Executive summary

Field crops research program was continued with the objective to increase the productivity of cereals (Rice, Maize, Wheat and other cereals), Oilseeds (Rapeseed-mustard) and grain legumes (Soybean and Groundnut). The strategies used were introduction and identification of suitable varieties and development of appropriate and affordable technologies that best suit the field conditions. The research activities were executed both on station and on farm for evaluation and validation of technologies.

In Rice, 10 lines in IET and more than 30 lines in observation trials were tested in station for yield potential, optimum maturity, pests and diseases resistance and other agronomic traits. Selected lines will be subject to further evaluation. Over 10 MT seed of released and promising varieties of rice was produced. This seed will be used mostly for dzongkhag promotional programs and OGTPs. Seeds are also demanded by other RDCs for testing in their regions. Similarly, seeds of wheat, maize and oilseeds were also produced and maintained in stock. Work on a new system of rice cultivation, known as System of Rice Intensification (SRI) was continued at the centre. The system showed some promise but further refinement in the use of varieties, inputs and spacing will be required.

Through the Biodiversity Use and Conservation (BUCAP) Program, seeds of improved rice and maize varieties were provided to farmers of remote villages of Taksha, Silly, Tsara and Adang under Wangdue Dzongkhag. The basic aim of the program is to improve crop productivity in the area using modern varieties and cultivation methods. It is also intended that such activities will broaden the genetic base of cultivated crops in the region. Seed selection training on maize was also imparted to the farmers to maintain and use quality seeds for higher production.

The sub-centre at Mithun, limited by staff, carried out variety evaluation work on maize and rice under the supervision of RDC Wengkhar and Bajo. Maize lines tolerant to GLS and TLB were evaluated under Tsirang condition. Seeds of released varieties of rice and maize were produced in bulk and also supplied to Tsirang and Dagana dzongkhags for testing and promotion.

Field Crops Research

1.1 Rice Research

1.1.1 Initial Evaluation Trial (IET)

IET consisted mainly of introductions of breeding lines intended for identification of promising materials in terms of grain yields, straw yields, maturity, height and resistance/tolerance to biotic and abiotic stresses. The promising lines and varieties from the observation trials were assessed in this stage. For the trial layout, a randomized complete block design with three replications was used. Seedlings were transplanted in an area of 10 m^2 plot with spacing of 20 cm x 20 cm. Chemical fertilizer was applied at the rate of 70:40:20 NPK kg ha^{-1}, with half the N top-dressed at panicle initiation. Butachlor 5G was applied at the rate of 1.5 kg a.i ha^{-1} to control monocot weeds. Hand weeding for *Shochum* management and irrigation were done as needed. A harvest area of 5.04 m^2 was used and grain moisture content was standardized at 14%. GENSTAT software was used to analyze the collected data.

The analyzed results are presented in Table 1. There were significant differences among the entries in terms of flowering, tillering, plant height and grain yield. The local check, Nabja, took the longest (145 days) to flower indicating its long growth duration and it had the maximum number of tillers. All entries, except BK1, were as tall as or even taller than Nabja. In terms of grain yield, IRB4 produced the maximum yield (5.00 t/ha) which was significantly more than the local Nabja (3.00 t/ha). Selected entries will be further tested in the ensuing season.

Table 1: Days to flowering, tillers, plant height and yield of entries in IET, 2009.

Variety	50%flw (days)	Tiller/hill (no)	Plant height (cm)	Grain yield (t/ha)
BK1	134a	10a	117a	3.50ab
IRB1	128a	16a	156b	3.30ab
IRB11	135b	10a	146b	3.90ab
IRB2	133b	14a	155b	3.70ab
IRB3	134ab	12a	156b	2.50ab
IRB4	140b	11a	131a	5.00a
IRB491	137b	11a	149b	2.30ab
IRB6	131ab	13a	123a	3.40ab
IRB7	130ab	14a	133b	3.50ab
IRB9	133ac	13a	155b	1.40b
Nabja	145d	20b	151b	3.00ab
P value	< 0.001	<0.01	< 0.001	0.03

Means indicated by different letters in columns are statistically significant (95% confidence level)

1.1.2 Observation Nursery (INVEDUST)

A total of 19 lines including a local check were tested under the international nursery of example varieties for distinctiveness, uniformity and stability test (INVEDUST) trials in 2009 season. The lines were introduced from the International Rice Research Institute, Philippines with the aim to evaluate and identify promising lines for the varied Bhutanese agro ecological conditions in mid altitude rice areas.

The trial was laid out in a single observation plot of 5m x 2m size. Forty five days old seedlings were transplanted. Spacing of 20cm x 20cm was maintained uniformly. In order to control the monocot weeds Butachlor was applied at the rate of 1.5 kg a.i per ha. This was applied two days after transplanting while inorganic fertilizer was applied at the rate of 70:40:20 NPK kg per ha. Half of nitrogen was top dressed at panicle initiation stage.

Results are presented in Table 2. 50% flowering days ranged from 124 to 134 days. Likewise, tiller number varied from 8 to 23 per hill. Local Tan Tshering was the tallest entry with 150 cm while IR46 was only 82 cm. Grain yield ranged from 4.83 to 10.78 t/ha. Promising entries from this trial will be further assessed in replicated trials in the next season.

Table 2: Performance of entries in INVEDUST, 2009

Variety	50% flw days	Tiller No	Plant height (cm)	Grain Yield (t/ha)
PSB RCSO	130	20	102	7.82
IR 28	131	15	110	7.92
PSB RC 92	124	14	121	5.91
PSB RC 44	129	13	128	6.31
PSB RC 9	124	12	129	7.19
BPI 76	125	14	120	10.67
MATATAG	131	15	111	7.05
PSBRCS	129	15	97	6.96
PSBRC 46	133	18	85	6.16
IR 22	129	23	110	4.36
PSBRC 1	132	10	102	6.78
IR 43	134	13	125	8.53
PSBRC 88	134	13	111	9.36
PSBRC 60	133	14	120	10.78
IR 46	129	21	82	9.10
IR 8	134	14	96	9.39
PSBRC 2	131	12	84	10.28
IR 72	132	13	91	8.59
Tan Tshering	127	8	150	4.83

1.1.3 Observation Nursery of Pedigree lines

The pedigree lines were observed in a single plot of 10 m^2 with the spacing of 20cm x 20cm. The management practices were followed as it was done in other trials. The main objective of the trial is to observe the uniformity and see whether the populations are still segregating. The lines that were susceptible to diseases and bearing undesirable traits were discarded. The lines were also evaluated for desirable agronomic traits such as the yield, maturity days, pest and disease resistance and plant height. Selected lines are given in Table 3.

Table 3: Performance of the entries of pedigree lines

Variety	50% flw days	Tiller No	Plant height (cm)	Grain Yield (t/ha)
IR 80496	134	18	168.2	6.57
IR 80489	131	10	160.6	5.12
IR 80496	129	13	155.1	6.78
IR 80489	133	10	167.6	7.16
IR 80489	128	18	155.3	5.62
IR 80489	135	15	162.6	5.53
IR 80496	134	13	160.6	2.83
IR 80496	131	19	146.4	3.7
IR 80484	132	18	159.7	4.23
IR 80485	129	14	164.1	2
IR 80485	130	10	156	4.51
IR 80485	133	12	168.5	5.81
IR 80489	129	12	174.4	2.92
IR 80484	130	22	168.7	2.59
IR 80484	135	13	152.9	4.18
IR 80484	136	19	161	8.61
IR 80484	133	10	163	5.10
IR 80484	134	14	143	4.61
Tan Tshering	129	17	152.4	-

1.1.4 Demonstration of released varieties

There are a number of farmers, extension staff and visitors visiting this centre on study tours. To demonstrate to the visitors on the various technologies and characteristics of released rice varieties physically, the following rice varieties were established at the research station.

Varieties

- Bajo Kaap 1
- Bajo Kaap 2
- Bajo Maap 1

- Bajo Maap 2
- IR 64
- IR 20913
- Khangma Maap
- Khumal 2 (Wengkhar Rey Kaap 2)
- Yusi Ray Maap
- Yusi Ray Kaap
- BR 153
- M 54

1.1.5 Seed Maintenance and production of released and promising varieties

Apart from adaptive research, the sector also maintains sufficient quantities of rice seed for demonstration or testing the varieties in new sites. The ad hoc requests from the Dzongkhags or Agriculture Extension are met from such seed stock. Moreover with the OGTP work plans into force there are lots of demand coming. The following quantities of seeds (Table 4) of different released varieties were produced and maintained in 2009 season.

Table 4: Seed Production of released varieties in 2009

Sl no	**Variety**	**Quantity (Kg)**
1	IR 64	2100
2	Bajo Kaap 1	510
3	Bajo Kaap 2	720
4	Bajo Maap 1	600
5	Bajo Maap 2	500
6	IR 20913	2101
7	Khangma Maap	409
8	Khumal 2	500
9	Khumal 6	300
10	BR 153	400
11	Guojing 4	370
12	B2983B	400
13	Machapuchery	280
14	Nabja	200
15	Tan Tshering	300
16	NR 10291	400
17	YOUMI	140
18	RHS	300
19	Paro China	45
20	IR 64 General cultivation	3248
21	IR 64 Nature farm	2320
22	**Total Seed Production**	**16143**

1.1.6 SRI Observation at RNR RDC Bajo

SRI or System of Rice intensification is a methodology for increasing the productivity of irrigated rice cultivation by changing the management of the plant, soil, water and nutrients. It was developed in Madagascar in early 1980s by father Henrie de Laulanie, a Jesuit priest. After its development many NGOs and government organizations worked for its promotion throughout the world. SRI is tested in the Asian continent and has yielded positive results. It is said that the average yield of SRI is 8-9 ton per ha with a potential to cross even 10-15 ton per ha.

Because plant populations are greatly reduced with SRI, seed costs are cut by 80-90%, and since paddy fields are not kept continuously flooded, water is saved up to 25 to 50%, a major benefit in many places where irrigation is a constraint. However, cessation of flooding means that increased weeding is required. If this is done with soil-aerating implements like a rotating hoe, this cost has a benefit of enhanced crop production.

SRI works with any variety and no great amount of external inputs are needed to benefit from SRI. It emphasizes more on organic manure than the use of inorganic fertilizers as results show better yield with organic manure. A minimum of two weeding is recommended in SRI with rotary weeder for good soil aeration.

SRI trials were continued in 2009 season with the objective to observe and ascertain its performance. Improved variety IR 64, Bajo Maap 1, Bajo Kaap 1 and local varieties such as Nabja and Tan Tshering were also tested. All the basic principles involved in the SRI system were followed.

Unlike the previous season. about forty farmers from Thedtsho geog (Rinchengang, Woonjukha, Thangu, Bajo) were invited to participate in this new method of rice cultivation. The basic aim of inviting the farmers was to showcase and demonstrate the new technology as the SRI is gaining popularity in the recent years due to its high yield and other benefits. The farmers were involved starting from nursery raising, transplanting, weeding, harvesting and yield assessment.

SRI Protocols followed

1. Seedlings are transplanted early

Seedlings of 8-15 days old or 2-3 leaf stage are transplanted without removing soil particles attached to the roots as soon as the seedlings are removed from the nursery. Handle seedlings with care. Extra care should be taken to prevent the seedlings from shock and seed sac should be attached during transplanting which supplies food to the infant roots.

2. Seedlings are transplanted singly rather than in clumps

Single seedlings are transplanted per hill and not in clumps of 2-3 or more. This facilitates individual plants to spread their roots and prevent competing with other rice plants for space, light and nutrients. Tiller formation will be optimized.

3. Wide spacing

Seedlings are transplanted in a square pattern usually at least 25 cm X 25 cm spacing, but this will depend on the soil fertility status of the location. Generally, the higher the fertility status, the wider the planting space required. Wide spacing expose plants to more sunlight, air and nutrients resulting in more root growth and more tillering.

4. Moist but unflooded soil conditions

In SRI, the soil is kept moist for about 10-12 days after transplanting but not flooded all the time like traditional practice. The field is allowed to slightly crack once in a week which allows oxygen to enter. Alternative drying and wetting method of irrigation is recommended. However, optimum water level of 3-5 cm should be maintained once the crop has reached reproductive/flowering stage.

5. Early weeding and soil aeration

It is important to do first weeding early, after about 2 weeks after transplanting. Even if there are no weeds, disturbing the soil helps in supplying air to the growing roots as well as smothering the germinating weeds. Soil aeration can be achieved by using hand rake that can be made locally, even with wood and long nails.

In 2009, a trial on SRI was carried out using IR64 variety. All the recommended practices were adopted. The primary purpose was to showcase SRI as an alternative method of rice cultivation. Results are presented in Table 5. IR 64 produced an average of 7.38 t/ha. However as seen from the table, non-SRI plot gave an average of 10.93 t/ha. This was mainly due to the higher number of hills per unit area (158 vs 69) due to dense planting which led to high yields. Planting space for SRI was 30 x 30cm, which seemed very sparse given the fertility status. There is a need to adjust planting space according to fertility status of the soil. Tillering in the non-SRI plots was low (20) due to close planting and this may not be efficient in terms of seed requirement. In essence, the comparison between SRI and non-SRI plots may not be fair as the original intention was simply to demonstrate SRI. The plan did not include a comparison plot. Straw yields in general were low as harvesting was delayed and the straw had completely dried up.

Refining SRI techniques to suit our conditions will continue in the coming season. It is planned that more varieties, both improved and local, will be subject to SRI and adjustments in planting space will be tried.

Table 5: Grain yield, plant height and tillering of IR64 using SRI and conventional method of cultivation.

Method	**Sample**	**GrainYield t/ha**	**Straw yld t/ha**	**No of hills**	**No of tillers**	**Plant ht cm**
SRI (IR 64)	1	7.83	1.70	69	31	97
	2	6.68	3.78	68	28	94
	3	7.50	2.56	70	27	92
	Average	**7.38**	**2.68**	**69**	**29**	**94**
Non-SRI (IR 64)	1	10.05	3.78	157	21	98
	2	11.00	3.75	188	20	98
	3	11.70	3.75	128	19	99
	Average	**10.93**	**3.78**	**158**	**20**	**98**

1.2 BUCAP Activities in the west central region

1.2.1 Taksha Sill and Tsara

Background

Taksha, Silli and Tsara village under Daga geog are one of the far flung villages of Wangdue Dzongkhag. These villages are located at a higher elevation of more than 1750 masl. None of the villages are connected by a motorable road. It takes a minimum of 4-5 hours to reach the nearest village Tsara and lack of accessibility has been a limitation for proper implementation of developmental activities in the village.

Traditional farming is normally practiced on the fertile wet sloppy wetland. They also have their respective dry land areas often located quite far from their homestead. Each village has its respective dry land and farmers migrate between the two land holdings for crop cultivation. The dry land areas are Domsa of Tsara, Bapche of Taksha and Ngaba of Silli. Shifting cultivation can also be seen.

Given the agro ecological conditions, all the cereal crops are grown in the village. The fields are occupied mostly by important cereal crops like paddy, maize, wheat, barley and buckwheat. Majority of the production goes for brewing purposes which leaves them to buy rice from the market. The local varieties otherwise produce ample quantities to feed themselves. They also cultivate mustard and certain vegetables such as potato, radish, peas, beans, spinach, and cabbage for their own consumption. The community practices diversified farming with limited sources of income.

The BUCAP (Biodiversity Use and Conservation in Asia Pacific) activities in these villages were a continuation of previous years and in line with the project objective of

conserving and developing agricultural biodiversity, enhancing the farmers capacity in PGR management and facilitate farmers' access to improved genetic materials. In order to fulfil the above objectives, the following activities were carried out.

a) Maize seed selection training

Maize is one of the main cereal crops cultivated in the dry lands area of these villages. Significant amount of production is used in alcohol brewing with minimum portion going as food item. Farmers cultivate both the local and improved varieties. However, due to seed degeneration and lack of knowledge on maintenance of seed, there has been a decline in crop yield. The symptom of seed degeneration has been confirmed by mixture of plants with different heights in the same field and discoloration of grain in the ears. Farmers revealed that they have no knowledge on scientific seed selection methods and practices. Thus, seed selection training on maize was considered imperative to realize higher production and decrease in varietal contamination. The training was imparted from 2-9 September 2009 and a total of 56 farmers participated in the training.

b) Promotion and monitoring of new improved rice varieties

After the initiation of Participatory Varietal Selection (PVS) program in these villages, there has been an increase in adoption of PVS selected rice varieties. While some farmers continue to maintain their own seed, many farmers have been demanding the seed of these improved varieties. Therefore, RNRRC Bajo had supplied 96 kgs of Machapuchery to Taksha farmers and 140 kgs to Tsara farmers.

Apart from seed supply, there has been continuous monitoring and technical backstopping in cultivation of these varieties. There have been no reports of major pest outbreak or disease incidence either to the improved or local varieties in all the communities. At harvesting time, a yield assessment was done to assess their performances and yield trends. The average yield for Machapuchery and Khangma Maap were 3.21 t/ha and 1.48 t/ha respectively. The yield was low as the crop suffered from drought/water problem at the time of anthesis/flowering (the most critical stage). However, the yields were at par with their local variety. More important is the broadening of genetic base of rice in the communities as farmers have now the option in choosing the varieties which was not the case before. Further, some of the farmers in Tsara village commented that the new white variety, Machapuchery was very good for zaw making and had higher milling recovery than that of their local variety.

c) Supply of Maize Seeds

In order to increase the food security of the village and to increase the income of the farmers by processing corn into kharang, 10 kg of Yangtsipa variety has been distributed to each household in the respective villages. The maize was sown in *tseri* (slash and burn system) and constant monitoring is being done by the centre. At the end of the season yield assessment will be done by crop cut method. Similarly crop cuts will be done in other crops to see the differences.

1.2.2 Samthang and Rukha

Samthang and Rukha received adequate attention from BUCAP program since its implementation from 2005. We are trying to phase it out as farmers' technical capacity has been built to be sustainable in the long run and vigorous PVS has been conducted. There is also visible impact of varietal adoption of PVS in the field. However, the previous harvested seed has been totally exhausted, RNRRC, Bajo supported 36 kgs of B2983B rice seed to farmers of Samthang and Rukha, 35 kgs of Khangma Maap to Kaschecko farmers to sow as upland rice and 27 kgs of IR64 to Samthang farmers. In maize seed, there was a support of 107 kgs of Yangtsipa for Rukha and 10 kgs of Khangma Ashom II for Samthang.

1.3 Wheat Research

1.3.1 Wheat observation trials

The trial was set up with the objective to introduce new improved varieties of wheat from India and to assess the general performance under Bhutanese agro-ecological conditions. The single plot observation trail was laid out in an area of $20m^2$ with the spacing of 20 x 20 cm. Fertilizers were applied at the rate of 60: 30:20 NPK kg per ha with timely hand weeding and irrigation.

Results are given in Table 6. Of the 19 varieties tested, 10 most promising varieties in terms of agronomic characters (plant height, vigour, maturity, grain types and disease tolerance) were selected for further assessment. These varieties will be tested in replicated yield trials in the coming season.

Table 6: Agronomic traits of Indian lines

Sl No	Variety	Plant Height (cm)	Yield (t/ha)	Remarks
1	PBW 343	73	2.50	Rejected
2	PBW 502	67	3.50	Selected
3	PBW 226	84	3.80	Rejected
4	UP 262	72	1.30	Rejected
5	UP 2338	69	1.42	Selected
6	UP 1109	89	5.50	Rejected
7	HD 2643	74	2.10	Rejected
8	HD 2733	62	2.60	Selected
9	HD 2329	70	2.60	Rejected
10	HD 2687	68	2.10	Selected
11	VL 738	86	2.00	Rejected
12	VL 616	96	3.00	Selected
13	VL 804	88	4.80	Selected
14	VL 802	84	2.30	Selected
15	HS 365	85	1.60	Selected
16	HS 240	85	2.50	Rejected
17	RR 21	92	3.60	Selected
18	HUM 234	76	2.00	Rejected
19	WH 542	53	1.60	Selected

Ten high yielding varieties from Nepal were assessed in single plots for their performance under Bajo conditions (Table 7). Many lines showed promise and they will be further assessed in the coming season.

Table 7: Agronomic traits of Nepal lines

Sl No	Variety	Plant Height (cm)	Yield t/ha
1	BL 2818	76	2.50
2	BL 2930	82	3.30
3	BL 3046	82	3.60
4	BL 3264	72	2.50
5	Gautam	66	2.00
6	WR 1123	82	3.30
7	WK 1182	85	2.80
8	WK 1204	87	3.50
9	WK 1444	77	2.80
10	WK 1481	87	3.50

1.3.2 Wheat Seed Production

Seed production of released varieties and promising lines was done for research purpose and for further testing (Table 8). A total of 366 kg seeds were produced in 2009-10 season.

Table 8: seed production of released and promising varieties

Sl no	Variety	Quantity (Kg)
1	Bajoka-1	165
2	Bajoka-2	125.5
3	Sonalika	25.6
4	Anupura	50
5	**Total Seed Production**	366

1.4 Maize Research

RNR RDC Wengkhar is the main centre for maize research. At RDC Bajo, small amounts of seeds of released varieties was produced and maintained. In addition, seeds of pop corn and sweet corn were also produced (Table 9).

Table 9: Maize seed production of released varieties

Sl no	Variety	Quantity (Kg)
1	Yangtsipa	585
2	Khangma Ashom 1	207
3	Khangma Ashom 2	114
4	Pop corn	10
5	Sweet Corn	45
6	**Total Seed Production**	**961**

1.5 Oilseeds

In the recent years, research on oilseeds has dwindled due to lack of new genetic materials for testing. The centre produced and maintained small amounts of seeds of released varieties for future use (Table 10).

Table 10: Seed production of released varieties

Sl No	Varieties	Production kg
1	M 27	1
2	T 9	2
3	PT-30 (Bajo peka 1)	3
4	BSA (Bajo peka 2)	6

1.6 Grain Legumes

Background

Food legumes are already an important component of the Bhutanese farming systems. They are grown in diverse land use systems such as dryland, wetland and kitchen gardens in different cropping systems and seasons depending on the altitudes and the species. However, over 75% of the national legumes area is on drylands. There are about 16 species grown in the country but the most widely grown species are *Glycine max, Phaseolus vulgaris, Pisum sativum* and *Vigna* spp. Most farmers grow traditional varieties and maintain their own seeds. Data on the area and production of grain legumes are incomplete and fragmented. The estimated area under grain legumes is about 33,000 ha and total production of about 14,000 MT. The average yields of grain legumes are around 497 kg/ha under monocropped conditions and slightly lower when intercropped (457 kg/ha).

Starting in 2009-10 season, research and development on pulses or grain legumes (dal group of crops) comprising of lentil (*Lens culinaris* or masoor dal or split dal), chickpea (*Cicer arietinum* or gram dal or chana), mungbean or green gram (*Vigna radiata* or gram or mungbean), urdbean or black gram (*Vigna mungo* or urd dal), rajmabean or kidney bean (*Phaseolus vulgaris* or bori dal) and field pea (*Pisum sativum* or matar) has been started at RDC Bajo through a Shuttle Breeding of Pulses project under the SAARC Division, Ministry of External Affairs, India. The project includes member states of Bhutan, Nepal, Bangladesh and India. The overall goal of this project is to improve and sustain the rural livelihood and nutritional security through enhanced pulse production using conventional breeding techniques. Specific objectives are:

- To evaluate elite breeding lines developed by the collaborators and IIPR for local adaptation and release

- To explore, collect and evaluate the existing variability in participating countries for use in pulse breeding program
- To share the available donors/improved breeding lines among collaborating countries
- To widen the genetic base of pulse crops through pre-breeding activities
- To evaluate segregating populations with broad genetic background in the participating countries for effective selection for location-specific requirements

As part of the project, three varieties of lentil from Nepal were introduced and evaluated in Bhutan. Although lentils have potential in Bhutan, the crop is not grown traditionally by farmers and was never tried in the country.

Materials and Methods

Three improved varieties of lentil from Nepal, Shital, Simal and Maheshwar Bharati, in an RCBD with three replications in 12 m^2 plots. A seed rate of 50 kg per ha was used. Fertilizers @ 18:46:20 kg NPK per has was applied. Weeds were controlled by 2 hand weedings. Trials were implemented at 2 locations: Bhur in Gelephu (393 m, latitude: 26:54:14 N; longitude: 90:26:2 E) and at Bajo in Wangdue (1180 m, latitude: 27:29:12 N; longitude: 89:54:3 E). In Bajo, the trial was sown on 27 November 2009 after rice. In Bhur, the trial was sown on 9 December 2009 after rice. Data on flowering, maturity, plant height, number of branches and pods, and seed yield per plot were recorded from a net plot size of 7.2 m^2. Both the trials were harvested in the last week of April 2010.

Results and Discussion

At Bajo, the growth of lentil was very slow probably due to low temperatures after the sowing was done. Sowing was a bit delayed as the rice was harvested late. Possibility of sowing early in the beginning of November or sowing in standing rice crop could be explored in the coming season. At Bhur, sowing of lentil was possible only on 9 December after rice harvest. Rice in this part of the country is transplanted only in July and harvesting takes place in end November. However, low temperature is not a problem. Bhur receives more rainfall than Bajo especially in March and April, due to which lentil was affected at maturity. Seeds were seen to sprout on the plants.

The analysed data for Bajo are presented in Table 11. There were no significant differences observed in flowering, maturity and plant height between the three varieties. However, Shital gave the maximum number of pods per plant followed by Simal and Maheshwar Bharati. This however did not translate to significant differences in seed yield.

Table 11: Flowering, maturity, number of pods and seed yield of three lentil varieties, Bajo, 2009-10.

Variety	50% Flowering (days)	75% maturity (days)	Plant height (cm)	No of primary branches	No of pods/plant	Seed Yield (kg/ha)
Shital	73 a	109 a	43 a	23 a	145 a	283 a
Simal	74 a	109 a	41 a	37 b	175 b	395 a
Mahesh-war Bharati	74 a	110 a	40 a	45 b	99 c	331 a
P value	0.48	0.77	0.48	0.004	0.0002	0.29

Means followed by the same letter within treatments are not significantly different according to 95% Confidence Interval at P≤0.05

Analysed results for Bhur are presented in Table 12. Like in Bajo, there were no significant differences in flowering, maturity, plant height and number of branches and pods per plant. In terms of seed yield, Shital produced the highest yield of 356 kg/ha which was significantly lower than that of Maheswar Bharati.

Table 12: Flowering, maturity, number of pods and seed yield of three lentil varieties, Bhur, 2009-10.

Variety	50% Flowering (days)	75% maturity (days)	Plant height (cm)	No of primary branches	No of pods/plant	Seed Yield (kg/ha)
Shital	77 a	112 a	33 a	8 a	25 a	356 a
Simal	77 a	112 a	32 a	8 a	18 a	303 ab
Mahesh Bharati	77 a	112 a	34 a	9 a	24 a	217 b
P value	1	1	0.54	0.70	0.53	0.05

Means followed by the same letter within treatments are not significantly different according to 95% Confidence Interval at P≤0.05.

Conclusions

Lentils were grown in Bhutan at two locations, Bajo and Bhur, for the first time. There seems to be some potential for lentils in the country, however, proper time of planting and other agronomic practices need to be refined. It is recommended that some more trials be carried out possibly in more locations. IIPR Kanpur may provide more trial kits for this purpose.

1.7 TSIRANG SUB-CENTRE

The research sub-centre at Mithun, Tsirang has been revived recently with placement of a few staff at the RA level. There is only one RA for field crops at the moment and there is a need to place graduate level staff urgently. Field crops sector mostly carried out variety evaluation of maize and rice and also concentrated on seed production for further testing and promotion in the region.

1.7.2 Community based maize seed production

The community based seed production was jointly initiated by RDC, Wengkhag in two geogs at 2 locations. A field day also jointly conducted by staff from RDC Bajo and Bhur with the objective to create awareness among farmers on improved maize varieties in their locality, particularly for tolerance/resistance to TLB and GLS diseases. Seed selection procedures were also demonstrated to the farmers. The group has 6 farmers who produced 264 kg of Yangtsepa at Nevary village and 175 kg Palmira seed at Bataray village. Farmers sold their seed to other neighbouring farmers through facilitation from research staff.

1.7.3 On-station maize seed production

Seed production of Yangtsipa and Khangma Ashom-II was carried out at the station. A total of 235 kg of Yangtsipa, 405 kg of Khangma Ashom II and 40 kg of Ganash II was produced. Out of this, 460 kg seed of all the varieties was issued to Tsirang Dzongkhag for promotion purposes. Other farmers of Dunglagang, Kikhorthang, Rangthangling, Tsholingkhag and Gosiling geogs were also given seeds for productivity improvement purposes.

In addition, evaluation of 15 different genotypes of maize for tolerance/resistance to GLS/TLB was done at the station in collaboration with RDC Wengkhar. Among the 15 varieties, entry No. 1 was selected for further seed selection purposes under Tsirang conditions. Seed increase of Population 44 C10 maize variety also done.

1.7.4 On-station seed production of rice varieties

Seed production of Khangma Ray Kaap-6 and Khangma Ray Kaap 2 was successfully done. A total of 864 kg of Khangma Ray Kaap 6 and 512 kg of Khangma Ray Kaap 2 was supplied to Dagana Dzongkhag for testing and promotion purposes as per their demand. Tsirang dzongkhag was issued 125 kg of Khangma Ray Kaap 6 and 102 kg of Khangam Ray Kaap 2 for promotion. Further, 260 kg of Khangma Ray Kaap 6 and 350 kg of Khangma Ray Kaap 2 was distributed to farmers in Mendrelgang and Patsaling goegs as per their demand. Farmers of Dunglagang, Kikhorthang, Rangthangling, Tsholingkhag and Gosiling geogs also received seeds of the above varieties for test purposes.

1.7.5 On farm evaluation of rainfed and irrigated rice varieties

As part of the Nationally Coordinated Trials (NCT), both rainfed and irrigated rice varieties from RDC Bhur for low altitudes were evaluated at Patala, Shemjong and Mendrelgang goegs to assess their adaptability and yield performance. Collected data were submitted to RDC Bhur for analysis and reporting.