards the achievement of the 11th Five Year Plan rice production target of Sarpang.

The cultivation of upland rice has proven to be a climate-smart agriculture technology for adaptation to climate change especially when water for rice production is increasingly becoming scarce.

In the event of limited irrigation water for rice cultivation, farmers now have an option to plant upland rice. With this success on upland rice, the BUCAP project stakeholders have expanded the on-farm conservation, development and utilisation program on a neglected and underutilised cereal like millet.



A SUMMER RENDEZVOUS THAT STILL HAUNTS AUM YANGZOM

Ugyen Tshering, ICS

It was last mid-summer and Goshing Wangling, a remote village in Zhemgang had transformed into an extraordinarily beautiful hamlet. The quaint little hamlet had turned extravagantly lush with tropical vegetation fencing the village while the inside remained chock-full with different varieties of agriculture crops growing green and fresh. It was possible to literally hear the butterfly wing beat and feel the soft seasonal breeze transport to some magical land of peace and plenty far away from the crowd of modern settlements.

The vista stretched far beyond the little settlements. One wonders that if Wangling can contain and give so much, what amazing wealth of floral and faunal beauty could exist between the tall, splendid mountains far away and the vast spotless azure sky behind them.

Peace that appears to reign so abundantly in this small village however was not absolute. Hidden behind the façade lies a chronic problem. Every summer, Wangling farmers have to constantly face rampaging wild animals that ravage their crops and nullify their hard work and toil.

In fact, when the village becomes laden with different crops, it attracts prying eyes of many, including different species of wild animals. In Wangling, battle has been raging for far too long. Ingenuity of either side has only prolonged the confrontation. Neither party seems to give up, not easily. Farmers tie their dogs on the fringes of the fields, guard their fields

themselves all day, erects scarecrows, attaches rope to their bedroom with other end attached to the tin hanging on the pole at the edge of the field but nothing of these seem to work as “magic bullet”.

The ‘other party’ has adapted and is prompt in devising equally genius tactics. The wild animals somehow manage to sneak in and grab mouthful. But this is tolerable and farmers seem not to mind much. The real plight or predicament is when the whole family or a solitary but notorious spoiler plunders the whole field in one single night. Then the situation becomes so dire that the year’s stock is at stake.

This is exactly what happened to Aum Yangzom, 59 of Wangling last summer in 2015. Until few days ago, before the incident, she was a proud owner a vast corn field. Rightly so because, from the very first day, she had carefully nurtured each maize plant and taken care of them as much as she has done her children. The manures were applied, all other weeds but the maize plants were uprooted diligently. The maize plants responded well to her care and efforts. They slowly and steadily grew putting up erect and solid stem with long and slender leaves.

The hard labour slowly fruited when her maize plants formed corncobs, ears and kernels. Every morning, she opened the husk on a random basis to check if the fruits are matured enough for harvest. She seemed in haste and rightly so, she knows it is at this stage that her maize plants are most vulnerable.

With the kernel fully formed with milky grains, a look at it makes every herbivore ooze out saliva from their mouth.

For a month or so, she had been very as busy and crafty as she had been in any other season. She had put in all measures to keep the wild animals away from her field. Old rags are in the field worn by a skeletal scarecrows and tins have been hung in every corner of the field. It had been months she last slept in the comfort of her home. She had spent sleepless nights in the temporary hut in the middle of the field, keeping the fire burning all through the night in addition to making all sorts of noises. Up until then, all this had succeeded in scaring away the wild animals and kept them at least few metres away from her field.

Her field was surrounded by dense forests and it harboured many species of wild animals such as wild boars, deer, monkeys, porcupines. More than anyone, she was aware that the wild animals awaits in a stealth mode ready to spring into action, the minute they get the opportunity. Then there is no second chance for her. They would come in big herd and plunder her whole field.

One evening, last summer, Aum Yangzom, prepared for yet another regular night in the hut. She prayed it be like her other nights because putting up in the hut was one thing but keeping her field safe was quite another. As the sun slowly disappeared from behind the last mountain in the horizon and the darkness engulfed her beautiful village, Aum Yangzom had a quick dinner and moved to the hut. She carried a traditional torchlight made of split bamboo. Once in the hut, she prepared a big bonfire and sat by the fireside occasionally crying out loud and banging the tins.

But as the hours went by, it started to rain. What started as drizzle, soon poured. All the noises she made got absorbed in the rain hitting the earth. But there is no fighting the natural phenomenon than to relent. As the fate would have it, by midnight she was fighting the overpowering sleep. She was listening to the rain falling persistently and the last thing she

heard was a rain drop hitting the pot she placed at the corner to collect rain from the leaking roof.

With a jerk, she woke up. It was eerily silent. The rain has ceased. She shuddered with the fear for her crops. It was already daybreak. She jumped out of her hut to investigate the field. She knew she failed herself in guarding her field. She should have never given to sleep. She was overwhelmed with fear. The fear like that of a man who just murdered another human being gripped her. She saw sky falling, world falling apart. Shivering, her legs could hardly carry her.

Within the first few metres of her hut circumference, her maize plants were standing. She told herself, perhaps wild animals gave her one chance. But as she ventured further, the worst fear came alive. She stood there dumbfounded at what she saw. She was horrified at what she saw. Her nightmare came alive. All her maize plants lie flattened on the ground with cobs all shredded open. The maize plants were brought down, plucked its cob. A big family of wild pigs had rampaged her field. They had ravaged the field sparing not a single plant and relishing lavishly on her maize. The whole field looked like two giant elephants had a fight.

She stood there for time she lost track of, doing nothing than shedding tears. She cried. She knew that it is her year's food stock that lie on the ground. The maize plants have been damaged far too severely that there is no bringing back to life. She blamed herself. She cursed herself. She wondered how she failed, why she couldn't keep herself alert, what made her fall asleep.

But for now, there was nothing she could do. All she could was think of how to feed her family for next 12 months, until it is season for yet another round of maize cultivation, another round of bout with her eternal enemies. But she makes herself one promise that perhaps next year, she won't fail herself and be able to better protect her crops from the rampaging wild animals.

Stimulus package helps Bidung farmer breed swines

Pema Gyeltshen, Livestock Extension Centre, Bidung

Shortage of piglets has been a longstanding issue in Bidung, Trashigang for a long time with no government farms in the vicinity of the village.

But, now, with introduction of contract farming policy and strategies in place, interested farmers can avail of stimulus support packages to start a pig rearing business. Already some Bidung farmers have taken advantage of the support.

Norbu Wangdi, a farmer from Retshangpek in Bidung has taken up pig breeding with the help from National Piggery Development Centre (NPiDC) in Gelephu. NPiDC provided Norbu with drawings and floor plans of the sty and livestock officers from Trashigang and Regional Poultry and Pig Breeding Centre, Lingmethang monitored the construction.

In October 2015, 20 piglets were introduced to the newly-build modern sty, bought from Lingmethang. Geog Extension Agent helped develop the first work calendar of the farm. Selection of Gilts will be done when the piglets are between 5 and

6 months old. Hereditary defects, prominence of teats, structural conformation of body and rate of weight gain will be assessed.

Norbu has already proposed to buy two boars for breeding the selected Gilts.

The Dzongkhag Livestock Sector supported the Norbu's farm (first swine breeding farm) with 50 bags of Growers Feed. As per the work calendar of the farm that expects no less than 50 piglets by the end of July, the first breeding will take place in the month of April.

The livestock sector hopes that the farm will meet the piglet demands of the Dzongkhag which and ease the pressure on government's nucleus farms.

For Norbu, adventure has just



begun. He has bigger dreams to accomplish. Norbu also plans to extend his adventure by taking up fattening the pigs for pork production in the future.

“Hereditary defects, prominence of teats, structural conformation of body and rate of weight gain will be assessed.”



TMR Formulation becomes the preferred choice of feed production

Dawa L Sherpa, D. K Gurung, Karma Wangchuk and Dorji Rabgay, RLDC, Tsimasham

Shortage of fodder during the lean season is a problem, particularly for dairy farmers. The period between December and April is critical. During this period, some farmers tend to conserve fodder in the form of hay and silage but this is not adequate. Incessant rain during the time of preparation, inadequate storage facilities and labour shortage, among others lead to spoilage.

To prevent fodder spoilage and help farmers to improve fodder quality from locally available resources and to reduce shortage in winter, many measures and varied options were tried. So far, however, conservation technique of Total Mixed Ration (TMR) formulation has by far been the most successful and popular option.

A demo was tried with dairy farmers' groups. Training was provided and the technology tested. Two groups of dairy farmers in Tashicholing, four in Yoeseltse, one in Ugyentse, and one in Samtse were trained on TMR formulation. Also, a group each in Phuentsholing and Sampheling, and two groups in Darla were trained on formulation of TMR. In total between December 2015 and January 2016, 124 members of 12 dairy groups were trained on TMR formulation and utilisation.

Advantages of making TMR feeding

- TMR allows feeding a nutritionally balanced ration allowing dairy cows to achieve maximum performance as a result of more stable and

ideal environment for the rumen microbes by providing adequate carbohydrates and nitrogen sources.

- A 4% increase in feed utilisation can be expected when using TMR compared to a conventional ration of forage and grain fed separately, twice daily.
- Farmers can also utilise a variety of by-product feeds with a TMR, thereby allowing for possible ration cost savings.
- Incidence of digestive and metabolic problems often decreases when a TMR is fed with increase of 5% milk production with a TMR compared to conventional rations as a result of these benefits.
- A TMR provides greater



accuracy in formulation and feeding if managed properly.

- Chopping of forages reduce (dry or green) the entire TMR to particle size to the mix that eases consumption and reduces waste.
- Greater variety of ingredients allows flexibility in formulating rations for various production groups.
- Blending all the feeds together in a TMR can mask the flavour of less palatable feeds.
- Nutrient analysis of TMRs sample fed to high producing lactating dairy cows formulated contained approximately 1% crude protein, NFC 40% nitrogen free extract, 29% neutral detergent fibre, 75% total digestible nutrient and 5% fat (Hoffman, 2001).
- Cost analysis showed, TMR is cheaper than other commercial feeds

How do you prepare TMR feed?

Ingredients used to formulate 100kg of TMR

1. Chopped green fodder or hay 15 kg
2. Ground maize or rice bran 50 kg
3. Mustard oil cake or ground pigeon pea 30 kg
4. Molasses 03 kg
5. Salt 01 kg
6. Mineral and Vitamins 01 kg

Steps

- Chop green fodder and hay or paddy straw to half an inch size and weigh up to 15 kg
- Weigh 30 kg mustard oil cake and break it into small particle size
- Weigh 3 kg molasses to make a solution of molasses in warm water
- Mix all the ingredients thoroughly; feeds if dusty, sprinkle water to settle the dust and enhance adhesive quality of feed ingredients.

Cost of preparing 100 kg TMR

• Ground maize 50 kg @ 018	= Nu. 900
• Mustard Oil Cake 30 kg @ 030	= Nu. 090
• Molasses 03 kg @ 020	= Nu. 060
• Salt 01 kg @ 015	= Nu. 015
• Mineral and Vitamins 01 kg @ 105	= Nu. 105
• Fodder 15 kg @ 003	= Nu. 045
• Labour-1man @ 27/hour -30 min	= Nu. 027
• Electricity charge	= Nu. 020
• Total Nu.	=Nu 1,264

Cost comparison of TMR with Karma Feeds

Unit cost of TMR production is Nu 12.64 and that of Karma Feeds is Nu 21/kg. Formulated TMR is 60 percent cheaper to Karma Feeds.

INDIAN PYTHON CAPTURED AND RELEASED THRICE IN TSIRANG

The Forest Divisional Staff lack the expertise and equipment to handle herpetofauna

Jigme Tenzin, College of Natural Resources and K.M Ghimerey, Tsirang Forestry Division

The Tsirang Forestry Division recorded capturing a rock python (*Python molurus*) thrice in nearby geogs between August-December 2015. However, the rock pythons were released back to safer places in the wild.

Python molurus species is known by three common names such as Indian python, black-tailed python and Indian rock python which are one of the largest non-venomous python species. It is usually found below 1,000 m above sea level within tropical and sub-tropical areas of Southeast Asian countries including the lower parts of Bhutan.

The first capture was reported towards evening and the second before midday by farmers from the same location. However, forestry officials from the division released both the pythons at the Changchikhola confluence 50 m below the same location. Morphometrically, the longest scientifically recorded specimen of rock python so far was recorded from Pakistan at 4.6m (15.1 ft)

in length and weighed 52kgs (Minton,1966).

“Disturbances in prey diversity could have caused the reptiles to move nearby the settlements,” said the Senior Forestry Officer of Tsirang Forestry Division.

Researchers found that Sunkosh river basin is a good habitat for subtropical herpetofauna and the cropping up of hydropower projects over Punatsangchu basin was likely to cause ecological disturbances leading to speciation in the future.

Therefore, more herpetofauna are likely to come nearby the settlements in search of prey with disturbances downstream. Similarly, immediate research is required to generate the baseline information across the Sunkosh river basin.

According to D.B Chettri, Forest Ranger of Tsirang Forestry Division, handling of reptiles requires skills and techniques; however, in Bhutan, foresters lack such expertise and have to handle them at their own risk when they receive calls from the farmers.



But so far the divisional staffs were able to handle reptiles thrice with crude methods self-taught from Discovery and Animal Planet Channels though the use of crude equipments which are not reptile-friendly injures the pythons. Therefore, it is high time for a biological hotspot like Bhutan to have trained wildlife rescuer staffs in each Divisional Forest Office to ensure wildlife safety and cater to the growing numbers of wildlife casualties in the country.

According to the Wang et al. 2002, metabolic rates of the Python molurus increases with temperature after ingestion and time required to return to the fasting level also increases with temperature. Therefore, with the gradual increase in temperature due to global warming, it would require more prey for the python to survive; further it can also change the hibernation schedules. According to the Department of Zoo-physiology (2002), rock pythons are usually lighter in

colour than the Burmese python which is limited to Pakistan, India, Nepal, Myanmar and Vietnam. It may be found as far as north like Quingchuan in China and as far as south like Borneo but is absent from the Malayan Peninsula. As per Meshaka et al. 2004, researcher had begun to introduce rock python in Florida Everglades, USA which is away from natural home ranges.

Generally, Python molurus has two sub-species through allopathic speciation due to geographical features. P. molurus is native to India, Pakistan, Sri Lanka, Nepal and P. molurus bivittatus (the Burmese python) is native to Myanmar, eastward across southern Asia through China and Indonesia.

Python molurus are strict carnivores and feed on mammals, birds and reptiles, but prefer more of mammal. The python has advance with quivering tail and lunge with open mouth. Live prey

is constricted and killed. One or two coils are used to hold in tight grip to crush their bones. After a heavy meal, an individual may fast for weeks and the longest duration recorded was 2 years. Non-connected of jaw bones leads to swallow prey bigger than its diameter. Moreover, prey cannot escape due to saw like teeth arrangement from his mouth.

Rock pythons usually live in grasslands, swamps, marshes, rocky areas, woodlands, open jungles and river valleys where there is a permanent source of water. Sometimes they can be found in abandoned mammal burrows, hollow trees, dense water reeds and mangrove thickets (Rhomulus, 1987; Mehrtens, 1987). Meanwhile, conservation status of rock python is classified as vulnerable due to declining population in IUCN in 2012 where it demands protection.

Records of captured and released python by Divisional staffs, Tsirang

Sl. No.	Dated	Location	Geo-coordinate		Morphometric measurement
			Northing	Easting	
1	29/8/2015	Pemathang, Goserling geog	27°.22".0.84'	90°.72".6.22'	15.1fts, 2fts girths with 40kgs
2	7/10/2015	Pemathang, Goserling geog	27°.14".1.82'	90°.82".9.19'	12.3fts, 1.5fts girths with 25kgs
3	28/12/2015	Baradurey, Barshong geog	26°.56".53.78'	90°.35".3.58'	11fts, 0.5fts girths with 15kgs

ENVIRONMENT: GLOBAL WARMING IS A REALITY. HOW IS IT AFFECTING BHUTAN?

Some field observations

Chencho Norbu, Department of Forests and Park Services

The experiences of being too wet or too dry coupled with episodes of severe wind, rain and hailstorms are no longer rare in Bhutan. The farmers lose crops either to pests and diseases or to floods, droughts, landslides and wind/rainstorms during these frequent extreme weather conditions. The high altitude farmers lost 80 to 90 % of their rice harvest during the rice blast epidemic in 1996.

The maize harvest loss suffered by the farmers above 1800 masl during the outbreak of northern corn blight disease was more than 50% of their production in 2007. The crop harvest of about 320 households was affected by the 2008 severe windstorm¹. The reported damage caused by the heavy monsoon rain in 2004 included 29 houses and 664 acres of arable land; 39 irrigations channels and 22 bridges of different types were damaged or washed away². This year, a heavy hailstorm damaged more than 367 acres of paddy in five geogs of Wangdue on Oct 13, 2015³.

Many affected farmers believed that these were the local signs of climate change or impacts of global warming. Interestingly, the cropping calendar of the farming communities across different agro-ecological zones in the country did not see significant shifts in planting/harvesting month or crop species. For example, the farmers in the wet-subtropical



A. Chang geog then, Thimphu, 1995



B. Chang geog now, Thimphu, 2015

zone continued to follow the same cropping calendar reported in the early 1990s⁴. Likewise, no change in the cropping calendar has been observed for the farmers of the dry sub-tropical zones today. Could this be the affect of microclimate?

On the other hand, almost all offices in the towns and cities in the temperate zones are now equipped with either electrical fans, air conditioners and heaters to combat extreme heat in summer and cold in winter. Why are the towns and cities warming up?

Kawang, Mewang and Chang geogs of Thimphu were once a thriving agriculture production system. The rise of the construction industry in the 2000s changed its landscape. All arable lands on the terraces, flood plains, and along the slopes of

these geogs were converted into business centres and real states (a & b). The concrete structures including roads and buildings sealed the landscape functions of regulating the microclimate.

“Many affected farmers believed that these were the local signs of climate change or impacts of global warming.”

Attempts are being made by the various institutes in the country to study the impacts of climate change on food security, forest bio-diversity and water resources including glaciers and glacial lakes. The field observations along the Snowman Trek clearly indicate that the glaciers are receding. There are no noticeable signs of anthropogenic activities above 4400 masl where most of our glaciers are located. Why are these glaciers receding? What percent of total water flow in our river basins come from glacial melt? Most studies of the Himalayan glaciers indicate high variability

and the estimate recorded so far for the eastern Himalayan region is around 30%⁵.

The global climate change negotiations, debates and scientific studies will continue. Bhutan, being a mountainous country cannot afford to wait for its outcomes or be complacent. Our rural settlements, towns and cities are all located in one or the other watersheds of the country. The creeks and streams that originate from local watersheds are the lifeline of our population, providing water for drinking, sanitation, and irrigation, in addition to producing clean power. Either too much or too little water is going to be a reality in these watersheds with the occurrence of frequent extreme weather conditions. It is going to be difficult to stop the receding of glaciers by local actions alone. However, it is possible to sustain healthy local watershed services through the introduction of best management practices.

1. *Building Climate resilience to Food Security and Rural Livelihood, Bhutan Climate Summit, 2011.*
2. *Report on the Assessment of Monsoon Related Damages in the Six Eastern Dzongkhags, MOA, August 2004.*
3. *Kuensel, National Newspaper, 2015.*
4. *Accelerated Food Production Program, UNDP/FAO- Technical Report. Bhutan, May 1990.*
5. *Himalayan Glaciers and Water Security: UNEP calls for Better Monitoring Information Access and Policy Coordination by Andrew Burger, Oct 2, 2012(globalwarmingisreal.com/)*

Banana skipper is best controlled through physical and biological means

It is suspected that the pest was introduced into the country through banana leaf packages of betel leaves from India

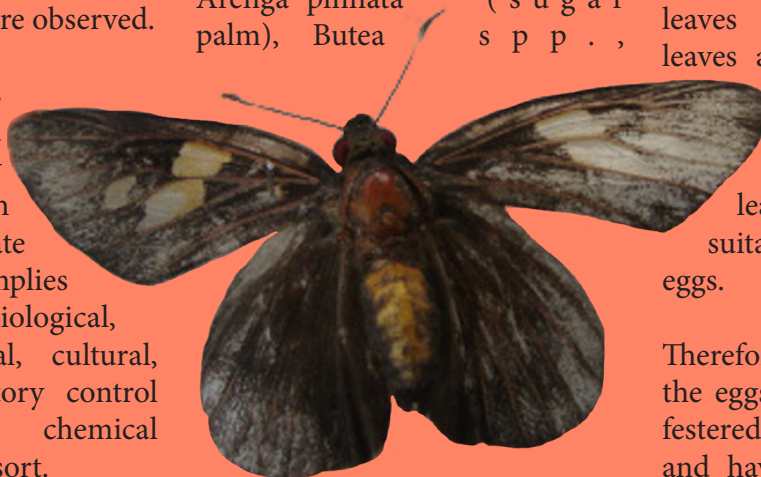
Chinta Mani Dhimel, RNR-RDC, Bhur

In order to update knowledge on Integrated Pest Management (IPM), a study of banana skipper (*Erionota thrax*) pest and its occurrence in Lobeysa was done in 2012. IPM is a crucial approach for crop protection both nationally and internationally. The different life stages, feeding habits, and habitat of the pest were observed.

This approach is ecologically and environmentally friendly in line with mitigating climate change. It implies implementation of biological, mechanical, physical, cultural, genetic and regulatory control measures keeping chemical pesticides as a last resort.

Erionota thrax which is commonly known as palm red eye, banana skipper or banana leaf roller is a pest that affects all types of banana (both domesticated as well as wild species), bamboo, coconut (*Cocos nucifera*), manila hemp (*Musa textilis*), *Canna* spp., *Strelitzia reginae* (flowers),

Heliconia spp. (dwarf banana used for ornamental purpose), other palms and zingiberales (Ashari and Eveleens, 1974; Prasad and Singh, 1987; Waterhouse and Norris, 1989; Sands et al., 1991; Gold et al., 2002, mentioned by Baker, R., Caffier, D., et. al., 2008). Other hosts include *Arenga pinnata* (sugar palm), *Butea* spp.,



Calamus trachycoleus (cane), *Chrysopogon* (gold beard grass), *Elaeis guineensis* (African oil palm), *Licuala grandis*, *Metroxylon sagu* (sago palm), *Nypa fruticans* (nipa palm).

The pest is known to be present in India. However, *Erionota thrax*

is not a pest affecting all of India's geographical terrain. Apart from the areas where it was introduced, it is only endemic to north-east India.

On the other hand, it is suspected that Bhutan was affected by the pest due to import of betel leaves from India. The betel leaves are packed with banana leaves softly and kept in a cool and moist condition to avoid betel leaves desiccation creating suitable environment for pest eggs.

Therefore, it is suspected that the eggs of this pest might have festered on the banana leaves and have been introduced into Bhutan through this activity. This is because the eggs are hard-shelled, dome-shaped and strongly attached onto the banana leaves. However, further studies need to be carried out to find out which parts of Bhutan are affected the most to trace where the pest originated.

In Bhutan, it has been detected more in Lobeysa (Wangdue) and some in Dunglagang (Tsirang) and Shompangkha (Sarpang). *Erionota thrax* was first reported in Hawaii on Oahu in 1973 and by 1975 it was found to be present on all major islands. It is a notorious pest of banana in Southern and South East Asia, Indonesia, the Philippine Islands and Guam. It is also found in India, Papua New Guinea, China, and Singapore. It is an introduced species on various Pacific Islands including Salomon Island and Mauritius.

The larvae are nocturnal and hide in the folds of the banana leaves during the day. Even if they are exposed by unfurling the leaf rolls, they wriggle, quickly rebuild and hide inside. However, the eggs are laid mostly on the ventral side of leaves protecting them from direct sunshine and rain and other environmental conditions.

The adults are less often seen although the larvae can be quite common on the host plants. This is due to the fact that the adult butterflies are active only during the early morning hours and just before dusk. They get attracted towards light.

From the observation made in the Lobeysa and farm at the College of Natural Resources, breeding and population growth is faster during summer than winter. The number of larvae and eggs found was more in September, the intensity of which decreased slowly towards October followed by November. To confirm it a larvae, it was reared and observed

for pupation. The process was completed within 10 days (8-18 October 2011) while another one kept later on 20th October had not emerged till 22nd November 2011.

Although *Erionota thrax* has minimal impact on the environment, it has a significant effect on banana plants. Its damage to banana plants increases probability of shifting of host to other plants. Heavy infestations can result in complete defoliation of banana trees although such outbreaks are sporadic. Heavy defoliation damages saleable plants, reducing the quality and number of bunches of bananas produced and their weight. Heavily damaged or defoliated plants are less suitable for vegetative multiplication. Even with lighter infestation, the leaves of the banana tree become useless wrapping material and affects photosynthesis.

The larvae which causes the damage, immediately after hatching, cut and roll the host leaf from the tip along the midrib in a dorsal side exposed position by excreting a sticky substance through its mouth, forming a tunnel and feed within the shelter. Mostly younger leaves are avoided since the eggs are laid on the unfurled leaves, so the larva after hatching cannot move far to the later unfurled leaves.

The larvae feed from one edge of the leaf and make another roll in the leaf as fresh food is needed. The leaf rolled tunnel is dusted with a white waxy powder produced by the larvae where

it stays. Some of its faeces pass through the partial openings at the bottom of leaf rolls while some remain inside. The rolled up leaves are often seen hanging in large numbers from the midrib of the banana leaf. It completes its pupating inside the leaf rolls by sealing the rolls with spongy net formed by it.

An adult lays its eggs usually in groups of 2-14 in numbers or sometimes individually, mostly on the ventral side of banana leaves. At the initial stage, the colour of the eggs are shiny silvery white which gradually change to pink in colour starting from the eggs' top portion. Thereby, gradually the eggs' colour changes from pink to ash white with a pink spot remaining still at the top. Finally before hatching, the whole egg turns ash-white in colour with a dark spot at the point where the pink colour had been. Eggs hatch in five to eight days.

The newly hatched larvae are grayish-green which change to pale green in later larval stages (instars). In the advanced stage, they are covered with short silky hairs and a white powdery substance, which is presumably a waste product of its metabolism. Its head is protuberant with dark brown to black in colour which is prominently distinct from thorax. It has three pairs of thoracic legs with claws and 4 pairs of fleshy abdominal false legs or prolegs with fifth anterior pair being less protruding. Well developed larvae are four to five centimetre long. The larval period lasts for 25 to 30 days.

Pupae are oblong, light brown in colour and are all covered with white powdery substance like that of larvae. Pupating is done within the rolled banana leaves. Pupating takes about 10 days to complete its stage.

Adults have a large head with clubbed antennae. The anterior wings have three distal pale yellow spots which are chocolate brown in colour while hind wings are dark brown with wing span of about 73 mm. It has large red eyes which is prominent. This butterfly is a strong, quick nocturnal flier.

Adults usually emerge in the afternoon and fly powerfully and erratically around banana plants in the early evening and early morning. They are frequently attracted to light. Lights in boats and loading aircraft may attract adults, assisting movement to uninfected areas. Life cycle takes about five to six weeks.

The pest is large in size due to which it can be controlled effectively through integrated pest management practices. Therefore, it is not essential for chemical control. Although, the effects of this pest is not so serious at present in Bhutan it might be in the future.

According to Boss (2011), *Dysdera crocata* (brown head breast spider) are suspected to be the predators of larvae of *Erionota thrax* as it was found along with its young ones inside the pupa case of *Erionota thrax*. They contain silk glands in their cephalothorax as well as their abdomens. They become active during night when

they come across still insects or in cases and shoot their venomous silk nets through holes in their fangs. These spiders live in variety of habitats like beneath the rocks, tree bark, caves, in shady areas, houses, dark corners, windowsills.

The *Ooencyrtus erionotae* is found to be an effective egg parasite in Guam. However when the butterfly population is high, spraying the banana plants with *Bacillus thuringiensis* will kill larvae without harming the parasites.

Black-Naped Oriole (*Oriolus chinensis*) bird catches the rolled banana leaves containing larvae, and then it takes them to the tree branches, opening the leaves and eating the larvae. These are effective controls for the pest. Further, black ants were also found feeding on larvae inside the rolled leaves. There was an ant nest nearby the banana clump. Therefore, it is suspected that ants are a predator of the larvae and control their spreading.

The eggs are visible to the naked eye if observed closely and can be destroyed by hands. When the leaves are found rolled and hung,

the larvae can be collected and destroyed. However, the leaves of the plants grow too high for close observation. Installation of light traps is another adult pest control since they get attracted towards light. Strict quarantine control is necessary for preventing introduction of pest.

As the damaging larva is big in size and prominently visible, chemical application is not necessary. In fact, physical and biological controls are best.

Other Parasitoids of banana skipper

1. *Ooencyrtus erionotae* (Hymenoptera: Encyrtidae)
2. *Pediobius erionotae* (Hymenoptera: Eulophidae)
3. *Agriommatus sumatraensis* (Hymenoptera: Pteromalidae)
4. *Charops* sp. (Hymenoptera: Ichneumonidae)
5. *Cotesia* (*Apanteles*) *erionotae* (Hymenoptera: Braconidae)
6. *Xanthopimpla gampsura* (Hymenoptera: Ichneumonidae)
7. *Brachymeria thracis* (Hymenoptera: Chalcididae)
8. *Palexorista solensis* (Diptera: Tachinidae)





COMMUNITIES' INVOLVEMENT IN SELECTION OF SUITABLE UPLAND RICE VARIETIES

11 09 2014

Banjar Pam is a small community in Tsamang geog, Mongar. It takes one and an half hour to walk up from the nearest road point. The community grows maize as main staple crop along with legumes, barley and other vegetables in a smaller scale. Though Bhutanese generally prefer to eat rice, all Bhutanese farmers do not own wetland to grow rice in sufficient quantities. Rice is considered more as a symbol of status in Banjar. Since they were unable to grow enough rice on their own, the community has to purchase it for consumption from outside the village. Thus, the Banjar Pam communities rely heavily on imported rice until 2013.

To help the community with rice production, the rice conservation project (ITPGRFA) was initiated by the National Biodiversity Centre (NBC) jointly with RDC Wengkhar and Geog Agriculture Centre. With the inception of the project, a demo plot was established containing six new varieties of paddy, 3 exotic (Chandanath1&3 and Machaphuchray) and 3 local selections (Zangthi1 &2, and Lumang) along with standard check Khangmamaap. This was done mainly to broaden the upland paddy diversity as it was noticed in other regions that the expansion of upland paddy cultivation over the years solely

depends on a single variety (Khangma maap) which is a disadvantage in long run.

Along with demo program, around 250 kgs of Khangma maap seeds were supplied to 45 households to further expand the cultivation area in Banjar. The demo plots were also utilised for educational purposes such as farmers training, seed selection training and participatory varietal selection.

Prior to the harvest, Banjar community members were invited for the assessment of demonstration trial to the demo site, to evaluate yield and select a suitable variety for their community.

The production assessment through crop cut found that the exotic varieties had a higher yield than that of local varieties. Among the exotic varieties, it was found that the Machaphucharay yields highest (1.97 tonnes/acre) followed by Chandanath-1 (1.78 tonnes/acre) and the lowest was observed in Chandanath-3. However, the yield of local varieties was observed to be stable, ranging between 1.0 to 1.5 tonnes/acre compared with that of Khangma maap. Participants preferred the Zangthi 2 (30%) followed by Khangma maap (24%). Preferences for other varieties were as follows: Zangthi



1(18%), Chandanath-1(16%), Lumang (9%) and Machphucharay (7%). It was observed that the high yielding exotic varieties were less preferred due to tall plant height which is prone to lodging and poor appearance of the grains. Among the local varieties, the participants preferred the varieties with red coloured grains, good aroma and medium plant height in nature.

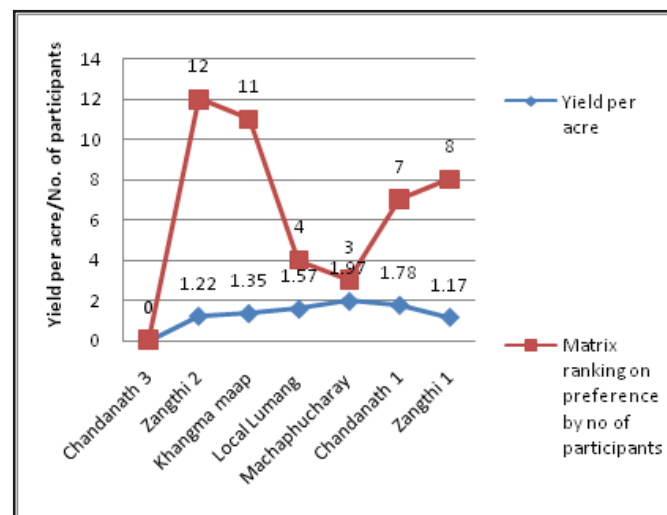
The revival of upland paddy cultivation is seen to have a better promise for the Banjar community which will definitely contribute towards rice sufficiency and reduce dependency on imported rice.



In the same year, the harvest from the field was good for individual households. Ap Sonam Tenzin, one of the participants, has sold almost 1000 kgs of Khangma maap seeds to the project after having set aside enough rice for personal consumption. “Having more varieties of rice to grow certainly gives us a sense of security”, Ap Sonam said.

The beneficiaries expressed their appreciation to ITPGRFA for their financial support. This year, farmers were able to cultivate upland paddy based on their choice and the cultivation area was up-scaled. According to Tshogpa Pema, “Upland paddy was cultivated only in Tseri (slash and burn) land in the past but the community has lost their traditional varieties Legyenchem and Bjokapa three decades ago because of change in cropping patterns”. He added that now they could cultivate upland paddy in dry land which is much easier compared to wetland paddy.

Banjarpas feel more empowered with more varietal options in paddy cultivation and cannot only contribute towards rice sufficiency in the community but also ensure the sustainability of upland paddy cultivation in the future.



Yield and preference matrix graph

AN ALL-YEAR-ROUND TUSSLE

Ugyen Tshering, ICS



Winter by a conventional farmer's standard is a lean season for agriculture farming. With severe winter temperature not in good favour for growth of many crops, most of the farmland remains barren. At this time of the year, most of the farmers' fields in villages are rendered bare wearing nothing but the deserted looks. Except for the cattle rummaging on what little green plants they can hunt down, dotting the vast stretch of bare fields, there is not much of activities happening. Needless to mention the crops, even sturdy weeds and different species of herbs have fallen victim to the harsh winter temperature.

The same patch of land is otherwise in summer adorned and garbed in all colours of the crops. The extraordinarily beautiful and extravagantly lush area laden with

different crops attracts attention of many, including different species of wildlife. As much as farmers try their every tactics to save what little they can from rampaging wild animals, wild animals on the other hand, try their every strategy to grab a mouthful or ravage the crops, given the opportunity. Human-wildlife conflict is at peak. Both the parties are in constant tussle to grab every opportunity to save or sneak into the agriculture fields.

Many believe winter provides much needed respite for the farmers when it comes to human-wildlife conflicts or at least it subsides. With no crops in the field to fight over or for that matter not many reasons to fight over, many presume that at least in winter, the rival part their way and maintain safe distance from each other. Many are with the notion that with not much to get from the villages, wild

animals such as wild boars, deer, monkeys, porcupine, for matter the ungulates and rodents venture far deep into the jungles looking for forest foods.

Many think that if farmers are left at peace, it is in winter. With most of the wild animals disappeared far, most people assumes, winter is time for the farmers to either laze around basking in the winter sun. If not, men are playing different traditional games while women join them singing and dancing, resonating the valley with all melodies.

On the contrary, Ann Dema, 59 of Limapong in Goshing geog of Zhemgang, a farmer by profession for all her life, wish if this is the case in reality. She equally wishes, if she has time for her to warm in winter sun or enjoy around taking break from the back-breaking toiling in the farm in summer. Or at least, the wildlife provides her a breather from ravaging her hard works.

After being able to save only the half of what her field yielded last summer from the rampaging wild

"Both the parties are in constant tussle to grab every opportunity to save or sneak into the agriculture fields."

animals, she has harvested the maize crops of the season. But was she really able to save the half? Her crops are not safe from the wild animals until it is consumed and buried deep inside her family's tummy.

This is because, even after harvesting from the field she has to store all her harvest in the temporary bamboo hut her husband built near her house, which serves as the granary storehouse.

"The cereal first needs to be seasoned before consumption," Said Aum Dema. It is the traditional practice in many parts of the country to build a small bamboo hut near or in edges of the field. The harvested crops are often stored in the hut and are left to be dried and get rid of moisture content before it is consumed.

The maize corns are piled up inside the open hut. The hut is purposely left open so that there is enough ventilation for enough aeration. "This speeds up the seasoning of the corn," explained Dema.

While the golden-coloured ripen maize corn lay piled on the floor of the hut, those of superior quality corns are stored as seeds for the upcoming season. Such seeds are hung by the ceiling.

Although she has long harvested her crops from the field and safely stored in the hut, there is no such thing as safe from the wild

animals. The open granary hut which displays or exhibits corn abundantly strewn on floor and ceiling does not miss the attention of the monkeys. The many pair of eyes is always transfixed from the forest thickets in the adjoining field. These packs of monkeys are always vigilant of her and take every opportunity to creep towards hut to claim the prized possessions.

"Hence, there is no basking in the sun or indulging in merry making in winter," argued her. Further she added, "as much as monkeys keep their gaze focused on the hut, I have to do the same." She went to say that it is difficult for her to even fetch firewood and drinking water. "I have to constantly keep guard of the hut. If I go missing from the scene, the monkeys immediately launch their attack into the hut."

Although she has long longed to visit her relatives in the next village, she could not do that. All thanks to team of monkeys that stays languishing by the bushes in the edges of the field. A day out, her hut awaits in a mess with all the stored crops plundered. If she is gone long enough, even her house is not spared.

"As much as fields go barren in winter, the forest is also rendered bare by the harshest seasons," shared Aum Dema. She told that in winter, many trees sheds leaves and does not bear fruits. "Since Monkeys and other wild animals

feed primarily on fruits, there are not much of alternatives left for them to fill their bellies in winter." When they cannot find anything in the forest, they turn their attention towards villages.

Triggered by desperation of hunger, the wild animals are known to get bolder in winter. In desperation to get a mouthful, the monkeys are said to grow more violent, vicious and aggressive in winter. In fact, if not for the adult, no children stands chance to guard the stored cereals.

If it is monkeys during the day, the nocturnal cousins are equally bothersome at night. The hut plays a guest house for many nocturnal wild animals that deploy all their tactics to get a morsel from the common storehouse.

Therefore, according to her, if human wildlife conflict is at peak in summer, the winter isn't any better. This is, if packs of monkeys trying to seize every given opportunities to sneak into the granary hut even on broad daylight is any indication.

So, in contrary to general assumptions that human wildlife conflict is a sole summer episode, they can be proved wrong. The tussle between the community and the wild animals is never ending confrontation. Hence, if only government do something, the vicious cycle of constant conflict is here to remain for ages.

A participatory approach

towards increasing potato yield for Thrimshing Farmers

Suraj Chhetri, Tashi Uden, Tshering Pem, Ngwang Tenzin and Madan Lal Gurung, NSSC

Potato is produced by all kinds of farmers from small landholders to tenants and large farmers. It is grown by all types of farmers from high altitude yak herders to the farmers of the sub-tropics and consumed by almost all people from children to old and poor to rich. Potato is purchased in high quantities and frequencies in the vegetable markets. Other important vegetables include chilli, radish, mustard green, turnip cabbages and pea. Preference for potato by children is reported as the most important reason for increased potato consumption. It can therefore be expected that the level of consumption may further increase. Potato can be cooked in many different ways with meat and cheese and is highly compatible with chilli, an essential ingredient in most Bhutanese dishes. It is especially important for high altitude dwellers where it is the only fresh vegetable available throughout the winter months beside radish and turnip.

The preferred and most widely eaten potato dish in Bhutan is Kewa datsi, a local preparation with cottage cheese, chilli and potato. Other uses include whole baked potatoes, boiled potatoes,

Alu sabzi. French fried potatoes or chips, Alu pakoda and samosa are also the favourite snacks among Bhutanese.

Potato varieties commonly grown in Bhutan are Desiree, Kufri jyoti, Khangma kaap and Yusikaap. Desiree is red-skinned variety grown in the country covering almost 90% of the total acreage under potato cultivation. Kufri jyoti, Khangma kaap and Yusikaap are white skinned varieties. Bhutanese farmers and consumers prefer the red skin variety Desiree because of its excellent keeping/storing quality, better prices and good eating quality. Kufri jyoti and Khangma Kaap is preferred in many parts of West Bengal due to its high yield potential. Some farmers believe the white skinned varieties (Kufri jyoti and Yusikaap) are less susceptible to wild boar damage when compared to red-skinned potato. In selected pockets, some old varieties have survived and are still preferred to the recognised varieties. Examples are varieties known as Bombay white, Darjeeling red round and Hazarey.

Potato in Eastern Dzongkhags

Eastern Bhutan includes 6 Dzongkhags;

Mongar, Trashigang, Trashiyangtse, Pemagatshel, Samdrup Jongkhar and Lhuentse.

Potato is the principal export crop in the east with highest market demand and with the potential to increase rural income thereby reducing poverty. In most geogs of Eastern Bhutan, potatoes are intercropped with maize. The major potato growing areas, which are quite famous are Khaling, Kanglung, Udorong and Nanog geogs. The Dzongkhags produce over 25% of the total potato crop in the country. Trashigang is the leader in potato production followed by Mongar and Pemagatshel. However, the productivity (yield/acre) is quite low in Eastern Bhutan compared to the national average. In some of the Dzongkhags like Wangdue (7434 kg/acre), Haa (7104 kg/Acre) and Bumthang (6508 kg/Acre), the productivity is more than double that of the east.

Many factors attribute to low yield such as low seed replacement rate, damage of crops by wild animals, pest and disease especially Potato Tuber Moth (PTM) in the east, labour shortage and so on.

Soil fertility management is one of the major production constraints for the potato growers in the east. Potato cultivation requires high inputs generating high yields and consequently removing substantial quantities of soil nutrients. Imbalance use of fertilisers is common there, farmers use it arbitrarily depending upon their own judgment and its availability.

The fertiliser sale records (Trashigang) from 2011-2014 shows that farmers prefer Suphala and Urea only. The percent share



of fertiliser over this period is alarming; Urea-71.73%, Suphala-21.04%, Single Super Phosphate -6.97% and Muriate of Potash-0.26%. In the absence of balance fertiliser applications, soil nutrient mining can take place due to removal of soil nutrients through plant uptake resulting in rapid decline of soil fertility leading to reduced crop growth and yield. Applying correct amount of fertilisers at the right time is very important to match the crop's nutrient requirement and to avoid nutrient losses through leaching or volatilisation.

Considering the commercial importance of potatoes for the farmers of Eastern and East Central Dzongkhags and to address the issue of low productivity, the National Soil Service Centre (NSSC) initiated a participatory approach which is Farmer-Extension Fertiliser Use Trials (FEFUT) at Thrimshing geog in Trashigang.

FEFUTs are simple balanced fertiliser trials conducted jointly by farmers and extension agents in farmers' field. They are conducted mainly for two reasons. Firstly, farmers and extension can assess the benefits of using improved nutrient management under their own farming system and secondly, by repeating such trials over several years, farmers can increase or decrease the rates of fertilisers according to the crop response and profitability in the previous years.

FEFUT trials include at least two treatments. One is the farmers' practice (FP)-the usual practice of each individual farmer, and the other is the recommended fertiliser nutrient application as recommended by NSSC.

In total, 10 farmers were selected for the potato FEFUT based on farmers' interest and availability of land. The test or treatment plots were initially estimated to be about one langdo (1013 m²) but actually ranged from 606.07 m² to 2,510.08 m². Treatment plots were either sited with each treatment in a separate terrace.

Implementation of the trial activities

were the responsibility primarily of the concerned farmers, supported by extension staff. Extension staff measured the plots, collected soil samples and guided farmers with fertiliser application (quantity, timing etc.) as recommended by NSSC based on the soil nutrient status. The Dzongkhag Agriculture Officer and NSSC provided technical backstopping.

Based on the laboratory analytical results of the soil samples from potato fields in Thrimshing, the average fertiliser application rate for the recommended practice (RP) was Suphala 213.3 kg and Urea 17.39 kg per acre which is equivalent to nutrient application of 40:32:32kg/ac (N: P2O5: K2O). The farm yard manure application in both the plots (RP and FP) was kept constant to 2.5 tac-1.

The rate for fertilisers was adjusted based on the field size and the fertilisers were distributed and applied by the farmers as per NSSC's directives and under the supervision of the extension staff. The fertiliser inputs made by the test farmers recorded by the extension staff revealed that only Suphala was applied on the farmer's plot (FP) far lower than recommended rates. On an average, inorganic fertiliser inputs in FP was only Suphala 70.07 tac-1.

Crop cuts (3 crop cut areas each of 16m²) were carried out from test plots both RP and FP at the time of harvest and accordingly farmer field day was conducted to demonstrate the results.

During the field day farmers were

advised to carry out soil test in every two years in order to determine the status of soil nutrients and to develop fertiliser recommendations to achieve optimum crop production. The objectives of such analyses are to correct imbalances of the major nutrients and to economise on fertiliser costs by applying only what is required for the following crop.

Results

A huge difference was observed between the RP and FP which was shown to the farmers on the spot. The highest yield was recorded in RP with production figure 10.7 tac-1 and the lowest yield was observed in FP with production figure of 2.53 tac-1. The average yield per acre was about 6.58 tac-1 and 4.49 tac-1 respectively for RP and FP.

The results show clear evidence of the benefits of balanced and recommended rate fertiliser application over farmers' practice of using unbalanced fertiliser. Farmers were quite impressed with the yield differences between RP and FP. Generally all RP had higher yield as compared to FP.

NSSC has carried out several FEFUTs with assorted crops across the country and the results are encouraging. Using balanced and recommended rate of fertilisers has always increased the crop production per unit area. NSSC will continue the activity so that farmers are aware of the balanced approach to soil fertility management in increasing crop production and income generation.



“Three eggs per child per week” program expands

B.B Rai, SAP, CoRRB

The “Three eggs per week per child” program has been expanded given its success during the pilot phase and potential in addressing concerns about malnutrition.

Poultry farms in six primary schools were established in 2014 at a cost of Nu. 370,000. A year and a half later 134,230 eggs worth Nu. 1.34 million were produced.

Besides supplementing school meals, the program also taught students how to rear chickens, an activity which may have provided them with a valuable experience that could aid them later in life, such as if they want to self-employ and start such farms for themselves.

The parents of students were also involved, an important element essential for the success of the program. Parents were included in the construction and management of the poultry farms. In the process, they were also made aware of the practical necessity of such farms, another significant requirement given the religious sentiments of some.

The concept of providing at least three eggs per child per week was developed to supplement

nutrition in the feeding schools. Eggs are a very good source of protein, vitamin and minerals, particularly for better eyesight and brain development. A boiled egg provides a minimum of 78 calories, that provides 4 percent of daily caloric requirement. Initial establishment cost and inputs along with providing basic skills are supported by the School Agriculture Program (SAP).



Agricultural education has been an integral part of school education system. About 50 percent of 553 schools (Primary and Higher Secondary) are already practicing agriculture through SAP that is jointly implemented by the Council for RNR Research of Bhutan (CoRRB) and Department of School Education.

In 2000, the SAP was revived from the OXFAM Project that existed till 1994. Today, SAP has become one of the most popular clubs among the member schools.

Classroom teaching has been added with field practical works to produce fresh vegetables to supplement food and nutrition in respective schools.

Providing nutritious food to children in schools require continuous efforts both from parents and government. With sporadic incidences of malnutrition among children in feeding schools, the government has been deeply concerned about the situation. Supplementing nutritious food only through vegetables was not enough. Thus, in order to overcome the gap and to improve the diet in the school feeding program with inclusion of livestock products, the “Three eggs per child per week” poultry program was piloted in six schools in Lhuentse.

Situation analysis: There are a total of 26 schools from primary to higher secondary levels in Lhuentse, out of which 13 schools have feeding support, including five-day schools with day-meal support. Out of 13 schools, six received support in 2014 through Government of India funding to establish the poultry program.

Requirements of egg laying hens: Normally, the Department of

Livestock (DoL) supplies day-old chicks (DoCs) to poultry farmers. However, supply of DoCs to schools will not be practical as there will be very high mortality with the low management practices by students. So, chicks (pullets) to be supplied to schools should be a minimum of 4-weeks old to reduce mortality rate and to ease the management practices. Normally, a hen starts laying eggs by 20-22 weeks. However, laying depends on the quality and quantity of feed provided during the growing stage. So, if schools start poultry farming by the first week of March 2016, they should be able to start collecting eggs by June until end of next academic year November, 2017. Thereafter, the schools should change the stock with a new batch of pullets. A hen can lay eggs for a maximum of two years. Production thereafter will decline by about 40 percent.

Although commercial pullets under proper management practices can produce about 280 eggs on an average, a hen

in school poultry is expected to produce only about 180 eggs per cycle (year).

If a child has to be fed with 3 eggs per week, then it requires 12 eggs per month per child corresponding to 120 eggs per student per academic year of 10 months. Therefore, if a hen can give 15 eggs per month under farmers' management practices, it can give a total of 150 eggs in 10 months. Therefore, one hen per child should be enough to meet the requirement in schools. However, feeding schools may implement the program with a target of achieving at least 50 percent self-sufficiency.

Cost of establishing poultry in feeding schools: Each feeding school will be provided with financial support to purchase construction materials and to purchase pullets and feeds until hens begin laying. Thereafter, the program must sustain through sale of eggs to the school mess.

Monitoring and evaluation: Geog Livestock Extension Officers in collaboration with school authorities, will be entrusted with the management of poultry birds and eggs production. They will also be asked to maintain the record of egg production and submit quarterly reports to the Dzongkhag Livestock Sector with a copy to SAP, CoRRB. The Extension Officer should visit the schools within their jurisdiction and provide necessary technical supports as and when required.

General risks of poultry farming: While eggs are good for health and easy to produce, there may be some associated health hazards. Precaution must be taken while handling and managing poultry farm.

- *An egg contains high cholesterol and saturated fat. Therefore, students might get only protein rich food. Although most of the students are at growing stage and need lots of protein for their body's development, the school diet should be balanced with a diversified menu.*
- *Culling after every two years. This religious sentiments and taboo takes time to change. Thus, schools are not encouraged to cull chickens. Instead it is advised to sell them.*
- *Feeds are expensive. Economic methods of feeding as per body weight have to be adopted in consultation with Geog Livestock Officers. Local feed formulation from locally available grains is also kept as option.*
- *Looking after the flock in winter (holidays). School should entrust this responsibility to the school caretaker, who is supposed to be in school during winter vacation. Proper feeding and drinking water has to be assured.*
- *Bio-security and risk to human health especially during avian flu. Schools should be watchful and listen to the advice of Geog Livestock Extension Officers. Only a few students should be handling the operational works*



such as feeding, watering and egg collection. Students who are involved in collection of eggs and providing feed should have proper garments such as gumboots, long-sleeved hand gloves, mask and cap.

- Disease can kill entire chicken populations. School should have other activities such as piggery, vegetables, mushroom cultivation and fruit plantation to supplement the sustainability of SAP. School should have generated certain fund to re-establish even after the revival of mass destructions.
- Commercial pullet breed are not meant for free scavenging. Although commercial pullets supplied from farms may not depend 100 percent on free range feeding, schools should cut green grasses and feed them whenever possible. Proper feeding plan and eggs production record can generate sustainable fund to feed the pullets.

General findings of the piloted

phase

Poultry program in the feeding schools has been found successful, although there is some resistance from religious groups. However, feeding our future citizens with nutritious food for their wholesome development is equally important. So during this pilot phase of implementation, schools have involved parents actively in construction and management, thereby educating them as well in the process.

Besides producing eggs for supplementing nutrition in their school diet, many students have learnt the process of rearing chickens which will go a long in empowering the youth for self-employment.

The cost of establishing the poultry farm in six primary schools in 2014 was Nu. 370, 000. School management did the construction locally with help of parents. After one and half years 134,230 eggs worth Nu.

1.34 million were produced. Eggs were sold to the school mess at a discounted rate. Some schools made it free. The strategies of sustaining the poultry program differed from school to school as they had to generate revenue to buy the commercial feed. The year ending fund from six piloted schools was Nu. 154,097 that was accumulated from the sale of surplus eggs.

Looking at the successful implementation of pilot poultry program in feeding schools in Lhuentse, SAP in collaboration with DoL is planning future expansion. The second phase of collaboration is aimed to supplement nutrition while providing education in all Central Schools, particularly in poor Dzongkhags. One time intervention with financial support followed by continuous monitoring both from the Dzongkhag and HQ should make the “Three eggs per child per week” program a reality.

Production of eggs during pilot phase in Lhuentse

No	School	Pullets Supplied	Eggs Prod (Jul-Dec 2014)	Eggs Prod Jan-Nov 2015)	2015 Eggs Consumed	2015 Eggs Sold	Cash Generated	Pullets Survived	Remarks
1	Zangkhar PS	150	4310	37670	14160	23510	73240	145	Doing good. Fed 3 eggs/week, 2 eggs @ Nu.5/ and 1 egg free.
2	Ladrong PS	120	5603	19278	4180	15098	-4674	83	Every Monday served 1 free boiled eggs. Feeding problem.
3	Gortshom PS	120	61	7066	1651	7066	68461	0	Fed free 2 eggs/week. Disposed old stock. New pullets will be bought.
4	Tshochen PS	119	1380	6431	1904	4437	-504	0	Fed 3 eggs/week, 2 eggs @ Nu.5/ and 1 egg free. Disposed old stock and made payment for new arrivals.
5	Domkhar PS	118	5004	21810	7188	14622	-426	99	Fed 3 eggs/week, @ Nu.6/egg. and 1 egg free.
6	Wambur PS	119	3300	22317	6660	3607	18000	0	Fed 3 eggs @ Nu.5/- Disposed old stock. New pullets will be bought in 2016 .
		746	19,658	114,572	35,743	68,340	154,097	327	

Total Eggs production (Nos)

134,230

Total value @ Nu 10/ egg

1,342,300

1.34



The amaranthus vegetable, a healthy ingredient to the student's diet

Bhim N. Nayan Dhital, Sinchula Primary School, Chukha

Amaranthus or Aayom in Dzongkha (Lhotsham kha: Lattay, some say Luuday

Bumthang kha: Muuda), is a leafy vegetable that if grown in the schools, could significantly boost the nutrition value of meals provided to students.

This vegetable contains iron, calcium, protein, manganese, fiber and vitamins.

Amaranth leaves and grains can be cooked or fried like spinach. Its seeds also can be consumed like how we prepare pasta. Its tender leaves are eaten as salad.

The word amaranth is derived from Greek word "amarantos" meaning one that never wilts. To us in Sinchula Primary School, amaranth came from Devitar in Dagana as early as March 2015.

Amaranth cultivation is easy. Its grain and leaves are very nutritious. In my school, not many amaranth plants were grown. We could manage only three servings each for 277 students. A few plants were reserved for seed maturation. I hope to share the seeds with my friends in the neighboring schools and to the community members.

Dhan Kumar Rai from Devitar brought some amaranth seeds. I reserved a few beds for its nursery. VeGoTs club prepared the beds of 1 metre breadth and 60cm drains in between. As its seeds are tiny like mustard, heavy splashing

can easily wash it away. Then we sprinkled the seeds in the month of April.

Mulching is very important. Weeding, thinning and watering are essential after germination. In May/June, its leaves can be consumed. We have two types of amaranths-red flowerings and white flowerings. Red is taller than white. White flowering amaranth bears dark green leaves, whereas the red flowering amaranth will have slightly reddish leaves. Process of gardening, consuming and seed saving is the same for both.

In Sinchula, it takes about 10 months for these plants to mature. Therefore, we must allow the plants to flower. We need support at this stage as the seeds are heavy which may lead plants to fall before grains mature to become next year's seeds.

We can cut the flowers very carefully. Like mustard seeds, it can be easily separated by threshing on plastic or paper bags. We must preserve seeds in paper or cloth. Preserving in plastic containers may invite moisture in the long run. However, amaranth seeds are very tolerant and can germinate easily.

There are many health benefits associated with amaranth. It helps to prevent diabetes, heart disease and cancer, among others. Amaranths oil is good for heart-related diseases.

According to local knowledge, amaranth has multiple health benefits. "Elders say that it can relieve body aches and wrench, from the health point of view, I encourage you to grow more," Sanjeev Subba, Sr. Health Assistant at the Sinchula Basic Health Unit said. He added that amaranth leaves are rich in iron and vitamin C.

"We call it pig weed in our village," said Dorji Wangdi from Pemagatshel, a former soldier. Though people of Sinchula are familiar with fat-hen, also called lamb's quarters (bethu in Lhotshamkha); they still say amaranth is new to them.

Aum Dechen, a vegetable gardener, said that amaranthus grow well in her hometown of Bumthang. "We fry the seeds and eat with zaw (fried rice). I heard people grind the seeds with wheat and consume together. But I don't remember eating the leaves. I think it is good to eat the leaves," she said.

Like other leafy vegetables, smaller the leaves, more tender they are. Tender leaves are tastier. Once amaranths start flowering, they are bitter in taste but is still tasty if mixed with root vegetables and bean pods.

I think if we plant amaranths on a large scale, its pink flowers in October, November and December would also provide an aesthetic value.

Woongringmo goes for watermelons

Farmers are now encouraged to go for large scale production

Worried about the stories and images of imported watermelons ripened or sweetened artificially going viral on the Internet?

A solution is on the way. Locally produced watermelons will soon hit the market with farmers in the east taking up watermelon as a cash crop.

To promote home grown water melons, the Research Development Centre (RDC) Wengkhar in collaboration with Dzongkhag Agriculture Sector and Geog Extension Centre initiated a watermelon and onion production initiative in Woongringmo village in 2014.

The village until then had been relying on growing chillies and winter potato. However, given erratic rainfall, pest and diseases, farmers had not been able to reap what they sow.

To start the program, 771 saplings raised in RDSC Lingmethang were distributed to 17 farmers and guided them technically from transplanting till harvesting as an outreach program. Approximately

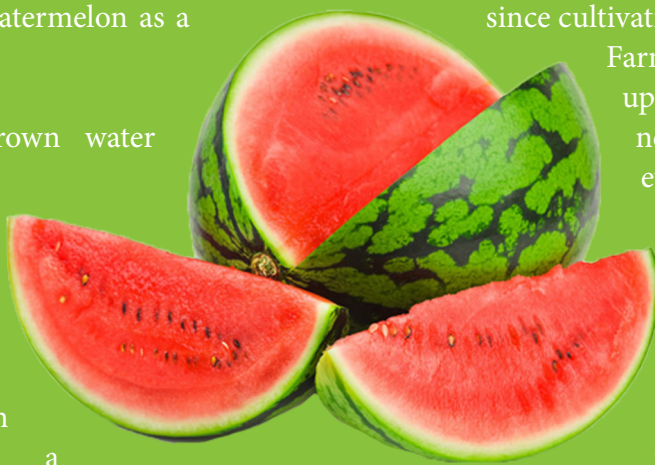
1.20 ac of land were brought into water melon production. Watermelon was ready for harvest in about three months.

At the time of harvest, a field day was organised for the farmers of Ramjar and Yallang to create awareness since cultivation of this crop is new to them.

Farmers were encouraged to take up watermelon production in the next season. Some of the farmers even intercropped watermelon with potato to increase crop intensity.

However, besides the success in production, finding a market was a challenge as production coincided with the availability of watermelon imported from India. Since the first production was not huge in terms of volume, it was not a major problem. Such initiatives will, however, require proper marketing coordination.

A market trial was conducted in Doksum town at the end of the farmers' field day. On an average, farmers earned about Nu.40 per kilogram of watermelon and each watermelon fetched Nu.240. Some of the melons weighed more than 9kgs. The total production in 2015 was 3 MT that translated to Nu. 120,000.



As the watermelon production in Woongringmo was successful, farmers were encouraged to grow them on a large scale. The Sector and RDC Wengkhar have plans to facilitate proper marketing with assistance of Regional Marketing Office at Mongar in the coming season.

Locally produced watermelon could substitute those imported in bulk from the neighbouring states of India. Despite helping farmers earn some extra income, produced with guidance from the RNR sectors, Woongringmo farmers could provide safe and natural watermelons. Watermelon is also now grown in Mongar by a farmer enjoying the fruit of the new initiative.



Rinzin Wangdi of Mongar who took up watermelon didn't know he would reap such a quick return when he took a loan from the Business Opportunity and Information Centre to grow watermelon and other fruits. He earned Nu.60,000 in three months besides getting an opportunity to meet the Hon'ble Prime Minister in his farm.

Meanwhile, in addition to watermelon, farmers of Ramjar and Yallang have also taken up bulb onion production under the Research Outreach Program to intensify crop production and to enhance their income.

Promoting vegetables in schools

The vegetables go to school helps in nutrition deficiency among school children

Thinley Dukpa, CoRRB

The lack of nutrition among school children is a problem in Bhutanese schools. This has resulted in students falling sick or in some case, death.



Considering that vegetables are rich source of nutrition, it was felt important to diversify agriculture to address malnutrition, particularly among children. In 2013, a project-Vegetables Go to School was initiated in the country. A memorandum of understanding was signed between the Council for RNR Research of Bhutan (CoRRB) and the Asian Vegetable Research Development Centre (AVRDC) based in Taiwan with funding from the Swiss Agency for Development and Corporation (SDC).

Thirty-five schools around the country were made members of the project. The schools were divided into intervention and control schools. A Focal Agriculture Teacher (FAT) from every school represents the project in the schools.

In an intervention school, it is supported with input materials such as seeds and simple tools for establishment of vegetable gardens. The project in school emphasises the supplement of food and nutrition, water, sanitation and hygiene (WASH) for health and involvement of family and community.



In a control school, no gardening is practiced and no inputs are supported. They are targeted only for collection of data as done in intervention schools.

The school gardening program gives multiplier effects by encouraging the establishment of private vegetable gardens at the homes of school children. In the school, among the important lessons learned is that a successful school garden program cannot be created in isolation but links must be built between nutrition, health,

and agriculture and education interventions to develop synergy.

School Gardening

Students are involved in a wide range of gardening activities in schools. The children's parents are also involved with the gardens. Soil fertility is a major constraint in all the gardens; however, this is being addressed well through composting.

Teachers in-charges are trained annually on gardening, WASH and nutrition. In this case, focal teachers have good knowledge of gardening, WASH and nutrition issues. Gardening in schools offers hands on, practical learning opportunities in a wide range of disciplines.

Promotional Activities

A promotional programme is developed as a reference material and provided to schools. The school decides how to engage students in learning about and eating vegetables through three types of promotional events: School Promotional Events which includes introduction

of Vegetable of the Month, art competitions, vegetable cook-offs, Family Promotional Events include planting a home garden, Family Day and Community Promotional Events which include Open School Day, and theatre.

“The lack of nutrition among school children is a problem in Bhutanese schools. This has resulted in students falling sick or in some case, death.”

The students are made aware about eating vegetables by providing them with pencil cases with the message “Eat more vegetables”. At the beginning of the school year or semester, teachers distribute index-sized pledge cards to students where students pledge: “I promise to eat more vegetables and wash my hands before I eat.”

Nutritional Promotion Activity

Green Gram Sprouts

Sprouts are germinated seeds of legumes. They are considered a wonder-food because of their high nutritional value. Sprouts ensure blood purification and strengthen the immune system to protect against several diseases. The seeds have the highest nutritional value when they are

seedlings. The sprouts contain a greater concentration of nutrients like Vitamin E, potassium, iron, antioxidants and protein. They also contain other nutrients like folic acid, zinc and magnesium which are very good for development of the brain. Natural sprouts are good for a healthy body and mind development. Considering the benefits of sprouting, the project is exploring the activity in schools.

Focal agriculture teachers in schools were taught how to prepare green gram sprouts. They were advised to feed students with sprouts during meals, which is a good supplement of nutrition for growing children. Apart from nutrition supplement from vegetable products, the students are encouraged to take green gram sprouts for physical and internal development. This is an initiative taken by Country Team Members of the project.

(The Project is supported by the Swiss Agency for Development and Cooperation. The research partners are AVRDC-The World Vegetable Center-Capacity building and project outcome assessment, Albert-Ludwigs-Universität Freiburg (ALU)-Data management (CRE: Creative Research Environment) and Swiss Tropical and Public Health Institute (STPH)-Case studies)

Irrigation channel and farmers' hope restored in Pemaling

Dechen Lhamo, Pemaling Agriculture Extension Centre; Tirtha Bdr. Katwal, RDC Yusipang, and Rinchen Dorji, NBC

There are not many farmers who are blessed with a perennial source of water, both for drinking and irrigation. Farmers of Kataray village, Pemaling geog in Trashicholing Dungkhag are the few fortunate.

But it is an eyesore for the farmers to see the fresh flowing water, the source for over 100 households, who own about 150 acres of paddy fields, not reaching their paddy fields. Ironically, farmers are increasingly facing shortage of water for rice cultivation and fields are left to fallow.

The problem is seepage and leakage. The locally dug earthen and old channel is found to be seeping, leading to huge loss of water. The problem is aggravated during monsoon when landslides wash away huge portion of the channel and the high cost of maintenance.

This is a challenge not only to farmers, but also to agriculture officials as sustaining rice cultivation is fundamental to the On-farm conservation of rice genetic resources. Given the importance, the project on

Participatory Conservation and Utilisation of Rice Genetic Resources for Livelihood and Food Security in Bhutan funded by the International Treaty on Plant Genetic Resource for Food

“This is a challenge not only to farmers, but also to agriculture officials as sustaining rice cultivation is fundamental to the On-farm conservation of rice genetic resources”

and Agriculture (ITPGRFA) offered the much needed support to rehabilitate the 1.50 km long irrigation channel. The project in Bhutan is implemented by the National Biodiversity Centre (NBC).

This came as a big relief to the rice growing farmers of Kataray. The rehabilitation work worth over Nu.1.35 Million was carried out on a cost-sharing basis between

the project and the farmers. The project provided all the construction materials and the beneficiaries contributed labour.

With the forthcoming cooperation and support from the Local Government officials of the geog, the channel was readied for use before the rice transplanting season in 2015.

Farmers are happy with the project. “This channel is our only option to bring water to the fields and we are very luck to receive the project’s support” Kumar Ghalley, one of the beneficiaries said. Today farmers have assured water for cultivating rice and other winter crops.

The project has come as a boon to the farmers. Taking advantage of available water, the Geog Agriculture Centre also initiated diversification of winter crops after harvesting rice by providing wheat and vegetables seeds.

Farmers are also eager to increase rice production by switching to the five good rice varieties that they have selected through the Participatory Variety Selection

farmers' ing geog

(PVS) process initiated by the project.

In addition to the rehabilitation of the irrigation channel, land development to facilitate farm mechanisation has also been started by the Department of Agriculture. The community has also received three power tillers supported by Remote

Rural Communities Development Project.

Farmers of Kataray village are overwhelmed with the support and are keen to restore the fallow wetland. The rehabilitation of the irrigation channel will go a long way in sustaining rice farming and conservation of rice genetic resources in Pemaling geog.



RDC Wengkhār Provide Choices for Fruit Growers

Kiwi, Wengkhār Tshelu Drukchu and Wengkhār Tshelu Ngarm are the newly released varieties

Loday Phuntsho, RDC Wengkhār

What is hairy outside, soft inside and packed with vitamins? Kiwi!

Not the flightless national bird of New Zealand, but the super fruit that is found until recently only in the wild and the latest fruit that are now commercially grown in the country.

“Bumthaps call it Yomrip; Trongsaps call it Lookcho and Thekiphal in the south”

A deciduous vine with broad leaves and cream-colour flowers that bear brown hairy (usually) fruits, Kiwi is known by various names in the country. It is Zhimpeykotong in parts of Trashigang and Mongar, Phangkolom in parts of Trashigang, Thimrup in Lhuentse, Trashiyangtse and some parts of Trashigang.

Bumthaps call it Yomrip; Trongsaps call it Lookcho and Thekiphal in the south.

From a sour fruit grown in the wild, the Research and

Development Centre (RDC), Wengkhār, Mongar studied the prospect of commercialising Kiwi by introducing and evaluating improved varieties. The Technology Release Committee of the Ministry of Agriculture and Forests officially approved the fruit in August 2015 as proposed by RDC Wengkhār for commercial cultivation. Released variety include: Zhimpeykotong Sep, which is hairless with yellow flesh; Zhimpeykotong Jangkhu (hairy with green flesh) and Zhimpeykotong Phoshing (male plant).

Kiwi is a crop for the warm temperate region. It requires 700 to 800 chilling hours below 7°C. In Bhutan, Kiwi can be grown from 1,200 to 2,300 metres above the sea level though its ideal elevation ranges from 1,500 to 1,900m.

Kiwis prefer well-drained soil and area that receives full sun to be able to produce fruit. Heavy clay soils make the plant more prone to root rot.

As they are vines, Kiwi plants require a lot of space to grow. Ensuring that from the start is vital. Depending on the

topography, it should be planted at a spacing of 6 x 4 m or 6 x 6m. Plants are usually trained into pergola system. You can train them on the fence too.

Plants can be propagated through grafting onto its seedlings with almost 100 percent success. It can also be propagated through cuttings though it is not as successful as grafting.

Kiwi plants are normally functionally dioecious and need male plants for pollination. Hence, for every nine to ten plants, one male plant is required for pollinating the flowers.

Pruning and thinning are a must. They are carried out during winter months while the trees are in dormant stage.

Annual pruning and training ensure fruit bearing on strong fruiting branches yielding good quality fruits. It is also essential to keep vegetative branches for foliar growth to prevent the main branches from sunburn during summer.

Fruit thinning is an important operation to yield good quality and marketable fruit size. Fruits

es More rs

that are relatively smaller, diseased, damaged, crowded need to be thinned (removed). After thinning, a tree can give 35 to 40 kgs of quality fruits.

For the want of quantity, not many growers practice thinning. This will compromise the quality and quantity of fruits in the following year. If thinning is not practiced, fruits will be smaller and in the following years production or quantity of fruits will be less because the energy reserve of the plants would have drained out by the excessive fruits.

Kiwi is a climacteric fruit that can ripen even after harvest if they have matured. This enables growers to harvest it when it is physiologically mature. It can be kept in a store for ripening after harvest.

Meanwhile, citrus (refers to a group of fruits that include orange, mandarin, limes, lemons, pummel etc), commonly known as orange though it is a mandarin, is one of the most important export commodities in Bhutan, but the varieties of citrus grown in the country is limited.

Conventionally, in Bhutan, citrus

is grown in a narrow range of 800m to 1,300m above sea level. Out of the 20 Dzongkhags, 17 grow citrus, but only a handful of varieties are grown limiting the choice for growers and consumers.

To commemorate the 60th Birth anniversary celebrations of His Majesty the Fourth Druk Gyalpo in 2015, RDC Wengkhhar released two varieties of citrus mandarin, Wengkhhar Tshelu Drukchu and Wengkhhar Tshelu Ngarm.

Wengkhhar Tshelu Drukchu is one of the most attractive varieties and ideal for 1,200 to 1,500m above sea level although it can also be grown from 800 to 1,700m.

Wengkhhar Tshelu Ngarm is one of the sweetest varieties and is

ideal for growing in low altitude areas, between 800m and 1300m, although it can also be grown from 800 to 1,700m.

Unlike other deciduous fruits, no major pruning is required for citrus except training of trees and thinning of crowded and damaged branches. The best intervention growers could do is practice fruit thinning to encourage quality fruits and avoid cycle of bumper harvest in one year and lean the next year.

Wengkhhar Tshelu Drukchu can be harvested from third week of December while Wengkhhar Tshelu Ngarm can be harvested by January at Wengkhhar conditions. Always avoid injuries to the fruits to prevent post-harvest diseases and damages.



Spring maize: many birds wit

The program allows farmers to extra cash while optimising land use and reducing dependency on import

Dorji Wangchuk, RDC Wengkharchang and Wang Gyeletshen, RDSC Lingmethang

If maize can be grown in varied climatic and soil condition, it is one crop whose production in the country should be enhanced.

Enhancing maize production has the potential to solve some of the growing problems. Besides being a staple crop in most part of the country, increased production could increase the marketable surplus of maize and allow farmers to earn some extra income.

Enhancing production could also reduce the dependency on maize based industries such as Karma Feeds and Army Welfare Project that import their raw materials and maize from across the border.

With these objectives, the National Maize Program (NMP) has started cropping intensification program through initiation of spring maize production to maximise land use. The program started on a small





Killing h a stone

Corporation of Bhutan with the Dzongkhags and geogs through collection points identified by the Dzongkhags.

However, most of the Dzongkhags reported that there were no marketable surpluses except Sarpang. Sarpang managed to market over 31MT of maize mainly to local vendors and is estimated to have earned around Nu. 0.50 million at a conservative estimate unit price of Nu.13/kg.

Similarly, the production from Mongar, Thridangbi has been used for Tengma processing and as of now the farmers processed 75MT of Tengma from spring maize and earned an income over Nu. 2.74 million.

Nonetheless, the Dzongkhags reported that the farmers have used additional maize produced for meeting their feed needs for back yard dairy and poultry. This has greatly reduced their dependency on commercial feeds.

For instance, Samtse reported that through the spring maize program the production has been greatly enhanced and the farmers of Yoesletse and Ugyentse geogs could greatly reduce purchase of feed for their backyard dairy and poultry.

The results are indicative that the spring maize production is contributing to household food as well as feed security.

scale to test the feasibility of maize production as a pre-rice crop in fallow paddy fields, especially in the southern belts.

A total of 4.4 metric tonnes (MT) of seeds were supplied to six Dzongkhags. The program also introduced five hybrids for evaluation from DuPont Pioneer, India.

Spring maize is sown in January to February and harvested by June or July. This allows farmers in rice growing regions to cultivate paddy after the maize

harvest. This way, farmers could take advantage of the limited land holdings.

Spring maize production in 2014 season was encouraging and the program was up-scaled in the 2015 season. Large-scale spring maize production was carried out in 12 major maize growing Dzongkhags. A total of 75.6MT of seeds were distributed to the farmers covering over 4,797 acres.

Marketing of surplus production, if any, was planned to be facilitated by linking the Food

Details of spring maize marketing in Sarpang

Sl. No.	Geog	Qty (Kg)	Collection Point	Remarks
1	Senghe	13000	Thoemba	Local sale
2	Shompangkha	1004		Sold to BMG, Chokhorling, Sarpang @ Nu. 13 per kg
3	Dekiling	1760	Chokhorling	Local sale
4	Samtenling	2500	Samtenling	Local sale
5	Sershong	150	Norbuling	Local sale
6	Chuzergang	8150	Geog Centre	Local sale
7	Umling	2000	Geog Centre	Local sale
8	Taraythang	2800	Geog Centre	Local sale
	Total	31364		

Expanding rice cultivation in Bumthang

Kencho Dem, Chhokhor Agriculture Centre; Rabgyal Drukpa, RDC Jakar and Ngawang Chhogyel, RDC Bajo

"Among the varieties, Jakar Rey Naab gave the highest yield of 2,763 kg/ac, followed by Khangma Maap with 1,963 kg/ac."



Bumthang is situated at 2600masl. It is one of the non-traditional rice-growing Dzongkhags in the country. Rice is grown in the Dzongkhag's two geogs of Chhokhor and Tang.

Cultivation of rice in Bumthang started over a decade ago with a release of a cold-tolerant higher-yielding temperate rice variety known as Jakar Rey Naab. The Dzongkhag continued to increase rice area and, currently, Bumthang grows rice on approximately 175 acres of land.

However, like any other rice ecosystems in Bhutan, Bumthang's rice is observed to be under severe threat of blast and other diseases. There is thus a need to introduce some disease resistant varieties.

The Research Development Centre (RDC) Jakar evaluated four potential varieties-Khangma Maap, Jakar Rey Naab (whitish hull), Jakar Rey Naab (awned) and Chandanath 3 for a period of over six years. In 2015, the four varieties were taken to the farmers for demonstration.

The on-the-farm demonstration was carried out at a village called Kharsa Goling located at 2,700masl to demonstrate the

feasibility of rice cultivation in collaboration with the RDC Jakar and the Dzongkhag.

Assessment of crop performance during the farmers' field day showed that the test varieties performed fairly well. Among the varieties, Jakar Rey Naab gave the highest yield of 2,763 kg/ac, followed by Khangma Maap with 1,963 kg/ac. The two other varieties-Jakar Rey Naab and Jakar Rey Naab did not do well.

The crop performance assessed from the rice demonstration trial at Goling Kharsa showed that Jakar Rey Naab was still the best variety for Bumthang. Khangma Maap could also be grown as an option.

Farmer participants during the field day agreed to try Khangma Maap as it was observed to be more resistant to blast than Jakar Rey Naab. The Department of Agriculture will have to continue with evaluation of high altitude rice varieties in order to field a variety better than the Jakar Rey Naab.

Meanwhile, the farmers of upper Chhokhor have shown keen interest to grow rice and few of them are all set to terrace their land to start rice cultivation starting next season. So, it is expected that Bumthang will have over 200 acres of rice area in the next few years.

The details of crop yield information for these test varieties are presented in the table below:

Sl. No	Varieties	No of tillers/hill	Plant height (cm)	Straw fresh weight (kg)	Grain yield (t/ac)
1	Jakar Rey Naab	18	106.45	5.15	1.72
2	Jakar Rey Naab (awned)	24.4	105.2	10	0.50
3	Khangma Maap	11.2	106	7	1.23
4	Jakar Rey Naab (whitish hull)	Discarded			

From the Andes to the Himalayas

Peruvian quinoa can adapt well in Bhutan

Cheku Dorji, RDC Bajo

Considering its high nutritive value, the Department of Agriculture (DoA) with the support from FAO introduced two varieties of quinoa-Amarilla Marangani and Amarilla Sacaca-from Peru for evaluation and adaptation in Bhutan.

Quinoa or quinoa (Chenopodium quinoa Wild) is native to Andes Mountains of Bolivia, Chile and Peru. This annual species belongs to goosefoot family and is related to weed, common lambsquarters. Quinoa is known for its genetic variability, wide adaptability and nutritional quality. It is sometimes referred to as “pseudocereal”, similar to buckwheat and amaranth and is a highly nutritious food. It is used to make flour, soup, breakfast cereal and alcohol. Quinoa flour works well as a starch extender when combined with wheat flour or grain, or corn meal, in making biscuits, breads and processed food.

As part of the nation-wide testing,

the Research Development Centre (RDC) Bajo evaluated two Quinoa varieties in the Phobjikha valley to assess the performance of the two varieties in the Bhutanese highlands.

As suggested in the protocol, the trial was established in Phobjikha

“Growing quinoa will not only increase dietary intake of plant proteins but will also be a source of income and food security to the farming families.”

farm at an altitude of 2,980masl, laid out in large single plots covering an area of 50m² each.

The field was ploughed and rotavated twice with power tiller. The seedbed was well leveled and drained to avoid water logging. The seeds were sown on March 27, 2015 in line for easy weeding with row-to-row spacing of 50 cm. Seeds were sown uniformly and at later stage, the plants were

thinned to maintain plant-to-plant spacing of 25 cm.

The evaluation observed that there was enough moisture and irrigation was not necessary after sowing.

Approximately 200kg farm yard manure was used during land preparation in each plot as suggested in the research protocol. It was well incorporated with soil and top dressed with Nitrogen @ 70 kg /ha. Weeding was carried out manually once a month after plants were between 30 and 35 days old. No pest and diseases were observed during the growth stages.

The crop was harvested manually on November 24, 2015. Three crop cut samples were taken from each variety with a sample size of 6m² each. It was observed that there was more rainfall in 2015 due to which there was less sunshine resulting in reduced photoperiod. As a result, most of the day temperature remained low and affected the plant growth.



The crop matured very late and harvest was delayed by about 80 days. If the climate and other factors remain normal, these two quinoa varieties are suitable and will perform better at the elevation of 2,980masl.

The results of the trial will be of importance in deciding whether quinoa should be introduced to family farming as an additional high quality protein to the diet. Growing quinoa will not only increase dietary intake of plant proteins but will also be a source of income and food security to the farming families.



The crop is at production trial at Phobjikha, Yusipang, Khangma and Jakar. Production trial will be conducted at mid and low altitude and in the coming time, the crop will also be tried at higher altitude areas of Merak, Sakteng, Gasa, Laya and Lingzhi.

The findings will also be useful in determining ecological requirements, suitable cropping systems, management practices and the most suitable varieties of quinoa for the specific conditions of the selected sites in the country. It will also help the agriculture sector make informed decision on conducting further trials to scale up quinoa production for enhanced nutrition and eradication of hunger.

Introduction of farmer-to-farmer extension program makes differences in agriculture

Kinley Tshering, Tashi Phuntsho and Sangay Jamtsho, RDC Wengkhar

National Extension System that provides agriculture extension services through Dzongkhag and geog extension centres scattered across the country is witnessing a gradual change.

“A total of 24 trained farmers who were further groomed with some additional skills which were not covered in the past trainings and created them into lead farmers to demonstrate their skills and knowledge’s to other farmers.”

It is shedding its conventional role of being input supplier to being one of facilitator. Given the country’s rugged terrain and limited resources(financial and human), among other challenges,multitasking has become necessary.

There is also, at the same time, widening gap between research and extension. Beginning

2002, therefore, the Research Development Centre (RDC) East started implementing the concepts of research outreach program to expand research services beyond the research centre, particularly in farmers’ fields by focusing on a village or a particular cluster of farmers instead of scattering around and diluting the efforts and resources. RDC Wengkhar, for instance, deployed several extension methods such as training of farmers groups in crop cultivation practices-mainly fruits,vegetables and cereals crops such as upland rice and maize. Production supports were provided through projects and demonstration farms established.

More than 500 demonstration orchards and 10 fruit nurseries were established along with 14 vegetable seed growers and nine community-based seed production groups.

Focus development of extension method called the Focus Village was introduced that focused on





the development of one village in one Dzongkhag. That helped create 25 citrus villages in the east. By the end of 2014, the centre selected a total of 24 trained farmers who were further groomed to act as lead farmers. Farmer-to-farmer extension training was carried out in some of the villages to test the effectiveness of the approach under MAGIP IFAD and HRDP Post project activity.

Farmer-to-farmer extension training program was implemented in Thragom and Ramjar villages in Trashiyangtse, and Bangtsho and Umling villages in Lhuentse. The training program on fruit orchard development and management focused on planting methods,

after care management of newly established fruit orchards, and training and pruning.

RDC Wengkhar and the geog agriculture sector facilitated the training program by mobilising the lead farmers to train other farmers. Norbu from Tsanrung, a lead farmer, trained 13 farmers of Ramjar on January 29, 2015. Dorji Rinchen from Yallang trained eight farmers of Thragom

on March 8, 2015, and Rinchen Wangdi from Wambur village trained 22 farmers in Bangtsho and Umling villages on March 10, 2015.

The use of this approach showed that it firstly makes training more effective as there is additional facilitator in addition to the extension staff. In the scenario where extension staff is on study leave, lead farmers could



New bird record for Bhutan

Burmese Shrike (*Lanius collurioides*) is the new bird species recorded for Bhutan. The bird weights about 26.2g with wing 8.6cm, tarsus 2.8cm and tail 9.3cm long. Some of the distinctive features of the bird are its dark chestnut mantle, white tail sides and chestnut rump.

The mist-netting team (Sherub, Ugyen Tenzin and Karma Wangdi) from the Ugyen Wangchuck Institute for Conservation and Environment (UWICE) sighted the bird in the "Scrub I" net line on 2 April 2015 at 8:00am. The team said that an insectivorous bird shrike has come back from their winter grounds in the altitudes. Capturing of the Burmese Shrike at this elevation is the highest record and on the western most in its distributional limits.



Source: UWICE



conduct training. The use of lead farmers also provides a platform for individual farmers to boost their confidence and be more responsible. Creating lead farmer along with demonstration farms have not only effectively delivered supports to the beneficiaries, but also equipped the farmers with the adequate skills.

The lead farmer approach to strengthen farmer-to-farmer extension will be proposed as one of the extension approaches in the implementation of the agriculture production support program under different projects/ programs. RDC Wengkhari will create lead farmers on an annual basis by targeting specific farmers with potentials of becoming lead farmers.

These farmers will be selected and nominated by the Dzongkhag Agriculture Sector based on the farmer's interest and potential. Priority will be given to farmers who are members of existing farmers' groups.

The lead farmers will be provided with adequate training on various topics planned across the year on the training calendar.

In order for the lead farmers to effectively demonstrate their skills, the farmers will be supported with incentives such as materials to develop their field-planting materials, seeds, simple irrigation equipment and plant propagation tools, among others. At the end of the year, upon completion of the lead farmer training, the project management and RDC Wengkhari certify and hand them over to the geogs.

The farmers would not only have benefited directly from the program by initiating development in their own farm but will also have enabled them to share their skills with others in the community. This batch of farmers will then be able to provide services to supplement further programs under Dzongkhags and geogs by conducting target trainings for other farmers.

Farm mechanisation in Maenbi geog

Wangchuk, Agriculture Extension Centre, Maenbi, Lhuentse

Maenbi geog in Lhuentse which is located 10km drive away from Mongar-Lhuentse Highway, follow mixed integrated farming (agriculture with livestock) pattern.

Paddy is the staple food crop grown in the geog. Maenbi has a total of 832.335 acres of wetland. About 60 percent of agricultural work is done traditional way. Only about 40 percent of the people in the geog use power tillers.

They pay Nu. 2,000 hire charge per day. Households with fewer members are often unable to hire a private power tiller and because of this, many farmers prefer to work at construction sites. This results in large scale fallowing of agricultural land. Records show that about 332 acres of land have been left fallow in Maenbi.

The geog recently got a power tiller. The farmers now are debating how to make best use of the one power tiller that the government provided to the geog. Farmers are worried that this might lead to problems in the community.

Thus, to prevent contention among villagers, geog agriculture sector has implemented some strategies. Public consultations are held to create awareness about guidelines, feasibility studies are conducted and demand list collected from the farmers. Power tiller has been identified

and work plan drawn to deploy the machine. The geog has put a requisition for additional power tiller.

The geog has to ensure that the machine has no technical problems. Operator will be briefed

about reporting time and working hours and timely arrangement of fuel and spare parts should be maintained. Operator should also maintain daily log book and inform farmers about their bookings.

Constraints	Remedies
First hand (new) implementation	Lacks how best to implement but could overcome with series of consultation meeting
Lack of skilled/unavailable operator	Many private operators are there but face challenge in selecting efficient operator. Over the time with hardship could manage to overcome the issue
Timely information dissemination	Lack of communication facilities and manpower shortage at geog. But personal sacrifices and support from colleague has helped to address the issue
Lack of power tiller track	Usage of machine is limited to availability of power tiller track
Unfriendly land terrain	Widening of terraces
Lack of power tiller shed (frequently lost of spare parts)	Frequent loss of spare parts occurred in the geog due to lack of power tiller shed. This has been hampering timely delivery of services to the farmers since farmers have to wait until new parts have been arrived.

Super Grain Bags to the rescue

An Eco-friendly and pesticide-free technology to manage storage insect pests

In what could discourage the use of synthetic insecticides during grain storage, an inexpensive and safe technology, the Super grain bag, is demonstrating its effectiveness in eliminating storage insects and prolonging the storage life of grains.

In Bhutan, Maize is a second important staple after rice, and it ranks first among food crops in production. It is grown mostly in the southern and eastern parts of Bhutan. Maize grains are stored for both seed and consumption. Most of the damage to maize and rice grains is caused by maize weevil (*Sitophilus zeamais*), rice weevil (*Sitophilus oryza*), lesser grain borer (*Rhyzopertha dominica*) and Angoumois grain moth (*Sitotroga cerealella*) in storage. Traditional methods of storage insect control like sunning, admixture of grains with ashes, smoking, shelling, rough grinding and air tight storage are still practiced but are ineffective in controlling the storage pests. In several stores, synthetic insecticides are also used to kill the storage insect which poses

health hazards.

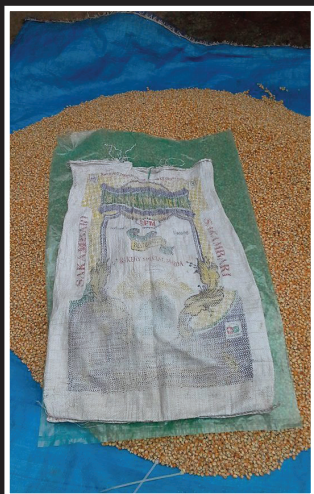
The National Plant Protection Centre, (NPPC) has been exploring safe grain storage technologies for the last several years. Amongst several available storage methods, the super grain bag has been found most appropriate for household grain storage.

This technology has been demonstrated on-farm in several south East Asian countries and found effective in preventing cereal grain losses to storage pests. The field demonstration trial implemented by NPPC in 2014 in Mendrelgang geog in Tsirang using super grain bags has shown excellent results in reducing storage losses due to storage insects and in maintaining the grain quality for extended periods.

Super bags work on the principle of “hermetic storage” where flow of oxygen and water from the outer environment is completely checked. This prevents damage and proliferation by storage insect

pests and helps reduce grain losses without using any insecticides. Live insects in the bags have been observed to die after 1-2 weeks of storage. Additionally, it greatly helps preserve the quality, germination and vigor of the seeds. It can be used to store a wide range of commodities (maize, paddy, milled rice, wheat, millet, beans, coffee, soybeans etc.).

These bags are produced by using Ultra high barrier specialty blend of polymers and low-density polyethylene as inner liner, which provide an effective and hygienic feature. With the help of superior quality super grain bags, the quality, texture, colours, fragrance and flavour of the grains are maintained for a long period of time. These bags are helpful for elongating the shelf life of the various grain products. Super grain bags are inexpensive and the price ranges from Nu.100-150 for a 50kg capacity bag. The Super grain bag is a product owned by GrainPro Inc Company, Philippines.



“Super bags work on the principle of “hermetic storage” where flow of oxygen and water from the outer environment is completely checked”

Steps for using Super grain bags

1. For maize and rice grain storage make sure that the grains are properly dried (<12% moisture content)
2. Place the super grain bag inside another bag such as a jute bag
3. Carefully put cereal grains in the double layered super grain bag. Do not overfill the super grain bag
4. Fill the super bag with dried seed or grain
5. Remove air from the bag completely. To remove air, press from both sides of the super grain bag to remove air from the bag. Then twist the free plastic to fold it into two
6. Tie off the twist part of the super grain bag with a strong rubber band or an adhesive tape
7. Close the outer bag by tying or sewing. Make sure not to puncture the super grain bag

Precautions for using Super grain bags

1. Make sure that the grains or seeds are properly dried. It is recommended to store the seeds in the super grains bags right after drying to prevent the initial pest infestation.
2. Place the super bag inside an existing type of storage bag (e.g., jute bags)
3. Don't overfill the super grain bags
4. Remove excess air from the super grain bags completely
5. Don't puncture or damage the super grain bags
6. Never carry the grain by holding on to the Super bag, always use the outer bag for carrying
7. Seal properly to prevent the gas exchange between the super grain bags and outer environment
8. Do not use hooks to hang the bags

New Frog record for Bhutan

Jigme Tenzin, College of Natural Resources



Leptobrachium bampu (Sondhi and Ohler) is the new frog species recorded for Bhutan. It was recorded in Pakhola stream (Simkharthang) under the rock crevices at an altitude of 1610 masl in Jigmecholing geog, Sarpang. A team of researcher sighted the frog during the Himalayan Bull frog survey in April 2015 carried out with fund support from Rufford foundation. With this addition, Bhutan will now have 36 species of amphibians.

Leptobrachium bampu is Anura group under Megophrydae family in which there are seven species recorded in Bhutan. Its distinguishing characteristic is the uniform grey-blue coloration of the iris and pupil is vertical and black. The head is wider than it is long. Snout and dermal projections are absent unlike some members of *Leptobrachium*. Tympanum is indistinct. Skin on dorsal and lateral parts of the head and body have fine ridges forming reticulum, lending it a wrinkly appearance.



9. After use, clean, dry and fold the Super grain bags for future use

Why is a Super bag important in relative to traditional storage systems?

1. It extends the viability of cereal seed for planting from 6 to 12 months
2. It prevents cereal grain pests (without using any chemicals)
3. When properly sealed, respiration of grain and insects inside the bag reduce oxygen levels from 21% to 5%. This reduction reduces live insects to less than 1 insect/kg of grain without using insecticides (often within 10 days of sealing)
4. The stability of controlled grain moisture inside the bag prevents wetting and drying of grain. This stability reduces the extent of grain cracking
5. Properly dried grains stored in Super grain bags prevents fungal infection of grains
6. Super grain bags are affordable and reusable

In order to promote Super grain bag for cereal grain storage, the NPPC in collaboration with Sarpang Dzongkhag Agriculture Sector distributed 20 Super grain



bags to the interested farmers of three geogs, Chuzergang, Dekiling and Gelephu. The main objective of the promotional activity is to study farmer's response, comments, acceptability and feasibility to Super grain bags. The focus is to compare the traditional method and Super grain bag in storing cereals in enhancing the grain quality, fragrance, shape and size, aroma, kernel conditions, the level of storage infestation and ease of handling.

In the farmer's field, maize and rice grains were stored in both Super grain bags and white woven sacks. White woven sack is used as control. After storing grains until planting season in the two different bags, grains will be inspected for quality, fragrance, shape and size, aroma, kernel conditions, the level of storage infestation and ease of handling.

The final report will be compiled after collecting these data. If the Super grain bag is found effective in preventing cereal grain insects and improve grain qualities at Sarpang, the technology will be promoted in other Dzongkhags where storage insect pests have been a major problem.

Declaration between EU and Bhutan on Climate Change signed in Paris



Source: Royal Bhutanese Embassy Brussels, Belgium

The Hon'ble Agriculture Lyonpo, Yeshey Dorji and Mr. Miguel Arias Canete, EU Commissioner for Climate Action and Energy signed the Declaration European Union– Kingdom of Bhutan Cooperation on Climate Change” on 10 December 15 in L’e Bourget, Paris on the sidelines of the UNFCCC COP21.

The Declaration takes cognisance of the need for a robust framework for transparency and accountability to enable effective processes for stocktaking as to whether Parties are collectively on track to achieve the long-term goal and strengthening Parties’ emissions reduction targets.

The Declaration recognises Bhutan’s unique situation as a land-locked and least developed country with a fragile mountainous environment and

the scale of funding requirement to address sustainable development needs including climate change mitigation and adaptation action significantly higher than presently available. It calls on the international community to support Bhutan’s efforts as described in its INDC.

Under the Declaration, Bhutan is recognised for its leadership role and the extraordinary ambition in addressing climate change efforts and considers Bhutan’s climate change policies as exemplary.

The Declaration reflects the intent of Bhutan and EU to intensify their cooperation on climate change focusing on enhanced support for the implementation of Bhutan’s INDC. Importantly, the Declaration call on other Parties in a position to do so to join this effort, taking into accounts

Bhutan’s extraordinary ambition.

EU is one of Bhutan’s close development partner and has committed €42 million for the period 2014-2020, focusing on sustainable Agriculture/ Forestry and Civil Society/Local Authorities. More specifically, the EU supports Bhutan in enhancing the resilience of rural households to the effects of climate change, as well as the sustainability of renewable natural resources through the Global Climate Change Alliance.



Vegetable production picks up in the East

DK Bhujel, Construction Development Corporation Limited

*“Farmers’ groups
and cooperatives
under this
programme
have traded
1,935.63MT of
assorted vegetable
worth Nu 38.81/-
million in 2014”*

Attaining self-sufficiency through enhanced production and marketing of agricultural products has been the major focus of the government for quite some time now. The increase in production and marketing of agricultural produce will not only help government fulfill its long-term objective of self-reliance but will also enhance household income, enhance nutritional intake and generate employment opportunities to a large section of nearly 69 percent of the population who are engaged in farming activities.

The Vegetable Value Chain Programme in the East (VVCP-E) started by Regional Agricultural Marketing and Cooperative Office, Mongar under Market and Growth Intensification Project (MAGIP) framework of IFAD with technical support from SNV has been one of the initiatives aimed for this very purpose. The objective of the program was to introduce semi-commercial vegetable production in the region to enhance the rural household income with increased focus on commercialisation.

The program that started with 69 farmers' group (FG) and cooperatives covering 20 geogs of the six eastern Dzongkhags in 2012 has reached 146 FG and

schools and institutions. Some FG and cooperatives are also taking seasonal advantage and exporting summer vegetables to India through auctions at the border towns. Since the start of VVCP-E

under the VVCP-E program not covered through linking program, sell their produce directly to local markets and even auction it through Food Corporation of Bhutan's auction yard to the neighboring state of Assam in India during peak season.

Summary of VVCP-E program as of 2015 along with Gender

Farmers Groups under VVCP-E in 2015						
Sl. No.	Dzongkhag	No. of Geog covered	No. of Farmers' Groups/Cooperatives	Total members		
				Male	Female	Total
1	Lhuentse	8	19	74	148	222
2	Mongar	10	31	77	285	362
3	Trashiyangtse	7	17	102	144	246
4	Trashigang	12	55	262	374	636
5	Pemagatshel	3	16	114	156	270
6	Samdrup Jongkhar	4	8	68	70	138
Total		44	146	697	1177	1874

cooperatives in 44 geogs out of 70 as of June 2015. The program is said to have already benefited 1,874 households in these geogs today.

Although production of vegetables in commercial scale has been of recent origin in the country, it has picked up quite well in the east. In the past, FG were mainly subsistence producers with little surplus for sale. Now with enhanced production and market infrastructure in place, system of marketing has drastically improved.

Farmers are seen selling vegetables in domestic markets including weekend market, roadside sales counter and linked market such as

in 2012 and up until 2014, farmers have traded 1,520.74 MT of assorted vegetables worth Nu.64.61 million through local markets and to schools and institutions.

One of the major markets for vegetables under VVCP-E program has been the schools and institutions in the region. Out of 146 FG under the VVCP-E, 98 FG and cooperatives have been linked with 47 schools and institutions located within the region for the supply of agricultural products throughout the academic year.

The linking program is said to have benefited some 1,303 households and 9,371 students in total. The remaining cooperatives

Linking program is believed to have benefitted the both farmers as producers and school as consumers for many reasons. Farmers have been able to enhance their household income through increased vegetable production and marketing. There are now permanent markets for their produce and schools and institutions offer them fixed price so that they do not have to worry about price fluctuation.

Schools and institutions as consumers on other hand have equally benefited from the linking program. More varieties of vegetables are now available for consumption with improved freshness and nutrition as produce are supplied on a weekly basis directly from the farmer's field.

With minimum pesticides contents and freshness, it has provided students with greater health benefits through improved nutrition intake. Regular and constant supply of vegetables from farmers' field has helped schools minimise wastage and spoilage during storage.

Three years on, the impact of VVCP-E is visible with some concrete outcomes. A gradual shift from subsistence to semi-commercial production of

Summary of schools/institutions linked with FGs for supply of RNR produce in 2015

Sl.No.	Dzongkhag	Schools/college					Institutes		Total Schools/institutions
		Pri- mary	LSS	MSS	HSS	Col- lege	Dra- tshang	Training institute	
1	Lhuentse	0	2	3	1	0	1	0	7
2	Mongar	2	1	2	3	0	0	0	8
3	Trashiyangtse	0	4	1	1	0	0	1	7
4	Trashigang	1	3	4	4	1	2	2	17
5	Pemagatshel	2	2	1	1	0	0	0	6
6	Samdrup Jong- khar	0	1	0	1	0	0	0	2
Total		5	13	11	11	1	3	3	47

vegetables is being observed with an increasing trend in vegetable cultivation for commercial purpose among the farmers in eastern region now.

Considering its success and further scope for expansion, more farmers are showing interest to form FGs and cooperatives focused on vegetable cultivation.

It has also been observed that women form the majority (62.81 percent) among the members. This shows that women are actively participating in economic activities such as cultivation and marketing of vegetables.

Diversity in vegetable production has been another effect seen with more than 25 different vegetables,

spices and other edibles being traded in 2014. The program has greatly helped farmers produce new varieties of vegetables that were previously not cultivated. This also means that more vegetables are there for the customers to choose from in the market.

Overall, FGs and cooperatives under this program have traded 1,935.63MT of assorted vegetable worth Nu.38.81/- million in 2014 alone, which has greatly helped reduce the imports of vegetables in the country, partially helping in realising the country's vision of attaining food self-sufficiency.

However, challenges still remain. The region being new to commercial production of vegetables, have been facing challenges related to both production and marketing alike. Some of the challenges are quite old and general, others are fairly new and specific.

The human-wildlife conflict,





irrigation problem, pest and diseases, farm labour shortage, limited land holdings and lack of credit facilities are some of the challenges specific to production. Weak road networks combined with high transportation cost, lack of market and infrastructure, inability of farmers to understand market dynamics, lack of coordination among stakeholders are some of the other issues hampering the programme.

In a program like this involving multi-sectorial involvement, collaboration and coordination among the relevant stakeholders is of paramount importance. The need for collaboration among stakeholders such as Department of Agriculture, Department of Livestock, Department of

Forests and Park Services, Research Centres, Department of Agricultural Marketing and Cooperatives, Dzongkhag and Geog Administration remains crucial at all point of time.

Research Centres and technical departments with vast experience in horticulture development in hilly areas can put their expertise to develop varieties suitable for different locations according to market preferences. Accordingly, introduction of innovative and affordable cultivation and storage techniques, better irrigation system and innovative system to tackle human-wildlife conflict is vital.

The continuity of such initiative depends largely on fixing

responsibility among the stakeholders, which is quite lacking at present. The inclusion of such programme in the Annual Performance Agreement of Dzongkhags signed with the government will go a long way in developing the program thereby guaranteeing its continuity.

The new initiative of the present government to come up with central schools around the country gives huge potential for up-scaling the linking program. But recognising the existing challenges and tackling them pragmatically will greatly help in making the most out of on new opportunities that lies ahead.

Reducing the yield gap: Making the most from limited resources

Innovation, better management practices and adopting new technologies are the keys to maximising our agricultural production

DK Bhujel, Construction Development Corporation Limited

Principle of production ecology states that the actual production in the real world is much less than what plants potentially can produce.

Potential production is determined by growth defining factors such as genetic factors and climatic conditions, however, limiting factors such as water and nutrients, and reducing factors such as weeds, pests, diseases and pollutants further reduce the production. The difference between potential production and actual production (production at the field level) is called the yield gap. To further limit the actual production, there are post-harvest losses such as damage of crops by insects, rodents and losses during the handling process.

Yield gap differs from place to place and region to region according to the agricultural system practiced, and vulnerability of that region to various limiting and reducing

factors. If the yield gap is less, not much can be done to minimise the gap. However if the yield gap is substantial, a lot can be done to increase actual production.

The yield gap is large in developing countries due to the lack of best management practices. Developing countries are not even able to tackle the basic challenges of limiting factors such as water and nutrient shortages and reducing factors such as pests and diseases including wildlife damages. On top of that are the external factors such as farm labour shortages, lack of mechanisation, and lack of knowledge in use of chemicals.

Nonetheless, developing countries are also facing food insecurity and population explosions. The increase in population and changing food demand will create a huge pressure on meeting food and nutrition requirements of the world whose expected population is predicted to touch 9.6 billion

people by 2050. For example, the African region has the largest yield gap (more than 60%); subsequently, it is also the region which is witnessing population growth at an unprecedented rate. The South Asian region to which Bhutan is a part of, is in no better situation. The region which holds almost one fifth of the world's population and is growing rapidly, has a substantial yield gap.

Looking from the opportunistic point of view, the region can feed its growing population fairly well if it successfully reduces its yield gap. Reducing yield gap basically means to increase production by reducing losses in the production process with better management.

Solutions

One realistic option towards meeting the growing food demand is to close the yield gap as far as possible with innovation, better management practices and new technology. Adopting and learning management practices

from advanced countries and applying it in the local context will help in increasing actual production.

Land cover on earth being finite, there is a lot of pressure on existing land for various purposes. Some of the major competing factors over use of land cover includes land use for developmental purposes, urbanisation, maintaining forest cover, alternative crop production (bio-fuel, jute, cotton, medical plants etc.) and growing feed and fodder for animals. With pressure mounting on existing land areas and its use, the only option viable would be to produce more from given land cover and the best possible way to increase production from same land area would be to close the yield gap.

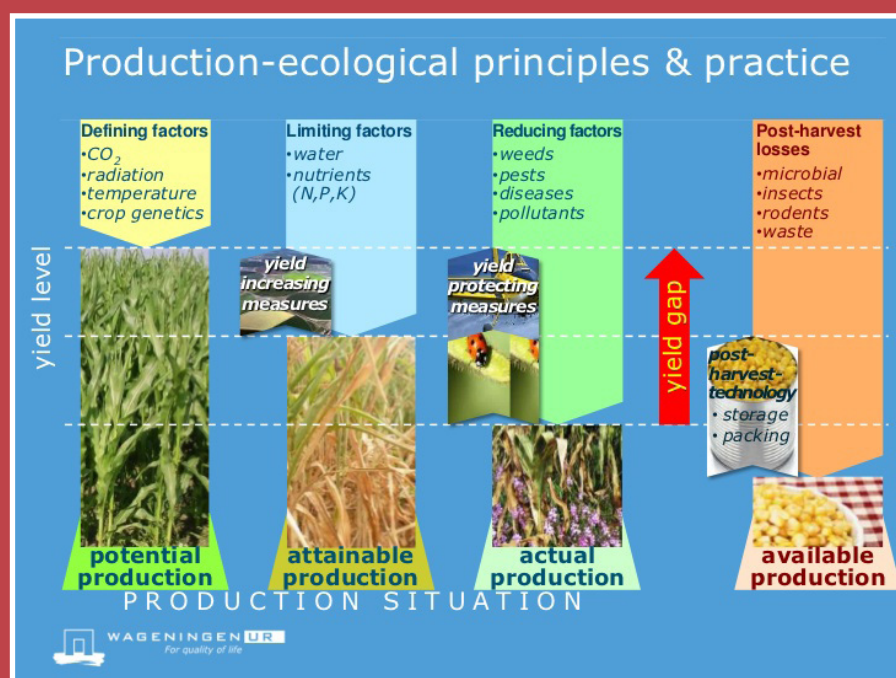
Increasing food production from limited land will require increased productivity from the same existing land. Limiting factors like water and nutrient shortages must be eliminated with reduction in pre-harvest losses such as losses in the field, as well as post-harvest losses such as storing, processing, marketing, distribution and consumption. Moreover, reducing yield losses with increasing resource use efficiency would also mean saving land for other purposes.

In addition, introducing improved varieties, better management practices, introducing heat, drought, pest and disease-tolerant varieties, better marketing and supply chain facilities at places would equally help curb the yield gap and post-harvest losses. Combined, such measures will go a long way in solving the food crisis that the world will most definitely face if not considered from the beginning.

A holistic approach considering all factors must be taken in consideration in understanding the yield gap with the objective of overcoming it. Understanding climatic conditions and the changing weather pattern of the region, temperature, soil types, cropping system and cultivars of crop in question will better equip us in dealing with the yield gap.

Principle of production ecology supports this option of growing our future food because it explains production processes of plants and factors influencing and affecting the growth. A thorough knowledge of such factors that affect the growth and production of plants are necessary for prescribing any preventive measures.

Learning these general factors and solutions can help people apply the knowledge in their own local context according to the need and severity of the factors. Proper applications of such knowledge to achieve better production, thus reducing the losses that occur at various stages of production will go a long way in solving the food insecurity of any country and global food crisis that the world is likely to face in near future.



Highlights of 2015



Wildlife Clinic and Laboratory

January 30, Thimphu: The Hon'ble Secretary, Dasho Tenzin Dhendup inaugurated the first Wildlife Clinic and Laboratory at Taba to provide timely and reliable services to the injured wild animals.

The unit will treat the injured and diseased wild animals. The laboratory will also carry out research and experiment to avoid zoonotic diseases from spreading to humans while also treating the injured wild animals. The injured animals are kept and looked after in an enclosure.

The centre has one manager, one veterinarian, two trained rangers, one wildlife technician, four attendants and one animal caretaker.

Dairy Kiosk

February 9, Thimphu: A Kiosk was inaugurated at Changkhorlo as a retail outlet for dairy products from dairy groups and associations instituted across the country. The outlet will provide assured market for producers and an access to quality product for the consumers. It will be operated by the Youth Business Cooperative on a public private partnership modality.

There are 153 functional dairy groups and associations which collectively produce around 30920 MT of fresh milk. The subsidy support package for two unit dairy cows in 10th five year plan had stimulated domestic milk production growth by 8% per annum.



Sixth Nomad Festival

February 23-24, Bumthang: The sixth Nomad Festival was organised at Thangbee ground in Chokhoer geog with a theme, 'Promoting harmony for bio-cultural diversity' to give a good platform to the nomads to showcase their unique culture and tradition to other Bhutanese and tourist. This was done through various exhibitions on the nomadic handicrafts, textiles, dairy products, cuisines and others.

As part of the celebration, a goem (Mahakala) and lham (Mahakali) chham, yak chham and several other mask dances were showcased to the gathering among others. Traditional Bhutanese games like khuru, sokum, jigdum, and pundo were also exhibited to the gathering.

Highlights of 2015



In-depth study for Golden Mahaseer

March 4, Thimphu: A project, one of the first in the Himalayan region has been approved for the scientific remote radio telemetry study on the Golden Mahaseer to understand its movements and habitat. The Mahaseer is the most iconic and the toughest sporting freshwater fish in the world.

The project will focus its study in Mangde chu and Dangme chu and establish a scientific baseline data of Mahaseer population and migration patterns before it is too late. It will set up 11 receiving stations at the identified areas and 30 nos. of Mahaseer will be surgically implanted radio transmitters.

MoAF website ranked First amongst all Websites

March 5, Thimphu: The Ministry of Agriculture and Forests' website was ranked First out of 137 websites, evaluated in its second round of competition. The Ministry's website provides regular updates of news, events, tender and other announcement related to RNR.

The websites were assessed on categories like usability and reliability, content and aesthetics, security and privacy, electronic and mail services, citizen participation, and features like subscription, email notification among others.

The website competition was initiated based on the Hon'ble Prime Minister's directive with the intention of encouraging agencies to use their websites to share information and services.



Trolley facilities introduced at CFM

March 26, Thimphu: Visitors at the Centenary Farmers' Market (CFM) can now enjoy the trolley facilities while buying vegetables. The BAFRA has introduced 20 trolleys at CFM for customers' convenience.

The trolley is expected to ease the customers inconvenience in carrying out the vegetables in and around the market. The trolley has been also introduced considering the improved life style while also making the vegetables shopping fancier and more convenient at CFM.

The trolley services can avail at the rate of Nu. 10/trolley. The trolleys are managed by a private firm, M/S Hand Trolley Hiring Agency Company to ensure its sustainability.

Highlights of 2015



First Royal Bhutan Flower Exhibition

April 1-6, Paro: The First Royal Bhutan Flower Exhibition, initiated upon the Royal Command of His Majesty The King to commemorate the 60th Birth Anniversary of His Majesty the Fourth Druk Gyalpo was inaugurated by Her Majesty the Royal Grandmother, Ashi Kesang Choeden Wangchuck. It was held at the Ugyen Pelri Palace.

The Exhibition was a celebration of the unique environmental and cultural heritage with the support and goodwill of citizens from all walks of life. It displayed creative installations incorporating flowers and models of some of the most historic Bhutanese structures, such as Taktshang Monastery and Punakha Dzong. The Exhibition saw almost 50,000 visitors.

Taklai Irrigation Channel

April 15, Gelephu: The Taklai Irrigation Channel was inaugurated in Chuzergang geog. With the rebuilt infrastructure in place, it ensures sustainability and assured irrigation water supply to almost 398 households helping them improved their livelihood and income.

People of Chuzargang and Sherzhong geogs are also hopeful that they will be able to cultivate without any troubles and even do winter cropping with which they can fight back poverty, securing food availability and improving their living standards.

Taklai irrigation system is the largest irrigation system in the country. It can irrigate over 2900 acres of paddy fields and was constructed in 1980s.



Centre for South Asia Forestry Studies

April 16, Bumthang: Her Royal Highness Ashi Chimi Yangzom Wangchuck inaugurated the Centre for South Asia Forestry Studies at the Ugyen Wangchuck Institute for Conservation and Environment, Lamai Goempa. It was a cherished dream of late Madanjeet Singh, the UNESCO goodwill ambassador.

The centre will offer Diploma, B. Sc and M. Sc courses in forestry jointly with the College of Natural Resources. It will also facilitate and conduct research in areas related to forestry with relevance to South Asia. Currently, six students from Bhutan, Nepal, Sri Lanka and Bangladesh are undergoing the forestry studies through centre.

Highlights of 2015



International Glacier Symposium

April 16-18, Bumthang: Around 45 participants including the world class leading glacier experts together with the national experts attended the International Glacier Symposium at the Ugyen Wangchuck Institute for Conservation and Environment.

The symposium was held to take stock of our current state of knowledge about Himalayan glaciers. The symposium is expected to contribute significantly towards the understanding of glaciers enhancing a fruitful collaboration with the regional partners. It covered presentations on the importance of Himalayan Glaciers, its study in Bhutan, snow cover mapping and monitoring in Hindu Kush Himalayas and the Glacier Lake Outburst of Ice Age among others along with issues.

Third Rhododendron Festival

April 18-20, Lampelri: The third Rhododendron Festival with a theme, 'Parks and Communities; Bio-Cultural Diversity in Bloom' was celebrated at the Royal Botanical Park.

It was aimed to preserve the unique culture and tradition of the country for the future generations and promote tourism creating a platform where people can gather together for the cause of conservation. It showcased three villages: Culture and Entertainment village, Education and awareness village and Food and Beverages village with other attractions like free guided walks, camping facilities and stalls with gifts and souvenirs to take home.



Outstanding Animal Protection Award

May 11, Thimphu: The National Dog Population Management and Rabies Control Project under the National Centre for Animal Health received the 'Outstanding Animal Protection Award' at the Animal Care Expo held in USA in April 2015. It was given for their excellent work in animal welfare, sterilisation and vaccination of free roaming dogs in Bhutan.

The project initiated is a humane attempt to control the country's dog population. In its first phase, it sterilised and vaccinated 36987 dogs and 1548 cats through catch, neuter, vaccinate and release protocol. The second phase covered 19224 dogs and cats and carried out mass sterilisation campaign among others.

Highlights of 2015



Revised NBSAP launched

May 22, Thimphu: The revised National Biodiversity Strategies and Action Plan (NBSAP) for Bhutan was launched at the National Biodiversity Centre coinciding with the International Biodiversity Day.

NBSAP provides a comprehensive overview of the past Biodiversity Action Plans outlining not only the significant achievements but also the weaknesses and the lessons learned. It also provides a clear coordination mechanism for fund mobilisation and effective implementation of the strategies outlined in the plan.

NBSAP has been prepared by national task force members representing key biodiversity stakeholders and has undergone a series of robust consultations.

World Tree Plantation Record Achieved in Bhutan

June 2, Thimphu: Bhutan set the new Guinness World Record for Highest Plantation of Tree Saplings by planting 49,672 tree saplings in One Hour by 100 people beneath the feet of the Buddha Dordenma statue. This was verified by the Guinness World Records Representative, Mr. Patel from the United Kingdom.

The plantation will immensely contribute to recoup the barren area below the famous Buddha Dordhenma and degraded forest area to achieve 60% of forest cover for all times to come for Bhutan. Bhutan beat the previous record of planting 40,885 seedlings in one hour by 100 people in Assam, India in 2012.



Mini Tiller MS88 proves effective

June 4, Paro: The Agriculture Machinery Centre (AMC) imported two units of Mitsubishi Mini Power Tiller MS88 in May 2015 to explore the effectiveness and efficiency of the machine in hilly areas. Weighing only 140 kilograms, the sample of medium size patrol engine power tiller was brought under pre-demonstration test at AMC.

After the test, the machine was found to be effective and efficient while ensuring quality of performance in the field. It can be handled and operated by a woman. The machine is being introduced to strengthen farm mechanisation services to the farmers in high terrace and narrow field.

Highlights of 2015



600th Community Forests

June 24, Wangdue: The Goenkha Community Forest under Phangyul geog is the 600th Community Forests (CF) in Bhutan. It has an area of 35.25 hectares (87.07 acres) with 28 households forming the Community Forest Management Group (CFMG).

With this, Bhutan has now 600 CFs covering an area of 66,934 hectares and involving 25,663 households as CFMGs. Wangdue has the highest number of CFs around 67 covering an area of 4,980.7 hectares and involving 1982 households.

The CF was handed over to the Phangyul CFMG by the Hon'ble Lyonpo, Yeshey Dorji who shared the importance of conserving our environment and the inter-dependence of agriculture, livestock and forestry with farmers.

Five companies certified by ISO 22000:2005

July 2, Thimphu: The Hon'ble Lyonpo, Yeshey Dorji awarded the ISO 22000:2005 certificates to five companies namely Bhutan Agro Industry Limited, Thimphu; Bhutan Milk and Agro Private Limited, Phuentsholing; Druk Air In-flight Catering, Druk Air Corporation Limited, Paro; Terma Linca Resort and Spa, Thimphu and Zimdra Food Pvt. Limited, Phuentsholing.

ISO 22000:2005 is a food safety management system designed to enable organisations to control food safety hazards along the food chain in order to ensure that food is safe for consumption. It also includes interactive communication system approach to Food Safety Management, Pre-requisite Programmes and Hazard Analysis Critical Control Point.



International Day of Co-operatives

July 4, Thimphu: The International Day of Co-operatives which falls on the first Saturday of the month of July every year was celebrated by planting asparagus and by launching cooperatives song above Tandrin Ney by the Hon'ble Lyonchhoen, Tshering Tobgay and the Hon'ble Lyonpo, Yeshey Dorji.

Theme for this year was 'Equality'. The Department of Agricultural Marketing and Cooperatives coordinated the event to exercise the mandate to implement the Cooperatives Act of Bhutan 2009.

The Royal Government of Bhutan has been promoting Cooperatives for the well being of communities and to ensure a strong and sustainable pillar of the private sector.

Highlights of 2015



Dog population management project

July 10, Thimphu: The third phase of the dog population management and rabies control project was launched by the Hon'ble Lyonpo, Yeshey Dorji and Dr. Andrew Rowan, the CEO for Humane Society International (HSI).

The Ministry approved the project following the success of the earlier two phases which covered 60993 dogs and 3354 cats in six years (2009-2015) through a catch neuter-vaccinate release protocol controlling the increasing dog population.

The Department of Livestock will implement the project for next three years with a fund support of Nu 10.23M. HSI has also committed to support the project with USD 92,719.

Horticulture farming for west-central region

July 14, Thimphu: A project titled, 'Integrated Horticulture Promotion Project in the west central region (IHPP)' to promote horticulture farming was approved under a technical assistance from the Japan International Cooperation Agency.

The Research Development Centre (RDC) Bajo will implement the IHPP covering Dzongkhags of Tsirang, Dagana, Wangdue and Punakha, benefiting the staff of RDC Bajo, Mithun sub-centre, its extension officers and farmers.

The project will upscale the technologies, systems and human resources developed by the Horticulture Research and Development Project that has proven successful in the east. It will be implemented from December 2015 to December 2020.



Hedge plantations along Thimphu-Babesa expressway

July 24, Thimphu: The Ministry of Agriculture and Forests carried out 6.2 kms hedge plantation along the divider of whole stretch of Thimphu-Babesa expressway.

Some 600 Ministry's staffs based in Thimphu planted around 30,000 seedlings consisting of Jasminum, Forsythia, Ceratostigma and Hypericum species which were raised by National Biodiversity Centre in Serbithang. The design of plantation was done in triangular with Jasminum planted in two rows with other species in single row. The 10 plots of Jasminum were interspersed with one plot of other species.

The plantation after completion was handed over to Thimphu Thromde.

Highlights of 2015



Survey confirms 103 Tigers in Bhutan

July 29, Thimphu: There are officially 103 tiger individuals (*Panthera tigris tigris*) roving freely within the wilderness of the country. The estimated range of credible tiger number in the country is within 84 to 124.

There is 0.46 tiger for every 100 sq. km of the overall survey area of 28,225 sq. km. However, there are 2 to 3 tigers in every 100 sq. km in areas like Royal Manas National Park, Jigme Singye Wangchuck National Park and Zhemgang Forest Division.

All these were confirmed by the National Tiger Survey conducted by Forestry Department during from March 2014 -2015.

Departments and Agencies sign performance agreements

August 14, Thimphu: In order to establish clarity for annual priorities, provide an objective and fair basis for evaluating the overall performance, the Departments and Agencies under the Ministry signed annual performance agreements (APA) with the Hon'ble Secretary, Dasho Tenzin Dhendup.

APA is an important mechanism to ensure accountability and help inculcate a performance based culture at all levels of government that was started in 2014. It includes the objectives, actions, success indicators and target among others for respective offices for July 1, 2015-June 30, 2016. APA for the Ministry was signed on 8 August in Paro.



First Annual Mushroom Festival

August 15-16, Thimphu: The community of Geney geog organised the first annual Mushroom Festival at Chizhi Goenpa in collaboration with the Department of Forests and Park Services, National Mushroom Centre and the Tourism Council of Bhutan. It was aimed to help preserve and promote the culture and tradition as well as to improve the livelihood of the community.

The festival showcased the different mushrooms for sale and food stalls along with cultural programs by community and schools. It also covered awareness programs on mushrooms and its poisoning, dairy and animal health, organic, forestry and health.

Highlights of 2015



Phuentsholing to provide better veterinary services

August 27, Phuentsholing: With the inauguration of the new city veterinary hospital (CVH) and satellite laboratory building, Phuentsholing will now provide better veterinary services.

CVH will provide clinical services including surgery, consultations, examination and dispensing of veterinary medicines. The laboratory will cater diagnostic services to in-house patients and monitor disease surveillance for Chukha and Samste. It also has a library facility for staff consisting of latest technical advances and other references. While the second floor has conference facilities, the third floor has two staff quarters.

The four storied building worth Nu. 18.87 million was funded by the Government of India.

Ministry presents its mid-term review to Hon'ble Lyonchhoen

September 9, Thimphu: The Ministry of Agriculture and Forests presented its mid-term review (July 2013-June 2015) to the Hon'ble Lyonchhoen, Tshering Tobgay at the Royal Banquet Hall.

The Ministry's 11th Five Year Plan outlay comprises of Nu. 13.5 billion, with Nu. 4.85 billion as capital outlay and Nu. 8.7 billion as recurrent budget. There has been a cumulative expenditure of Nu. 2,106.398 million against a cumulative revised budget of Nu. 2,913.146 million for two years. Major achievements highlighted were in terms of farm mechanisation, vegetable production, sustainable management of forest and water resources, biodiversity conservation, milk, egg, beef etc.



Exploring feasibility of rice fortification

September 10, Thimphu: The agriculture officials discussed the feasibility of rice fortification with a team from Bangladesh led by Mr. Md Anyul Kabir, the Joint Secretary for Ministry of Women and Children Affairs.

Rice fortification is an enrichment of rice with essential vitamins and minerals after harvesting to increase its nutritional value which is regarded as a safe and cost effective intervention.

The meeting realised that the fortified rice has both opportunities and challenges in Bhutan. The need to have a proper study to technically understand the nutritional status and fortification and to create more awareness on nutritional aspects was felt during the meeting.



Highlights of 2015



58 CNR Diploma Graduates join the RNR family

September 15, Thimphu: Fifty-eight graduates joined the RNR family after successfully completing their diploma course from the College of Natural Resources (CNR) and having made through the selection process as per the available slots in the Ministry. To prepare them for their jobs, the Ministry conducted a day-long orientation program for them.

Different Departments and Agencies presented their vision, mission, plan and policies referring the 11th Five Year Plan to the graduates. After every presentation, graduates were given the opportunity to put up queries, interact with the speakers and the officials present.

Feed Mill for the East

September 20, Trashigang: The 32 tonnes capacity feed mill plant was inaugurated in Namla which will produce cattle, pig and poultry feeds and will supply them to the six eastern Dzongkhags of Trashigang, Trashiyangtse, Mongar, Lhuentse, Pemagatshel and Samdrup Jongkhar.

With the plant, farmers can now avail feed at affordable prices and the company shall deliver the feeds to the farms wherever possible. Thus, it is expected to solve the earlier feeds related issues in the east. The National Centre for Animal Nutrition, Bumthang will provide the technical support in terms of its feed formulation and quality monitoring as and when required.



Third National Park Conference

October 1-3, Lampelri: The third National Park Conference with a theme 'Paradigm shift in Protected Area Management System in Bhutan' was held at the Royal Botanical Park.

The conference emphasised on emerging conservation issues and discuss on the importance of research in conservation, fund management and strengthening of collaborative conservation program. The launching of Bhutan for life, a global initiative of government with a long lasting financial support for the conservation of protected areas in Bhutan was also discussed.

The day also observed the launching of 'Field Manual for National Snow Leopard Survey' and 'Guideline for recreational Infrastructure'.

Highlights of 2015



Jomolhari Mountain Festival

October 7-8, Thimphu: The third annual Jomolhari Mountain Festival was held at Dangochong, near Jomolhari base camp. It was aimed to promote ecotourism opportunities in the Jomolhari region, showcase local culture and tradition, encourage yak herding and promote dairy products and enhance community participation for biodiversity conservation.

More than 150 people gathered to witness the day. The Royal Institute of Health Sciences with fund support from the Bhutan Foundation organised a free health check up services for the people. The festival was organised by Jigme Dorji National Park jointly with communities of Soe Yutoe, Soe Yaksa, Nubri and Jomolhari School.

Bhutan Bird Festival

October 8-10, Zhemgang: To celebrate the incredible display of diversity, life and promote tourism, the first ever Bhutan Bird Festival was held at Tingtibi with a theme, 'Celebrating Birds, Celebrating Life'.

The festival provided an opportunity to make people aware and appreciate the incredible bird diversity in the Dzongkhag and helped its people to derive benefits through tourism. It also hosted a competition on bird photography, bird-athon and a quiz on the biodiversity of Bhutan. Khengrig Namsum Cooperative also displayed their indigenous arts and crafts for public viewing. The festival attracted more than 500 visitors.



35th World Food Day

October 16, Samdrup Jongkhar: Thirty-fifth World Food Day (WFD) in Bhutan was celebrated at the Martsala Middle Secondary School with a theme, 'Social Protection and Agriculture: Breaking the Cycle of Rural Poverty'.

On the day, various cultural programs, quiz, display of farmers' products and food were organised. Awarding of annual awards for School Agriculture Program was also held. The day also created awareness and educated public on the modern agriculture techniques, importance of eating nutritious food to strengthen economic status for better livelihood.

The Hon'ble Education Lyonpo, Mingboo Drukpa graced the occasion organised by CoRRB jointly with FAO and Department of Education.

Highlights of 2015

International Snow Leopard Day

October 23, Paro: The second International Snow Leopard Day was celebrated at the Drugyel Lower Secondary School with a theme, 'Taking Stock of the Elusive Snow Leopard for a Healthy Alpine Ecosystem'.

The day helped to advocate on conservation significance of the elusive snow leopard and the importance of its fragile mountain ecosystem and the conservation status of the species in Bhutan. It also included a quiz and art competition amongst five different schools in Paro Dzongkhag. An exhibition of posters and banners on snow leopard depicting their status and threats were displayed for the public view and awareness.



A multipurpose trail around Thimphu valley

November 8, Thimphu: The Hon'ble Lyonchhoen, Tshering Tobgay and the Hon'ble Lyonpo, Yeshey Dorji inaugurated the multipurpose trail at Taba.

A 60-km trail will help check haphazard urban expansion, act as a fire line and provide access for combating fire during forest fire incidences in addition to providing direct outdoor recreational benefits to city dwellers.

On the day, Lyonchhoen also launched the dedicative publications such as pictorial book on the Royal Bhutan Flower Exhibition and Celebrating the Glorious Reign of the Fourth Druk Gyalpo along with an in-country manufactured plough which was designed and manufactured by Agriculture Machinery Centre, Paro.

Bhutan participates in Fifth Agro-Protech

November 19-21: Bhutan participated in the Fifth Agro-Protech which was held at the Milan Mela Grounds and ITC Sonar in Kolkata, India. It was aimed towards productive, competitive, diversified and sustainable second green revolution.

The Agro Protech was a fair for agriculture and horticulture covering all other areas of agriculture. It was an ideal exposition where visitors gained lots of knowledge about the foremost developments and progress of agro processing and food industry.

Bhutan Agro-industries Limited and Khengrig Namsum Cooperatives showcased the Bhutanese indigenous products which attracted a good number of visitors.



Highlights of 2015



Climate-smart Agriculture reference books

November 30, Thimphu: The books and the training manuals on Climate-smart Agriculture (CSA) were launched by the Hon'ble Lyonpo, Yeshey Dorji. CSA in Bhutan is fairly a new concept towards increasing food production and continue agriculture under climate change scenario through developing knowledge based climate resilience farms-farmers in a gender inclusive participation.

The CSA project was supported and implemented by SNV jointly with the Department of Agriculture in 6 pilot Dzongkhags of Thimphu, Tsirang, Sarpang, Wangdue, Chukha and Samtse from 13 June 2013 until 30 November 2015.

Bhutan has 28 White-bellied Herons thriving

December 4, Lobeysa: Bhutan today has 28 White-bellied Heron (WBH) individuals thriving in several river basins, revealed latest population census conducted by Royal Society for Protection of Nature (RSPN) from 27 February to 3 March 2015. With just over 200 in the world, Bhutan has 14 percent of the world's total WBH population.

With the first one in 2003, RSPN has been carrying out WBH population census regularly for last 13 years. The census found that atleast 12 WBH juveniles are produced every year. Hence, the number of WBH in the country has, on an average remained constant during the entire survey period.



RNR Exhibition to commemorate 108th National Day

December 17, Paro: An RNR exhibition held coinciding with the celebration of the 108th National Day at Paro drew visitors in drove.

The RNR exhibition stalls included services provided by the Ministry through the Agriculture Machinery Centre, National Post Harvest Centre and National Seed Centre. Besides displaying different machineries, the live demonstration was also done to the visitors. Different information and education materials were also displayed by the Department of Livestock, National Biodiversity Centre, Bhutan Agriculture and Food Regulatory Authority, Department of Agricultural Marketing and Cooperatives, Rural Development Training Centre and Department of Forests and Park Services.

Jigme Singye Wangchuck Outstanding Environmental Stewardship Award



UWICE

In commemoration of His Majesty the 4th Druk Gyalpo's 60th Birth Anniversary, the Jigme Singye Wangchuck Outstanding Environmental Stewardship Award (JSW-OESA) was conferred upon the three exceptional environmentalists: Mr. Tshering Penjore, Principal Research Officer at Research Development Centre-Wengkhar, Dr. D.B. Gurung, Dean of the College of Natural Resources and Mr. Sherub, Chief of Research and Education at UWICE on 8 October 2015.

Mr. Tshering Penjore has helped fabricate and construct low cost and effective electric fencing thereby helping contain and prevent crop loss. This has helped reduce human-wildlife conflicts significantly across the country. He has also pioneered a low cost

drip irrigation system for farmers which can be turned on and off using mobile phone internet, helping improve livelihoods and ensuring the conservation of water.

Dr. D.B. Gurung is an avid naturalist and author of the Orchids of Bhutan. His pioneering work documenting the fishes and aquatic diversity of Bhutan has led to a publication of the first checklist for fishes in Bhutan. He has been a mentor to innumerable number of students thereby helping nurture the next generation of environmental stewards.

Mr. Sherub, with an avid passion for birds has tirelessly worked to document and record the incredible diversity of birds in Bhutan. From recording their

sounds to noting their behaviours, Sherub is the penultimate naturalist in Bhutan today. He is the reference and the guide when it comes to birds.

JSW-OESA recognises and honours individuals, groups and institutions from all backgrounds for a lifetime contribution towards ensuring the security and sustainability of Bhutan's pristine environment. It particularly merits those who have gone beyond the normal call-of-duty in their service towards environmental protection. This prestigious award consists of a citation signed by Her Royal Highness Ashi Chimi Yangzom Wangchuck, patron of the Bhutan Ecological Society and the Hon'ble Prime Minister of Bhutan along with a cash prize of Nu. 350,000.

Ensuring On-Farm Crop Diversity and Food Security through Solar Electric Fencing

Rinzin Choney, RDC Wengkharchu; Tirtha B Katwal, Tsamang Agriculture Extension Centre; Rinchen Dorji, National Biodiversity Centre and Dorji Wangdi, RDC Yusipang

Solar fencing could very well be the most viable solution towards addressing human-wildlife conflict (HWC) in rural Bhutan.

On an average, annually, farmers spend about two months guarding

their fields. Wild animals manage to destroy the crops even so.

This has led many farmers to abandon their fields. Vast acres of farmland can be seen left

“As all efforts to address human-wildlife conflict continue to fail, solar fencing could be the most effective answer”

fallow due to increasing animal attack. The rate of rural to urban migration has increased in the recent years.

In Tsamang geog in Mongar, farmers have stopped growing minor cereals due to increasing HWC. Tshogpa Pema of Banjar said due to this conflict cultivation of minor crops like foxtail millets, little millets, finger millets and

lentils have declined in the recent past.

Aum Tshering, 60 years old from Ganglapong, said because wild pigs damage their crops, the only option is to depend on shops in Autsho. “Every year we are reducing the number of crops we grow in our community,” she said.

Tsamang Gewog is one of the project sites for on-farm conservation project on Participatory Conservation and Utilisation of Rice Genetic Resources for Livelihood and Food Security in Bhutan.

The project was supported by International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The National Biodiversity Centre nationally coordinated the project and was implemented in collaboration with the RDC Wengkharchu and Dzongkhag Agriculture Sector, Mongar. The project provided about Nu. 0.6 million for community solar





fencing to help prevent wildlife from attacking crops.

About 13.52km solar fence was installed in Banjar Pam, Ganglapong Khatoe, Gamlapong Khamea, Khulling and Narang Gomchu covering almost 397.97 acres of agriculture land. This surprisingly helped farmers keep wild animals at bay and they are encouraged to grow traditional crops in the geog.

“After the installation of solar fencing, not even a single cob of maize or single tiller of upland rice was lost to either wild or domestic animals,” said Sonam Darjay, Mangmi of Ganglapang.

It has also been observed that villagers no longer have to stay up all night guarding their fields. “The solar fence not only saved the crops, it has also helped in keeping away the wild animals from attacking our domestic animals,” said Tshogpa Pema.

The benefits of solar fencing are all too apparent in the geog. In Banjar Pam, the fields are covered with Rajma on a large scale, while in Ganglapong and Khuling, farmers have revived the winter cultivation practice of growing wheat, barley and buckwheat. In Narang, Rajma bean cultivation has been up-scaled and farmers are expecting a good harvest.

As all efforts to address human-wildlife conflict continue to fail, solar fencing could be the most effective answer.

Details of electric fencing, beneficiaries, fencing length and expenditure

Fencing sites	Households benefited	Farmland covered by Fencing (acre)	Fencing length (Km)	Total cost (Nu.)
Banjar	33	28.77	2	79219.00
Ganglapong Khatoe	14	87.34	2.43	142123.00
Ganglapong Khamea	35	166.66	3.13	179500.00
Khuling	6	27.95	2.46	79219.00
Narang Gomchu	50	87.07	3.5	142123.00
Total	138	397.97	13.52	622184.00

Wild citrus find could lead to new materials for high altitude citrus

Tshering Penjor and Choki Nima, RDC Wengkhār

Citrus, the major cash crop of Bhutanese farmers, cultivated mostly in lower elevations is faced with the problems of citrus greening.

The presence of the brown psyllid vector coupled with management factors such as mineral and nutrient deficiency has affected many orchards in citrus growing areas.

Orchards in higher elevation (>1600 masl) are free of brown psyllid vector. This provides some opportunity for citrus development. The Research Development Centre (RDC) Wengkhār so far has released two mid-altitude varieties Wengkhār Tshelu 1 and 2 that are currently under promotion through the research outreach program.

In view of exploring cleaner areas and considering the impact of climate change, the need to explore development of citrus materials suitable for mid-elevations and above 1600 to 1800 masl is increasingly becoming important.

Sometime in 2006, wild citrus (*Citrus ichangensis*) was spotted in Korila 2,500 masl, which led to the centre's initiatives to explore genetic potentials of this indigenous cultivar. In later survey *C. ichangensis* is found to be grown truly in wild in many places (Mongar, Lhuentse, Trongsa, Zhenbang, Gaa, Trashigang, Trashiyangtse) in Bhutan within 1800-2300 m altitude range. An observational study in the wild forests of Korila, Mongar and Rimchu area under Punakha began as a part of a MSc. Programme with the University of Saga. Seeds from wild citrus were collected and grown in Wengkhār. Additional collections of different types of indigenous citrus other than *ichangensis* began including some of the cultivated types from different places. An indigenous citrus germplasm Block was then established at RDC Wengkhār by 2011.

The program took a step further with the beginning of a genetic characterisation of wild citrus under a collaborative research between RDC Wengkhār, Department of Agriculture, the

University of Saga, Japan and the University of Kagoshima in Japan with support of the collaborating Universities, Japan Society for Promotion of Science-Ranpak Program and MoAF/RDC Wengkhār.

The collaborative program has so far led to finding of *Citrus ichangensis* in Bhutan, which is considered to be one of the most cold-tolerant citrus cultivars and has been reported to citrus scientific communities through publications. A group of citrus plants similar to Mexican lime (*Citrus aurantifolia* (Christm.) Swingle) has also been found growing in different locations in Bhutan. Research found and identified genetic phenomena called Loss of Heterozygosity (LOH) in citrus genetics as a cause of diversification in lime, which was published in scientific reports, 2014. Later it is also found that genetic makeup of these citrus is different from the standard lime (Mexican lime) and designated a new name as 'Himalayan' limes. The sequence data of various citrus genomes (sequence data of *rbcl* gene,

genetic growing areas



matK gene and RAD-Seq) from 135 accessions and 22 genera of the Rutaceae under sub-family Aurantioideae were deposited in DDBJ Gene Bank which can be freely used by other researchers.

Starting 2013, the indigenous citrus research program attempted a breeding program for the first time. Apart from several crosses of exotic citrus with local varieties like Morakha mandarin to improve the horticultural characteristics of local varieties, several hybrids of local cultivars crossed with wild citrus species for future rootstock improvement began. All these materials are currently planted in the Indigenous Citrus Germplasm

“Sequence data of rbcL gene, matK gene and RAD-Seq of 22 genera of the Rutaceae under sub family Aurantioideae were deposited in DDBJ Gene Bank which can be freely used by other researchers.”

Research Block at Wengkhaz

These initiatives may not necessarily result in economically valued citrus cultivars immediately, but will enrich the genetic diversity of citrus cultivars for the future breeding programs.

The identification of wild citrus found in higher elevations in Bhutan and the initiatives to put them into use could contribute to a new research area in citrus and develop climate resilient cultivars, promote conservation of native cultivars and contribute towards enhancing genetic diversity of native crops.

Do you know?

Embryo Transfer (ET) technology in cattle

What ET means?

It is the technique by which embryos are collected from elite donor females and are transferred to recipient females to enhance greater genetic gain in shorter interval.

ET can be used to produce multiple progenies from desirable genetic combinations of sire and dam.

Embryos may be transferred shortly after collection (fresh transfer), or frozen after collection for thawing and transfer at a later date. It is a new technology being introduced in Bhutan in 2015-16.

Advantages and Benefits of ET

ET techniques allow top quality female cattle to have a greater influence on the genetic advancement of a herd and exploitation of reproductive abilities of low yielding cows (surrogate mother)

A high yielding cattle normally produces 8-10 high yielding calves during her lifetime. With ET technology we can get 80-100 calves during its lifetime.

Important technology for the conservation of important cattle breeds particularly in Nublang / Siri breed in Bhutanese context which have threats of endangerment.

The general epidemiological aspects of ET indicate that the transfer of embryos provides the opportunity to introduce genetic material into populations of livestock while greatly reducing the risk for transmission of infectious diseases.

Complement in achieving self sufficiency in milk and milk products through faster development of dairy enterprise Better income generation for farmers through improved production

Source: National Dairy Development Centre, Yusipang

What is ISO/IEC:17025:2005 Accreditation?

The ISO/IEC 17025:2005 is the International Organisation for Standardization (ISO) and the International Electro-technical Commission (IEC) for testing and calibration laboratories. Therefore, the laboratories accredited to this International standard have demonstrated its' technical competence and precision to produce reliable test and calibration data. The periodic evaluation is being carried out for its' compliance in implementation of ISO/IEC: 17025:2005 requirements.

Benefits

The ISO/IEC 17025:2005 accreditation gives recognition to the laboratories for its technical competence for testing the product samples. Therefore, laboratory test reports issued by the accredited laboratories are internationally recognised for its competence, gaining customer confidence and ensuring product quality and safety, besides increasing market access.

In Bhutan, the National Food Testing Laboratory at Yusipang is being accredited for ISO/IEC: 17025 (General Requirements and Competence of Testing and Calibration Laboratories) since November 2012. The scope accreditation includes both chemical and microbiological quality and safety parameters covering various food and agricultural product categories including drinking water.

Source: <http://www.bafra.gov.bt>

Agro-biodiversity

What is Agro-biodiversity?

Agrobiodiversity is diversity of domestic flora and fauna associated with Food and Agriculture. These include different crop varieties and livestock breeds.

Bhutan is very rich in agrobiodiversity both in terms of species and genetic diversity. There are over 100 species of domesticated crops and over 10 species of livestock in Bhutan. Within species, there are variations contributing huge genetic diversity of crop varieties and livestock breeds.

Importance of Agro-biodiversity

- Traditional varieties and breeds are well adapted to a wide range of environment
- Some of the traditional varieties and breeds possess high nutritional value, medicinal properties and superior eating qualities
- These genetic resources

Conservation Services

Despite richness in agrobiodiversity and huge benefits derived out of these agro-biological resources, these genetic resources are being eroded at an unprecedented rate due to several factors. Therefore, effective conservation of this agro-biological wealth is of paramount importance for food security and enhance climate resilience of the farming system.



and potential sources of genes to develop new varieties of crops and new breeds of livestock as per the changing demand

- Diversity is important for food and nutrition security

In view of the importance of agrobiodiversity and declining trend of these important genetic resources, Ministry of Agriculture and Forests through National Biodiversity Centre provides Gene Banking Services. These genetic resources are conserved indefinitely in the Gene Bank and made available to the farmers in future.

Procedure for availing the services

If you observe that certain breeds and varieties are at the risk of being threatened or going extinct, please inform your nearest RNR Centre who will inform the National Biodiversity Centre (NBC) for necessary interventions.

Source: NBC



How to handle bees safely?

Though beekeeping can be potentially lucrative and also an interesting activity, it has its share of risks and dangers. The various risks and safety measures are as follows:

- The risk of honey beekeeping is getting stung by bees. If stung, the bee sting should be removed immediately to lessen the effect of venom. This can be done by scarping or plucking the sting.
- Use protective equipments and wear protective clothing. The protective clothing should be smooth and light-coloured as bees react unfavourably to dark material or material made of wool.
- A beekeeping hat is another type of protective gear that is essential for bee safety and safety of the handler. A folding wire veil that is fitted firmly on a hat is an ideal choice.
- Beekeeping suits and coveralls are also one of the essential clothing that helps in bee sting safety. Standard coveralls are the best choice and they are fitted with cuffs and bands. The length of the coveralls should be enough to protect your ankles while bending to reach the bottom box of the hive.
- To provide safety to honey bees and from a bee sting to the handler, gloves play an important role. Gloves can be of plastic-coated material or vinyl.
- Use a smoker. Smoke provides stimulation to bees and they gorge nectar or honey. This process

disturbs their defective behaviour making them easy to handle.

- If you are using pesticides in and around beehives, take care not to let the pesticide fumes or residue enter the beehives. This may be fatal for the bees. For bee safety, make sure you use pesticides when there is no breeze or wind that may carry the residue towards beehives.

Source: Department of Livestock

Proper handling of Apples

Although not apparent apples are delicate and will spoil easily if rough handled. Carelessness during harvesting and packing will subsequently cause major fruit loss. Following are some of tips for proper handling of Apples to ensure quality:

- Follow a good spray, fertiliser and irrigation programme and ensure good orchard hygiene

Reason: Fruits when harvested will be of superior quality and less susceptible to storage problems.

- Harvest at the correct stage judging by colour, size and taste

Reason: The apple continues ripening after picking and if harvested over mature will have a short “shelf life”. Conversely, immature apples will not have the eating characteristics acceptable to the customer. The correct stage is when apples have developed sufficient sugar levels (upto 10+/1% Soluble Solid Content), and attained good colour and size.

- Harvest using “lift, twist and pull” method

Reason: If the fruit is pulled from the tree, the stalk becomes detached increasing water loss

and acting as entry points for disease-causing organisms.

- Harvest during cool parts of the day and avoid direct sunlight on picked apples

Reason: High fruit temperatures are detrimental to the fruit’s shelf life. The high temperature equals to high respiration rates and water loss which equals to faster deterioration. Direct sunlight will cause sunscald on apples.

- Avoid injuring the fruits

Reason: Injured fruits shrivel faster and are subject to secondary disease infection giving rise to storage rots.

- Once picked, avoid exposure to rainfall

Reason: Water soaked apples are more subject to decay.

- Avoid dropping or throwing of apples

Reason: Dropping and throwing causes bruising which will increase the fruit’s respiration rate and faster decay will result. Bruising will also lead to post harvest disease problems.

- Ensure the packing area is well protected from direct sun and rain and it is spacious.

Reason: A cramped pack house reduces work efficiency. Protection from the elements is

important.

- Sort out (reject) diseased and injured fruits before packing

Reason: Diseased and damaged fruit will cause problems in the box and eventually in the store, by causing infection over time.

- Ensure picking and packing containers are clean and smooth

Reason: Rough boxes and baskets can puncture fruits and the dirt can carry diseases.

- Ensure boxes are strong and uniform

Reason: Uniform boxes can be stacked correctly and can withstand pressure thus protecting the fruit during both transport and storage.

- Avoid overfilling of boxes

Reason: Overfilling can cause damage and therefore reduce shelf life and market value of the fruit.

- Store fruits in a cool, well ventilated area

Reason: Inadequate ventilation increases heat, carbon dioxide and ethylene build up, which will all lead to faster fruit deterioration.

Source: *National Post Harvest Centre, Paro*

Proper handling of Potato Tubers

Potatoes are storage organ and have low respiration rate. They can be stored for relatively long period of time. However, careful harvesting and post-harvest methods ensure reduces loss during transportation and storage. Following proper handling tips can be useful.

- Cut the potato haulms (portion of the plant above the ground) about 2 weeks before harvesting

Reason: This will harden the tubers which minimizes bruising during handling. This also reduces spread of blights from the foliage to the tubers.

- Allow soil to dry adequately after a heavy rain before harvesting

Reason: When potato is harvested wet, the skin of the potato peels off readily and the storage quality becomes poor.

- Harvest potatoes at the right stage of maturity as indicated by the drying of leaves and stem

Reason: Mature potatoes are more tolerant to damage. The skins of immature potatoes

peel off during harvesting and handling.

- Harvest the tubers carefully to minimize injury

Reason: Injured parts become entry points for decay causing microorganisms

- Protect harvested potatoes from rain

Reason: Moisture on the surface of the tubers encourage rapid growth of decay-causing microorganisms. It also promotes sprouting.

- Cure tubers at high temperature (15-25C) and high relative humidity (80-95 %) for 5-10 days under a shed (protection from rain and direct sunlight), higher the temperature, the quicker is the curing process

Reason: This will enhance formation of new skin layers over damaged tissues, which will protect the tubers from micro-organisms and excessive moisture loss.

- Ensure potato sacks are clean and smooth

Reason: Dirty sacks can carry

disease-causing organisms. Sharp threads of the bags can cause punctures and cuts.

- Avoid stacking sacks or the loose crop very high

Reason: Tubers at the bottom layer will become damaged

- Store potatoes for table use in dark and well-ventilated areas

Reason: Exposure to light results in greening and production of toxic substance called solanin, while inadequate ventilation results in faster deterioration

- Store potatoes in low temperature regime

Reason: Low temperature prevents excessive water loss and rapid sprouting.

- Avoid storing tubers with fruits

Reason: Ethylene gas produced by ripening fruits enhances sprouting of potatoes.

Source: *National Post Harvest Centre, Patna*