Report

On

Assessment of Winter Chili Production in Southern Dzongkhags for 2017-18 FY

National Vegetable Program
Agriculture Production Division
Department of Agriculture
Ministry of Agriculture and Forests

June 2018

Prepared by:

This report is compiled and prepared by National Vegetable Program, APD, DoA, MoAF based on the consultative progress review meeting held from 23 May to 7 June 2018, and with contributions from the farmer representatives from each of the production sites, Geog Extension Officers, Dzongkhag Agriculture Sector of the eight target Dzongkhags and vegetable researchers from respective Agriculture Research and Development Centres.

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Abbreviations and Acronyms

Ac	Acre
APD	Agriculture Production Division
ARDC	Agriculture Research and Development Centre
BAFRA	Bhutan Food and Agriculture Regulatory Authority
CARLEP	Commercial Agriculture and Resilient Livelihood Programme
Cm	Centimeter
DAOs	Dzongkhag Agriculture Officers
DAMC	Department of Agriculture Marketing and Cooperatives
DoA	Department of Agriculture
FMCL	Farm Machinery Corporation Limited
FSAPP	Food Security &Agriculture Productivity Project
FYM	Farm Yard Manure
FY	Fiscal Year
Gm	Gram
Kg	Kilogram
IFAD	International Fund for Agriculture Development
M asl	Meter Above Sea Level
mm	Millimeter
MoAF	Ministry of Agriculture and Forests
MT	Metric Tonnes
NCHM	National Centre for Hydrology and Meteorology
NOP	National Organic Program
NSC	National Seed Centre
Nu	Ngultrum
RGoB	Royal Government of Bhutan

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Above all the Department would like to thank the growers, Geogs and Dzongkhags involved in the production program for putting in their full efforts and supports to make the program successful.

SUMMARY

The winter chili production program for 2017-18 was implemented in 56 geogs of 8 Dzongkhags falling under Humid Sub-tropical and Wet Sub-tropical Zones with altitude ranging from 150-1200 m asl from August 2017 following the staggered production system. The production program was implemented based on comprehensive production plan developed in consultation with all the geogs and Dzongkhags with an objective to make the availability of fresh green chilies (the favorite of most of the Bhutanese) in the domestic market during the winter season from December to March. The production program was also implemented in collaboration with FMCL in their four regional farms.

The production inputs were supported mostly from RGoB funding and for project target Dzongkhags (Chukha, Samtse, Sarpang and Dagana) the funds were sourced from FSAPP-World Bank and some fund support from CARLEP-IFAD for Dzongkhags (Samdrupjongkhar and Pemagatshel) in the East. The overall total budget spent for the winter chili production program in 2017-18 FY was Nu. 22.549 million (Inclusive of all expenses) and out of which Nu. 21.588 million, was spent only for production inputs.

The production this season was not as expected. The total actual production as of May 2018 was 140.64 MT from total area of 322.34 Ac. The decrease in actual area cultivated and low production against that of the plan was mainly because the first to almost third staggered transplants were destroyed by heavy and continuous monsoon over the period August to October in most of the production sites. In 2017, Bhutan received slightly above normal rainfall (average of 1916.29 mm) with most regions receiving rainfall above the average. The highest rainfall was recorded at Sarpang followed by Samtse, Phuntsholing and Samdrupjongkhar (NCHM, 2017). The other reasons for lower production were due to low temperature affect on plant growth and development and incidence of pests and diseases.

However, the program have greatly benefited the farmers involved in the production program as they received production inputs free of cost which they can utilize it for few more years, gained practical know-how on production practices, better impact on technology demonstration and adoption, and above all they earned adequate cash income as they had readily available domestic market for the fresh green chilies during the winter season. Most of the farmers have sold their produce in the market during winter season with price ranging from Nu. 150-250/kg. The simple cost benefit analysis of the program indicated that it was worth investing in such focused approach production program. At an average market price of Nu. 200/kg of fresh local green chilies produced (140.64 MT) the estimated return from the program was Nu. 28.128 million worth with a profit of Nu. 5.579 million over the overall total investment (Nu. 22.549 million) for the program.

1. Background

With the import ban of Chili, Beans and Cauliflower in the year 2016, the Department focused on increasing the internal production of these banned vegetables especially during the winter season. Based on the production and feasibility assessment of winter chili production done by ARDC Samtenling in May 2017 in the southern Dzongkhags, the Department in consultation with the Dzongkhags (8 Dzongkhags falling under wet sub-tropical zones) developed the detailed plan of action in July 2018 and implemented the winter chili production program with the objective of making availability of green chilies in the domestic market during the lean season (December to March). The production program was implemented following the staggered production system with first nursery starting from mid-August 2017 in all the production sites (56 geogs under 8 Dzongkhags and 4 FMCL farms). The targeted total area was 608.66 ac and expected production was 973.92 MT (@ 1.6 MT/acre) from 8 Dzongkhags and 80 ac with expected production of 128 MT from FMCL farms (Kana, Gelephu, Nichula and Phuntshothang).

2. Production input supports provided

The production input support worth Nu. 21.588 million was provided to the production sites by the Department for the winter chili program. The production input support was provided to respective production sites based on the analysis on inputs required as put up by respective Dzongkhags after the consultation meeting held in July 2017. The summary of the expenditure made on production inputs for each of the production sites were as given in the Table 1. (Details in Annexure 1).

For effective utilization of the inputs supplied for the intended purpose an agreement was signed between the Dzongkhag, Geog and Beneficiaries stating that the grower will use the inputs exclusively for vegetable production and the grower will produce chili for minimum of three years. Therefore, the investment made last season when divided across three years comes to Nu. 7.196 million per year.

Table 1: Summary of expenditure made on production inputs for each of the production sites (Nu. in Million)

Dzongkhags	Hybrid seeds	*Nursery materials	**Protected cultivation materials	***Irrigation materials	TOTAL
Chukha	0.120	0.063	0.292	0.348	**0.822**
Dagana	0.438	0.124	0.247	1.620	**2.428**
Pemagatshel	0.984	0.135	0.308	2.871	**4.297**
Samtse	0.571	0.210	1.670	1.457	**3.907**
Sarpang	0.568	0.210	1.585	2.454	**4.816**
Samdrupjongkhar	0.594	0.090	0.157	0.706	**1.547**
Tsirang	0.307	0.092	0.470	1.534	**2.403**
Zhemgang	0.072	0.029	0.216	0.685	**1.002**
FMCL Farms	0.366	0.000	0.000	0.000	**0.366**
TOTAL	**4.018**	**0.952**	**4.943**	**11.676**	**21.588**

*Plug trays and Watering cans

**Poly-house plastics, Nylon belts, Shade nets, Rabbit fencing nets and Plastic mulches.

***Syntax, HDPE pipes, Flexible pipes, Drip sets, Sprinklers, Water harvesting (Silpaulin sheets) and Electric water pump

3. Review of progress for 2017-18 winter chili production

The progress review of the 2017-18 winter chili production program and plan for coming winter season was done in all the Dzongkhags involving farmer representatives, geog extension officers, researchers, BAFRA and geog administration from 23 May to 6 June 2018. The consultative review meeting was done with the following objectives;

- Review the progress of the program in each of the Dzongkhags (Production, economic analysis, technology adoption assessment).
- Assessment of the suitability and farmer's acceptability of the varieties promoted.
- Take stock of lesson learnt, issues/challenges and recommendations from growers and extension colleagues.
- Prepare plan for the coming winter season in line with 12 FYP target.

3.1. Area and Production

The production this season was not as expected. The total actual production as of May 2018 was 140.64 MT from total area of 322.34 Ac against the expected production of 515.74 MT from the same area based on the national average yield of 1.6 MT/Ac.

Table 2: Area and Production (Plan Vs. Actual) for winter chili

Dzongkhag	Plan		Actual		Percent area against planned area	Percent production against expected production
	Area (Ac)	Production (MT)	Area (Ac)	Production (MT)		
Chukha	19.90	31.84	12.85	2.13	64.6	6.7
Dagana	73.00	116.80	35.28	9.79	48.3	8.4
Pemagatshel	164.00	262.40	24.95	3.40	15.2	1.3
Samdrupjongkhar	99.00	158.40	39.7	12.18	40.1	7.7
Samtse	95.11	152.18	76.99	17.27	80.9	11.3
Sarpang	94.60	151.36	86.27	89.53	91.2	59.2
Tsirang	51.05	81.68	26.5	4.46	51.9	5.5
Zhemgang	12.00	19.20	10.30	0.869	85.8	4.5
FMCL Farms	80.00	128.00	9.50	1.01	11.9	0.8
TOTAL	**688.66**	**1101.86**	**322.34**	**140.64**	**43.0**	**12.4**

Besides the production in the above sites, seedlings of the hybrids were also provided to Udzorong geog, Trashigang Dzongkhag. The farmers of Udzorong grew the chilies inside 4 polyhouses (5x10 m size with area of 200m^2) and in open field of 0.1 ac with total production sold as of May 2018 was 70 kg which was sold at Nu. 200/kg earning an amount of Nu. 14,000.00. The production is still on from the plants grown inside the polyhouse and is expected to last for a month.

The decrease in actual area cultivated and low production against that of the plan was mainly because of the following reasons as reported during the review meeting across all the Dzongkhags.

- The first and second staggered nursery seedlings got delayed and those seedlings transplanted in the main field died in most of the production sites especially in lower belts because of continuous rainfall during the month of August to October. In 2017,

Bhutan received slightly above normal rainfall (average of 1916.29 mm) with most regions receiving rainfall above the average. The highest rainfall was recorded at Sarpang followed by Samtse, Phuntsholing and Samdrupjongkhar (NCHM, 2017). The weather data of the Samtenling too indicates the heavy rainfall received when the first and staggered seedlings were transplanted in the main field (Table 3).

Table 3: Weather data from ARDC Samtenling, 2017

Months	Average monthly T-Max (°C)	Average monthly T-Min (°C)	Average monthly RH-Max (%)	Average monthly Soil temp at 5 cm depth (°C)	Average monthly Soil temp at 15 cm depth (°C)	Average monthly Soil temp at 30 cm depth (°C)	Monthly Total Rainfall (mm)
Jan	24	15	61	18	21	20	7
Feb	26	17	65	19	23	21	16
Mar	26	18	69	21	24	22	50
Apr	27	21	79	23	27	25	154
May	29	23	86	25	29	27	456
Jun	29	24	91	26	30	28	1075
Jul	30	25	90	28	31	29	924
Aug	29	24	93	26	29	27	2078
Sep	29	23	93	26	30	28	1032
Oct	29	22	79	25	30	27	127
Nov	28	18	72	22	25	23	12
Dec	26	17	70	19	22	20	0
Annual Average	**28**	**21**	**79**	**23**	**27**	**25**	**5930**

Note: Rainfall-total

- The annual average maximum and minimum temperature was 23.1°C and 11.6°C respectively in the year 2017 (NCHM, 2017). And in most of the production sites it was observed that there was fluctuation in the day and night temperature, the night temperature in most places was below 10°C during winter months which adversely affected the chili plant growth and development as most of the production was done in open condition. Therefore, there was lower production.

- Incidence of pests and diseases both in the nursery and main field condition also affected the production. In the nursery stage there was problem of red ants and damping off, while in the main field the main problem was infestation by thrips, mites and aphids which lead to curling of leaves and stunted growth of the chili plants. The crop stand also got infected with wilt diseases in most of the fields due to intermittent sunshine and rainfall. No chemical control measures were adopted and used only Neem oil and cow slurry which could not effectively control the pests and diseases.

- Most of the production was carried out in open field without plastic mulches from which they observed lower production. The production carried out under poly house as well as in open field by using plastic mulches had better production as reported by the growers. The research trial conducted by ARDC Wengkhar comparing the yield between open and in polyhouse condition indicated highly significant yield differences as shown in the Table 3.

Table 4: Yield comparison between open field and under poly house

Condition	Yield of 3 hybrids (gm/plant)		
	PAN 1498	SHP4884	SV2319HA
Open field	140[a]	154[a]	163[a]
Poly house	410[b]	413[b]	457[b]
P value	<0.001	<0.001	<0.001

3.2. Comparison of Investment and Income from the program

The winter chili production program have greatly benefited the farmers involved in the production program as they received production inputs free of cost, gained practical know-how on production practices and above all they earned adequate cash income as they had readily available domestic market for the winter chili. During the review meeting with growers and extension colleagues, they reported that there was no problem of market for winter chilies, instead they were not able to fulfill the demand of the local market in their respective Dzongkhags.

The total budgets spendin 2017-18 for the winter chili production program was Nu. 22.549 (Table 1).

Table 5: Summary of expenditure made for the winter chili program 2017

Expenditure Details	Amount (Nu.)
Production inputs (Hybrid seeds, nursery production materials, protected cultivation materials and irrigation materials)	21.588
Planning meeting with 8 Dzongkhags (conducted on June 2017)	0.404
Consultation meeting on marketing – Vendors, Growers, Dzongkhags, DAMC and DoA	0.070
Field day on transplanting	0.008
Review and Planning meeting with 8 Dzogkhags (conducted on May 2018)	0.374
TA/DA for the APD officials	0.105
Total Nu. in Millions	**22.549**

The winter green chilies produced from the production sites were mostly sold in their local market and some quantities were sold in CFM Thimphu. It was reported that the farmers sold their produce in the local market at the rate of Nu. 150-200/kg and the farm gate price as Nu. 100/kg (but most of the farmers produce were sold at Nu. 150/kg). As per DAMC report on prices for vegetables in CFM market, the retail price of green chilies (small local) from the month of Dec 2017 - May 2018 ranged from Nu. 250-400/kg (Dec Nu.250/kg, Jan Nu. 250/kg, Feb 400/kg and May 200/kg).

Based on the farm gate price of Nu.100/kg and Nu. 150/kg, local market price of Nu. 200/kg and CFM price of Nu.250/kg for fresh local green chilies (small), the estimated returns in terms of monetary value are as given in the Figure 1.

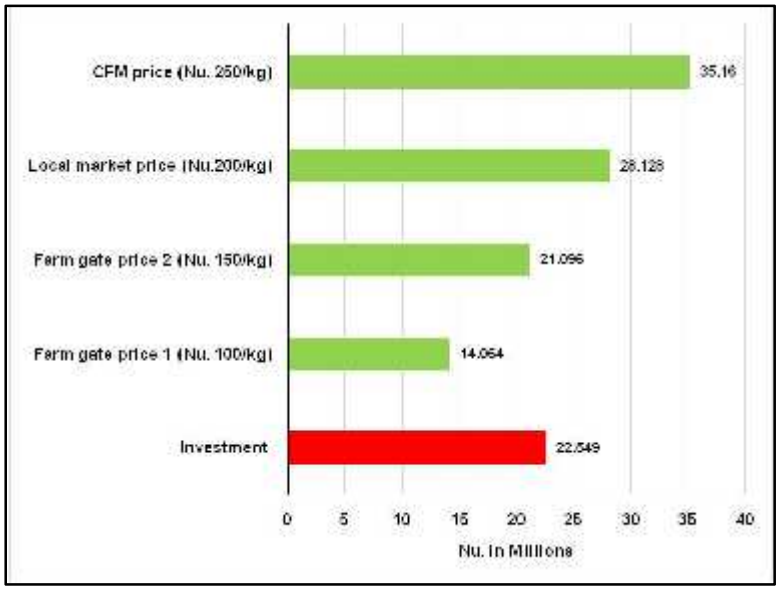

Figure 1: Value of Green Chilies from different markets against total investment

The differences of returns against investment indicates that the investment made for the program was worth enough despite negative differenceswhen sold at farm gate price and achieving the expected production level(Figure 2). The farmers involved in the production program also expressed that it was worth growing winter chilies despite many abiotic and biotic challenges that they faced and production is still on in the field. Some of the farmers from across the production sites during the consultative meeting and over the field visits reported on production and cash income earned till May 2018 as cited in the box 1 below.

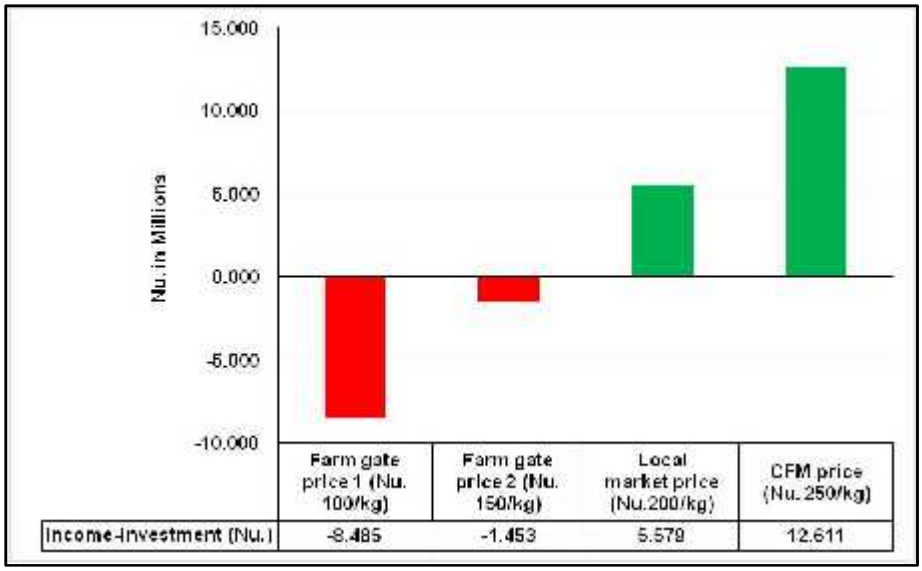

Figure 2: Income versus Investment differences from different markets

Mr. Neten Dukpa from Samtenling, Sarpang Dzongkhag grew chilies in 3 ac of land. The total production he harvested till date was 4300 kg. He sold 3500 kg at the rate of Nu. 150/kg and 800 kg at the rate of Nu. 100/kg. He earned total amount of Nu. 605,000.00. He reported that the harvest was continuous as; from the 1st staggered transplants he harvested 11 times, from 2nd staggered transplants 8 times and from 3rd staggered transplants 4 times.

Mr. Dawa Sherpa from Lhamoizingkha, Dagana Dzongkhag cultivated an area of 0.5 ac and sold about 800 kg earning an amount of Nu. 120,000.00 (sold at Nu. 150/kg). He harvested 5 times and there is still production and expected to harvest till June end.

Mr. Deepak Chhetri from Samtenling, Sarpang Dzongkhag sold 1286 kg earning cash income of Nu. 154, 320.00 (sold at Nu. 120/kg).

Mr. Lok Bdr. Ghalley from Samtenling, Sarpang Dzongkhag sold approximately 350 Kg at the rate Nu. 120/kg earning an amount of Nu. 42,000.00.

Box 1: Statements from some of the farmers on production and income earned

3.3. Technology dissemination and adoption

The best part of the program was that the technology dissemination and adoption was very effective as the program being implemented in focused approach. The production technologies promoted were staggered production system, use plug trays / plastic cups for seedling production, low cost poly houses for nursery and production, plastic mulching and water use efficient technologies particularly drip irrigation. With the adoption of staggered production system right from nursery to harvesting, extension colleagues as well as farmers were able to understand the correct timing of nursery raising, transplanting and harvesting in their respective production sites and have enabled them to have continuous supply of fresh produce to the market. The farmers reported that the use of poly houses and plastic mulching have greatly benefited them and have observed vast production differences between open field condition and the ones under poly house and those cultivated with use of plastic mulches. The use of plastic mulches have enabled them to use FYM judiciously, saved labour required for weeding and irrigation and maintaining the soil temperature for growth and development of the chili plants. Drip irrigation was effective as during winter season there is shortage of water for irrigation. The impacts of the technologies promoted were positive in the sense that farmers are now aware and coming forward to upscale the technologies.

It was decided during the review meeting across all the Dzongkhags that effort will put in up scaling the protected cultivation technology (use of polyhouses, plastic mulches, drip irrigation systems) to increase the production from unit area in the coming winter season.

Figure 3: Production technologies promoted for winter chili production

4. Winter Chili Production trial in ARDCs

The on-station production trial on winter chili was conducted in ARDC Samtenling and Wengkhar with the objective to come up with suitable cropping calendar and fast track evaluation of hybrids under open and green house conditions. The research will continue for another 2 years to come up with concrete research results. The findings reflected in this report are the result of first year research trial.

ARDC Wengkhar, Mongar

The on-station winter chili production trial was carried out in Lingmithang, Wengkhar and Khangma stations evaluating the performance of 3 hybrids (PAN 1498, SHP 4884 and SV 2319HA) in open field and green house conditions. The results from the first year evaluation are as follows;

- In Wengkhar and Khangma condition, the production trial failed because of the low temperature during winter season.
- However, under Lingmethang condition the trail was successful in both open field and polyhouse condition.
- The result under open field condition in Lingmethang (650 m asl) indicated that the yield per plant of the 3 hybrids did not differ significantly but the individual fruit weight of SV 2319HA and SHP 4884 was significantly higher than that of PAN 1498 (Table 5)

Table 6: Chili fruit parameters of 3 hybrids under open field condition (Lingmethang)

Variety	Plant height (cm)	Pod length (mm)	Pod width (mm)	Fruit weight (gm)	Yield/plant (Kg)
PAN 1498	69.6[a]	52.6[a]	6.8[a]	110.9[a]	0.140[a]
SHP 4884	68.8[a]	59.0[a]	7.3[a]	189.7[b]	0.154[a]
SV 2319HA	75.4[a]	53.2[a]	7.4[a]	190.2[b]	0.163[a]
P value	0.08	0.5	0.12	<0.001	0.13

- The result under polyhouse condition in Lingmethang showed similar results that the yield per plant did not differ significantly and the individual fruit weight was significantly higher for SV 2319HA and SHP 4884 compared to PAN 1498. PAN 1498 and SV 2319HA have significantly higher plant height than SHP 4884 (Table 6).

Table 7:Chili fruit parameters of 3 hybrids under polyhouse condition (Lingmethang)

Variety	Plant height (cm)	Pod length (mm)	Pod width (mm)	Fruit weight (gm)	Yield/plant (Kg)
PAN 1498	90.0[a]	69.0[a]	7.1[a]	139.9[a]	0.410[a]
SHP 4884	81.4[b]	56.2[a]	8.2[b]	198.8[b]	0.413[a]
SV 2319HA	89.2[a]	55.3[a]	8.1[b]	198.8[b]	0.457[a]
P value	<0.001	0.4	0.03	<0.001	0.09

- The yield comparison of these 3 hybrids in open field condition vs. under polyhouse condition resulted in significantly higher production under polyhouse condition (about 4 times higher than in open condition) which clearly indicates the effect of temperature on yield of chili plants in winter season (Table 7).

Table 8: Yield comparison between open field and under polyhouse condition

Condition	Yield of 3 hybrids (gm/plant)			No. of Days from Transplanting to Harvest
	PAN 1498	SHP4884	SV2319HA	
Open field	140[a]	154[a]	163[a]	134 Days
Poly house	410[b]	413[b]	457[b]	110 Days
P value	<0.001	<0.001	<0.001	

- In general among the 3 hybrids, SV 2319HA is the best though statistically there was no significant differences with other 2 hybrids.

ARDC Samtenling, Sarpang

Research on performance evaluation of 27 chili varieties using check variety (Sha Ema and Indian Local available from NSC) and best season for these varieties were conducted on-station starting from August 2017. The trial is still on-going and the results are not yet compiled. However, on the timing of staggered production of winter chili under Samtenling condition it was observed that the staggered production should start from August to October to get the production during lean season (Dec – Feb).

5. Challenges/Issues and recommendations

The farmers and extensions involved in the winter chili production in most of the production sites were into the production program for the first time and were not confident enough during the beginning of the implementation of the program. Nevertheless, after implementation they were able to gain confidence and skills despite facing various challenges/issues. The general issues/challenges faced by the growers and possible recommendations proposed during the review meeting are as given below.

Challenges/Issues	Recommendations/Suggestions
The uniform timing followed for staggered production for last season does not apply uniformly in all the production sites. It was observed the timing for staggered production depends on the location of the production sites.	Based on the experience gained by the growers and extension colleagues, it was suggested that the timing and interval for the staggered production will be implemented based on the locality of the respective production sites with reference to the plan produced by ARDC Samtenling. But all were informed to make sure that the green chilies are made available in the market starting from December month. Individual gewogs are requested to submit the production plan and approaches that they want to adopt.
Damages by heavy and continuous rainfall both especially for the first and second staggered nursery and transplants during seedling stages.	It was recommended to support the growers with pre-fabricated greenhouses on cost sharing basis (80:20) especially for nursery production and up-scale use of plastic mulches in the main field in order to avoid splashes and damages from heavy rainfall.
Problem of pests and diseases – leaf curling of the chili plants were observed in most of the production sites few weeks after transplanting in the main field. The common pests observed were Thrips and Mites. The main disease observed was chili wilt.	The use of pesticides were discouraged, however, to overcome the pests and disease infestation issues it was recommended to apply effective bio-pesticides right after the seedlings are transplanted in the main field. If the infestation is severe or epidemic then was informed to use pesticides as per the recommended dosage. Use of recommended fungicide (root dip in fungicide solution, preventive application of fungicide to the crop stand once established, drenching of nursery bed). The growers were informed that possibilities of supports for bio-pesticides and capacity development will be requested to NOP.
Hybrid varieties requires good soil fertility for its optimal production, but it was observed that in most of the production sites especially in the southern belts there is issue of low soil fertility.	Farmers were encouraged to make composts in their individual farm and also bio-digesters in households where there are stall feeding cattles. The support for bio-digesters will be explored from Dzongkhags and National Organic Program.
Shortage of irrigation water for the winter production.	The materials for irrigation water management was supplied to all the growers involved in the program based on the request put up individual Dzongkhags during last season, but it was flagged out that in some production sites the materials were not enough (especially the drip sets). There is need to provide additional support on drip sets and plastic mulching needs to be promoted for effective conservation of soil moisture. Plastic mulch with twin color (black and white) to be sourced instead of black and silver. The construction of water harvesting structures using silpaulin sheets at household level was encouraged, but

	especially in the southern belts there was issue of restriction by MoH if the structures are open because of mosquito breeding. It was agreed in areas where malaria is not a concern to support with water harvesting structures.
The Ministry has instructed Geog Agriculture Extension Officers to verify and provide the authentication letter for sale of banned vegetables. The Geog colleagues reported that it is very difficult at times since most of the vegetable vendors manipulates with the form (in terms of quantity) and mixes with products from India. There is no prescribed format for issuance of authentication letter; different geogs uses different formats which is very much vulnerable to manipulation.	The geog extension officers suggested having a uniform format across the country in the form of booklet or receipt with identification number in each page, which will keep track of the manipulations if done by any as a copy of the letter issued with serial number will be with the concern extension and BAFRA officials. Need to discuss with BAFRA and come up with possible solutions for effective implementation.

6. Way Forward (Plan for 2018-19 winter season)

During the consultative meeting with the Dzongkhags the plan for 2018-19 winter seasons was drawn up. Following points have been agreed during the meeting across the Dzongkhags;

- It was decided that the staggered production system will be pursued but the timing will be decided based on the locality and experience from last season in respective production sites. The geogs were informed to target the maximum produce to be available through December to February as during these months there is acute shortage of locally produced green chilies in the market. All the geog extension officers are requested to submit the staggered production plan for their respective geogs.

- The importance and effectiveness of protected cultivation (use of polyhouses, plastic mulches, drip irrigations systems) for better production of not only chilies but also other vegetables. This has been realized by the farmers and extension colleagues, hence, needs to be up scaled in the coming season for increased production and to make locally grown green chilies and other vegetables available in the market during the winter months.

- As most of the southern belts have poor soil fertility, incidence of pests and diseases are high due to climatic factors and to encourage natural or organic production, it was felt necessary to support the growers with organic production technologies such as promotion of bio-digesters, compost making, vermi-compost, bio-pesticides, bio-fungicides and capacity development of the farmers on organic production. National Organic Program will be consulted for provide necessary support.

- Protected cultivation technology demonstration and promotion in potential production sites with an area ranging from 0.5-1.0 ac was agreed upon. The selected sites should have assured irrigation, available dry land and interested farmer (in group or

individual). The protected structure will be used for year round vegetable production (mainly focusing on temporarily banned crops and other high value vegetables).

Table 9: Proposed area for Protected Cultivation for Year round vegetable production

Dzongkhag	Geog / location	Area (ac)
Dagana	Tashiding	1.0
Samtse	Tashicholing / Hangey	1.0
	Denchukha	1.0
Chukha	Phuntsholing / Sadu Madu	0.5
	Dungmin / Durungri	0.6
Pemagatshel	Decheling / Telung	1.0
	Chimung / Awashing	0.5
Total		**5.6**

- The farmers have raised the issue of damages to low cost polyhouses due to heavy rain and were requesting to support with pre-fabricated green houses which will be durable and can be used for both nursery and main plant production. To this the farmers were informed that the support will be in cost sharing basis of 80:20 as per the Department's cost sharing mechanism and needs to be included in the plan for budget sourcing. The request for pre-fabricated green houses of dimension 5m x 20 m are as given in Table 9. The Department needs to explore for budget in 2018-19 for the support.

Table 10: Request for pre-fabricated green houses on cost sharing basis

Dzongkhags	No. of Pre-fabricated GHs (5m x 20 m)
Chukha	2
Pemagatshel	4
Sarpang	24
Total	**30**

- Water harvesting structures needs to be promoted to solve the problem of irrigation water. It was agreed that at the household level interested farmers will be supported with Silpualin sheets for construction of water harvesting ponds.

7. Picture story

Figure 4: Low cost polyhouse construction for nursery production

Figure 5: Nursery raising under low cost polyhouse

Figure 6: Seedling production by use of plug trays and plastic cups

Figure 7: Transplanting in open field

Figure 8: Transplants using plastic mulch and drip irrigation

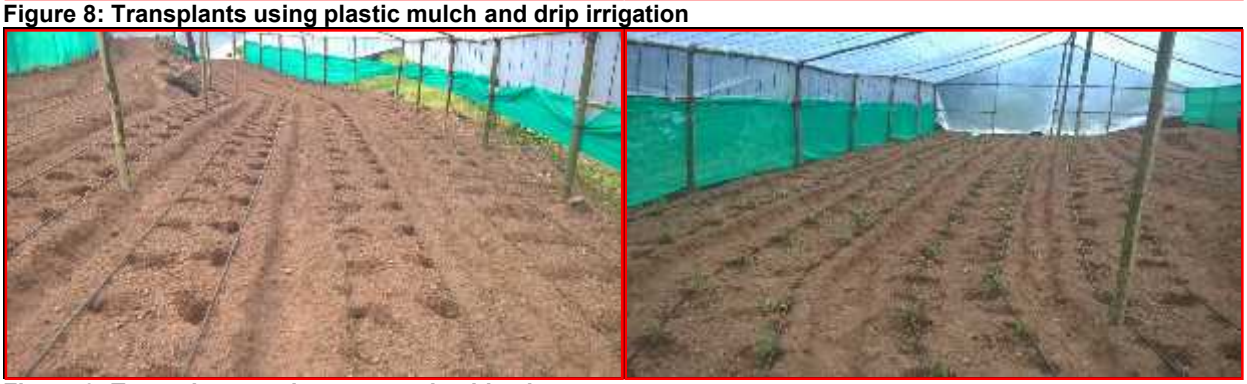

Figure 9: Transplants under protected cultivation

Figure 10: Chili crop stand in the main field

Figure 11: Fruit of harvest

Annexure 1: Details of Expenditure made for the respective Dzongkhags and FMCL farm

Dzongkhag	Details	Unit	Chukha	Sarpang	Samtse	Z/gang	Dagana	Tsirang	S/jongkhar	P/gatshel	FMCL Farms	Total	Unit Rate	Total Cost (Nu.)
Hybrid Seeds (@ 12 pkts per acre)	Hybrid	Pkts	238.8	1135	1141	144	876	613	1188	1968	960	8263.9	500	4,018,000
Plastic film for greenhouse	10 x 5m	Nos	22	87	93	13	18	39	9	8	0	289	8,750	2,528,750
Nylon belt for greenhouse		Nos	22	87	93	13	18	39	9	8	0	289	1,250	361,250
Green shade net		Nos	4	3	71	3		22		50	0	153	3,150	481,950
Plastic film (mulching)		Bdle	17	34		12	19	3	19	20	0	124	3,500	434,000
Rabbit fencing net	30 x 3m	Nos	0	733	645	43	0	0	0	0	0	1421	800	1,136,800
Syntex tank (Ltrs)	500	Nos	10	15	30	30	43	30	45	100	0	303	9.5	1,439,250
	1000	Nos	2	3	23	2	16			30	0	76	9.5	722,000
	2000	Nos	0	35	2	7	0	0	0	0	0	44	9.5	836,000
	3000	Nos	0	12	0	0	0	0	0	0	0	12	9.5	342,000
	5000	Nos	0	6	0	0	0	0	0	0	0	6	9.5	285,000
Drip irrigation	250 m^2	set	10	15	30	30	30	30	45	100	0	290	6,500	1,885,000
HDEP pipe	20 mm	rolls	0	21	60	0	42	0	0	0	0	123	33	405,900
	25 mm	rolls	41	67	34	4		0	0	0	0	146	43	627,800
	32 mm	rolls	0	3	12	0	0	102	0	0	0	117	71	830,700
	40 mm	rolls	0	2		0	0	0	0	0	0	2	110	22,000
	50 mm	m	0	0	0	0	0	0	0	100	0	100	146	1,460,600
Flexible pipe threaded	25 mm	rolls	5	70	50	20	50	0	25	0	0	220	8,000	1,760,000
Electric Water pump	1.5 Hp	Nos	0	0	0	0	20	0	0	0	0	20	20,000	400,000
	2 Hp	Nos	0	1	0	0	0	0	0	0	0	1	25,000	25,000
Water can	10 Ltrs	Nos	72	149	148	12	68	4	0	0	0	453	500	226,500
Sprinklers		Nos		6	45	25	130		0	0	0	206	750	154,500
Silpaulin Sheet	8 x 6 m	Nos	0	0	0	0	1	63	0	0	0	64	7,500	480,000
Plug trays		Nos	300	1500	1510	250	1000	1000	1000	1500	0	8060	90	725,400
TOTAL														**21,588,400**

Annexure 2: Winter Chili supportfor 2018

Dzongkhag	Details	Unit	Chukha	Dagana	Samtse	S/jong khar	P/gats hel	Sarpang	Tsirang	Z/gang	Wangdi	ARDC/F MCL	TOTAL
Planned Area	Dry land	Acre	21.25	72.51	77.5	35.5	44	134.85	63	7	12	23	**490.6**
Hybrid + OP Seeds	Hybrid + OP	Pkts	855	871	930	426	528	1619	792	84	144	846	**7095**
Pre-fabricated Greenhouse	20x5m	Set	2	0	0	0	4	24	0	0	0	0	**30**
Plastic film for greenhouse	20x 5m	Nos	16	26	88	2	9	88	0	0	0	0	**229**
Nylon belt for greenhouse		Nos	16	26	88	2	13	88	0	0	0	0	**233**
Green shade net	50%	Nos	10		142	17	32	10	0	0	0	0	**211**
Plastic film (mulching)	25 microns	Bdle	29	367	287	240	120	261	0	0	0	0	**1304**
Rabbit fencing net	30 x 3 m	Nos	0	0	390	0	52	1025	0	0	0	0	**1467**
Syntex tank (Ltrs)	500	Nos	1	0	0	0	0	0	0	0	0	0	**1**
	1000	Nos	10	0	0	0	0	38	3	0	0	0	**51**
	2000	Nos	0	0	0	0	0	31	0	0	0	0	**31**
Drip irrigation	250 m^2	set	22	193	164	92	29	25	0	0	0	0	**525**
HDEP pipe (mm) 100 m rolls	20 mm	rolls	0	29	0	0	0	0	0	0	0	0	**29**
	25 mm	rolls	10	12	47	0	15	71	6	0	0	0	**161**
	32 mm	rolls	0	0	20	0	0	0	0	0	0	0	**20**
Flexible pipe (Threaded)	25 mm	rolls	15	45	100	10	89	343	3	0	0	0	**605**
Water can	10 Ltrs	Nos	8	0	0	80	34	218		0	0	0	**340**
Silpaulin Sheet (300 GSM)	12 x 9 ft	Nos	13	246	33	13	0	0	0	0	0	0	**305**
Bio Pesticide (Neem oil)		Litres	0	0	27	30	0	0	0	0	0	0	**57**
Neem Powder		Kgs	0	0	700		0	0	0	0	0	0	**700**
Vermicompost		Kgs	0	0	0	2400	0	0	0	0	0	0	**2400**