TWELFTH FIVE YEAR PLAN

2018-2023

DoA

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DEPARTMENT OF AGRICULTURE

Ministry of Agriculture and Forests

Royal Government of Bhutan

Thimphu

March 2019

TWELFTH FIVE YEAR PLAN 2018-2023

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FOREWORD

Planned Agriculture development started since 1960s and farming had remained as one of the mainstays of Bhutanese populace with over 57.2% of them depending on agriculture for livelihood. The agriculture system has also evolved over time; gradually transitioning to commercial production from that of subsistence systems. Horticulture crops like vegetables, fruits, potato and medicinal & aromatic plant and spices are main cash crops contributing substantially to the rural household income. On the other hand, field crops like cereals and legumes continue to be the staple diet.

The growth in agriculture sector is due to various interventions made by the Royal Government of Bhutan and with the support from development partners. The effort to facilitate and support agriculture production still continues with adoption of policies and interventions as per the need of the hour.

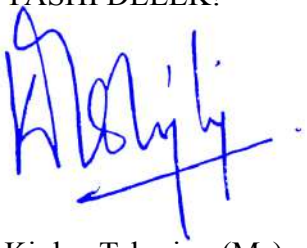
We continue to grapple with many challenges that are unique to agriculture like crop depredation by wild animals and erratic weather patterns. Despite many challenges, the production of crops had increased over the past years. All efforts are being made to channel the limited resources in increasing the current production manifolds and also support key cross sectorial thrust areas like irrigation, farm mechanization, organic farming, agriculture enterprise and land development.

I am pleased to introduce the Department of Agriculture's 12th Five Year Plan. This document captures the key achievements of the 11th FYP as well as the plans and programmes for the 12th FYP. Further, the plan also outlines areas of interventions in the form of investment strategies to accomplish the goals.

This document will be the key reference for drawing annual plans and most importantly, it will also serve as a guidebook to track the progress of the agencies through timely monitoring and evaluation.

Finally, I would like to request concerned agencies to refer this document and liaise with each other in realizing the departments' goal and priorities.

TASHI DELEK!



Kinlay Tshering (Ms)
DIRECTOR

GLOSSARY OF ACRONYM

AED	:	Agriculture Engineering Division
AKRA	:	Agency Key Result Area
AMC	:	Agriculture Machinery Centre
APA	:	Appraisal Performance Agreement
APD	:	Agriculture Production Division
ARDC	:	Agriculture Research and Development Centre
ARDSC	:	Agriculture Research and Development Sub-centre
ARED	:	Agriculture Research and Extension Division
BAFRA	:	Bhutan Agriculture and Food Regulatory Authority
CMU	:	Central Machinery Unit
CNR	:	College of Natural Resources
CoRRB	:	Council for RNR Research of Bhutan
DAMC	:	Department of Agricultural Marketing and Cooperatives
DAO	:	Dzongkhag Agriculture Officer
DoA	:	Department of Agriculture
DoL	:	Department of Livestock
DSE	:	Department of School Education
DT	:	Dzongkhag Tshogdu
FALC	:	Floriculture and Amenity Landscaping Centre
FCBL	:	Food Cooperation of Bhutan Limited
FDI	:	Foreign Direct Investment
FMCL	:	Farm Machinery Corporation Limited
FYM	:	Farm Yard Manure
FYP	:	Five Year Plan
GDP	:	Gross Domestic Product
GNHC	:	Gross National Happiness Commission
GT	:	Geog Tshogdey
HWC	:	Human Wildlife Conflict
ICTD	:	Information Communication and Technology Division
IFPP	:	Integrated Food Processing Plant
IMO	:	Institute for Market ecology
IWP	:	Individual Work Plan
KPI	:	Key Performance Indicator
LFSR	:	Labour Force Survey Report

LG	:	Local Government
LULC	:	Land Use Land Cover
MAPS	:	Medicinal Aromatic Plants and Spices
MoAF	:	Ministry of Agriculture and Forests
MoE	:	Ministry of Education
MTR	:	Mid-Term Review
NARS	:	National Agriculture Research System
NBC	:	National Biodiversity Centre
NCHM	:	National Centre for Hydrology and Meteorology
NKRA	:	National Key Result Area
NMC	:	National Mushroom Centre
NPHC	:	National Post Harvest Centre
NPPC	:	National Plant Protection Centre
NSB	:	National Statistical Bureau
NSC	:	National Seed Centre
NSSC	:	National Soil Services Centre
OD	:	Organizational Development
PCCM	:	Program Coordination Committee Meeting
PHCB	:	Population and Housing Census of Bhutan
PPD	:	Planning and Policy Division
PPP	:	Public Private Partnership
RAMC	:	Regional Agriculture Machinery Centre
RDTC	:	Rural Development Training Centre
RNR	:	Renewable Natural Resources
RSD	:	RNR Statistical Division
SAP	:	School Agriculture Program
SOE	:	State Owned Enterprise
SSR	:	Self-Sufficiency Report
SSR	:	Self-Sufficiency Rate
TTI	:	Technical Training Institute
VRC	:	Varietal Release Committee
WWF	:	World Wildlife Fund

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1. BACKGROUND

1.1. Introduction

Agriculture is the main source of livelihood for 57.2% of the total population in Bhutan (LFSR, 2016). Agriculture sector alone has contributed 10.64% of the total 17.37% (NSB, 2017) contributed by the RNR sector to country's GDP. The GDP from agriculture sector has grown at an average of 4.72% annually since 2012 (NSB, 2012-2017) and it is valued at Nu 17, 513.39 million in 2017. Therefore, agriculture is one of the Five Jewels of the Economic Development Policy of Bhutan which has made significant contribution in improving the livelihood of rural communities.

With an average farm size of 2.22 acres (PHCB, 2017), most farmers practice subsistence to semi-subsistence integrated farming systems. Despite its small size, Bhutan's agro-ecology is diverse with large variation in altitude and micro climatic conditions. Rice, Maize, Potato, Citrus, Arecanut, Apple and Cardamom are the most dominant crops cultivated in Bhutan. Over the last two plan periods, farming in Bhutan has seen a dynamic shift from subsistence nature to commercialized farming. The major interventions that have triggered this transition process are investments in irrigation and farm roads; electric-fencing to protect crops from wildlife damages; development and promotion of high yielding crop varieties; focused commodity approach and provision of essential support services including market infrastructures.

The Population and Housing Census of Bhutan (PHCB), 2017 has reported that 93.8 % of total population is sufficient with food during 12 months prior to the census reference day. This translates to 6.2% of the total population experiencing food insufficiency in the country. The report also states that more households in rural area (8.1%) have reported food insufficiency than in the urban areas (2.9%). Bhutan is now self-sufficient in Fruits and Potato with the Self-Sufficiency Rate (SSR) of 132% and 162% respectively in 2016, while Cereal and Vegetable Self-Sufficiency level stands at 61.16% and 95.54% respectively.

The major agricultural export commodities are Citrus, Apple, Potato, Vegetables and Cardamom. The combined export value of these commodities has increased to Nu 2,394 Million in 2017 from Nu 1,663 Million in 2012. However, export volume has slightly decreased from 54,056 metric ton in 2013 to 47,830 metric ton in 2017. On the contrary, both the import volume and value of mostly imported commodities[1] has increased from 70,867 metric ton worth Nu 1,754 Million in 2013 to 120,246 metric ton worth Nu 3,578 Million in 2017. Cereal import (2013 to 2017) has increased drastically from 54,031 metric ton to 90,021 metric ton (RSD, 2017).

The country has been banking on its intact ecosystem to pursue its goal of organic farming. A total of 5,560 acres of agricultural land is brought under organic agriculture benefiting 2,680 households through capacity building, support to production inputs, product development and certification. As of now, ten products had been developed and certified in collaboration with

[1] Rice, Maize, Vegetables, Cooking oils, Potatoes, Fruits and Nuts and Citrus

the National Certification Body, Bhutan Agriculture and Food Regulatory Authority (BAFRA) and International Certification Body (IMO). A total of 24 farmer groups and cooperatives had been established to strengthen marketing of the produce.

Building upon the past plans achievements, in 12th FYP, the department will focus on six major commodities; Rice, Maize, Vegetables, Fruits & Nuts, Citrus and Potato due to their indispensable contribution to nations' food self-sufficiency, nutritional security, poverty alleviation and income generation. The support services for the remaining six commodities (Wheat and Other Cereals, Oilseed, Grain Legumes and Pulses, Medicinal Aromatic Plants and Species (MAPS), Floriculture and Mushroom) will be continued. The emphasis on the irrigation development will also be continued. In addition, the other thrust areas in the 12th FYP includes; enterprise development, organic agriculture, land development, farm mechanization, innovation and promotion of climate resilient technologies.

1.2. Plan formulation process

The overall formulation of 12th FYP was guided by the standard process and time-frame given by the Gross National Happiness Commission (GNHC) and the Policy and Planning Division (PPD), Ministry of Agriculture and Forests (MoAF). In addition, several rounds of consultation workshops and meetings were conducted with Dzongkhags, Central Programs and Agriculture Research and Development Centers to make the plan document inclusive. The consolidation and validation of baselines, targets and corresponding activities were thoroughly discussed through meetings, workshops and correspondences with relevant stakeholders.

Table 1: 12th FYP formulation process

Timeline	Activities
January 2017	➢ **Plan inception workshop, Thimphu** - Discussion on the Draft Conceptual Framework. Draft AKRAs, KPIs and strategies prepared by PPD was presented to departments and agencies
February 2017	➢ **Core Group meetings** - Formulation of AKRAs and KPIs on the NKRAs lead by MoAF (NKRA 5-Healthy Ecosystem Services enhanced; NKRA 8- Food and Nutrition Security Ensured). Simultaneously, MoAF participated on formulation of AKRAs and KPIs to which the Ministry is collaborator.
March 2017	➢ **Consultation workshop, Thimphu** - consultation workshop with departments and agencies on the first draft plan objectives, AKRAs and KPIs. The workshop was organized by PPD, MoAF in consultation with GNHCS. ➢ **Consultation meeting with Dzongkhags** - Consultation meeting with Dzongkhags involving Dasho Dzongdags/Dzongrabs, Dzongkhag Thrizins, Dzongkhag Planning Officers, RNR sector heads and staff to ensure alignment between Ministry's plan objectives, baselines and targets with that of Dzongkhags.
April 2017	➢ **Review meeting on draft AKRAs, KPIs, baselines and targets** - Draft AKRAs, KPIs, baseline and target was reviewed based on the outcome of consultation meeting with Dzongkhags and sectors. The first draft was then submitted to GNHCS for their review and comments.
June 2017	➢ **Workshop at Paro** - Following the comments from GNHCS, a week-long workshop to finalize AKRAs, KPIs and also to identify key issues/challenges and corresponding strategies for plan was discussed. The workshop also identified list of preliminary sectoral programs and flagship program. ➢ Finalization of AKRAs and KPIs.

July 2017	➢ **Presentation to RNR-GNHC**– A presentation on the final AKRAs, KPIs, preliminary list of sectoral programs and list of flagship program was presented to RNR-GNH Committee for endorsement and directions.
August 2017	➢ **Consultation meeting between Departments and Central/Regional programs/centres**– consultation between departments and respective central programs and regional offices to agree on the set of programs and also to achieve better synergy between centre and fields ➢ **Presentation to Department:** Presentation and discussion on 12th FY programs plans with Director, Chiefs and Senior Officials
September 2017	➢ **Program formulation:** A team of 12th plan core working group members reviewed overall plan and drafted programs ➢ **Consultation meeting with Dzongkhags and Central Programs, Phuentsholing**: A consultation meeting with DAOs and Central Programs to finalize baselines, targets and draw broad activities of 12 FYP was held. ➢ First draft plan programs submitted to PPD, MoAF
October 2017	➢ **Consultation on draft programs** - After submission of draft programs to GNHCS, simultaneously, one day consultation was organized by PPD with all staff of MoAF including relevant SoEs to invite diverse views. ➢ **Revision and presentation of revised programs by the respective sectors**: Based on the comments received during one day consultation meeting, all sectors presented the revised plan programs to the Ministry.
December 2017	➢ **Submission of final draft 12th plan document to the Ministry**: Following Paro Write-shop, the final draft plan document was reviewed, refined and submitted to PPD
February & March 2018	➢ **Regional review and planning meeting with ARDCs, Bajo, Samtenling, Wengkhar and Yusipang** to further breakdown of annual target for 1st year of the 12th plan with Dzongkhags
March 2018	➢ **12th plan write-shop**: Write up of the Department plan involving Division chiefs, senior officials and plan focal officials led by the Advisor, drafted the first Departmental plan at IMSL, Serbithang
September 2018	➢ **Concretization and finalization of plan document**: Re-packing and fine tuning of first draft guided by Agriculture Adviser and Specialist was organized at Jambayang resort, Thimphu. A working group was formed for the task.
October 2018	➢ Submission to Department for review and comments
November 2018	➢ Discussion and update baseline crop data with PPD 12th plan focal
January 2019	➢ Finalization and publication of 12 FYP

2. SITUATIONAL ANALYSIS

Agriculture is one of the core growth areas of Bhutanese economy providing employment to 57.2% of the total population (LFSR, 2016). Out of the total land of 3,839,400 hectares, only 2.75% is under cultivation (LULC, 2016). Bhutanese Agriculture Sector has come a long way since the introduction of modern agriculture techniques in first Five Year Plan. Agriculture production in Bhutan has made significant contribution to enhance food and nutrition security and reduce rural poverty. In 2017, crop sector alone contributed about 10.64% of the total RNR sector contribution to GDP (17.37%) and it is valued at Nu 17,513.39 million (NSB, 2017).

2.1. Production

The diverse agro-ecological conditions are favorable to grow wide varieties of agricultural and horticultural crops in the country. Rice, Maize, Citrus, Cardamom and Vegetables including Potato are dominant crops in Bhutan. The Rice and Maize production has increased by 10.7% and 28.8% respectively from 2012 to 2017 (Table 2). This increase is attributed by

the increase in productivity during the 11th plan period. The increase in productivity of Paddy and Maize was recorded at 12.7% and 23.8% respectively. The production of wheat and Other cereals significantly dropped by 24% and 32% respectively since 2012, indicating lesser interest of the farmers to grow these crops due to shift in crop priorities. The Oilseeds, Grain legumes and pulses production remained insignificant throughout the plan period though there is increase in production in the past few years.

Table 2: Production trend of important food crops

Sl. No.	Commodity	Production (MT)					
		2012	2013	2014	2015	2016	2017
1	Paddy	78,014	75,228	77,038	80,261	85,090	86,385
2	Maize	73,024	75,715	77,244	83,714	82,035	94,052
3	Wheat	5,038	4,286	3,465	3,730	2,521	3,833
4	Other cereals*	10,624	8,601	6,698	6,845	7,121	7,236
5	Oil Seeds**	1,245	1,641	1,473	1,292	1,314	1,536
6	Grain legumes and pulses***	698	1,302	1,642	1,395	1,476	1,230
Total		168,643	166,773	167,560	177,237	179,557	194,272

Source: Agriculture statistics, 2012-2017
**Other cereals: Buckwheat, Barley and Millet **Oil Seeds: Mustard, Ground nut, Soya bean, Sunflower, Pyrilla and Niger ***Grain legumes and pulses: Rajma bean, Mung bean and Lentil*

Vegetables and Potato production has significantly increased by more than 61% and 33%, respectively (2012-2017) (Table 3). Significant increase in Ginger and Cardamom production were recorded at about 57% and 249% respectively, contributed mainly by increase in cultivation area driven by high demand. The production of Apple, Fruits and Nuts has slightly increased by about 5% and 7% respectively. On the other hand, the production of Citrus decreased by 43% since 2012. The decrease in Citrus production was mainly due to pest and disease, old and unproductive trees and loss of land to other use forms.

Table 3: Production trend of important cash crops

Sl. No.	Commodity	Production (MT)					
		2012	2013	2014	2015	2016	2017
1	Vegetables	43,026	46,778	49,681	52,044	56,216	69,427
2	Potato	43,000	50,390	53,612	49,359	58,820	57,223
3	Ginger	5,014	3,756	4,983	7,434	10,871	7,859
4	Cardamom	643	1,162	1,781	2,091	2,736	2,245
5	Mushroom	4	19	17	19	82	122
6	Citrus	49,501	33,469	45,226	15,977	42,003	28,017
7	Fruits & Nuts	17,364	14,773	16,415	17,967	18,282	18,600
8	Apple	7,666	8,032	7,051	5,308	6,587	8,039
	Total	166,218	158,379	178,766	150,199	195,597	191,532

Source: Agriculture Statistics, 2012-2017

2.2. Import and export

As mentioned earlier, the export as well as the import value of the following important agriculture commodities has seen an increasing trend over the years (Table 4). In 2017, Bhutan's major export commodities[2] were valued at Nu 2,394 million, while the import of mostly imported commodities[3] was valued at Nu 120,246 million (RSD, 2017). The overall increase in export value from important cash crops accounts to about 44% increase. The Cardamom export has significantly increased by almost 147% followed by Vegetables (42%) and Potato (10%) from 2013 to 2017. A major drop in export volume was recorded in Apple and Citrus by 38% and 35% respectively.

Table 4: Export trend of important cash crops

Commodity	Volume (MT)					Value (Nu in millions)				
	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Potato	21,861	26,849	19,908	24,460	24,045	360	689	371	543	459
Citrus	24,975	21,148	17,820	15,546	16,141	519	543	468	439	478
Apples	4,314	5,437	3,488	3,790	2,659	99	139	102	128	69
Vegetables	2,083	2,191	2,896	3,730	2,953	29	50	68	65	58
Cardamom	823	746	846	1,289	2,031	656	789	941	1,342	1,330

Source: RNR Statistics 2017

Rice, Potato and Vegetables are the most imported commodities in the country. Rice import increased from 23,991 metric ton in 2013 to 62,383 metric ton in 2017. Annual expenditure incurred to import Rice during the plan period is about Nu 1.5 – 1.9 billion.

Table 5: Import trend of major commodities

Commodity	Volume (MT)					Value (Nu millions)				
	2013	2014	2015	20 16	2017	2013	2014	2015	2016	2017
Rice	23,991	24,183	52,853	64,314	62,383	479	518	1,126	1,537	1,696
Maize	16,433	18,808	9,216	19,061	24,073	27	239	129	302	344
Vegetables	13,728	15,212	15,702	15,504	13,998	234	234	357	323	286
Oils	9,416	15,954	14,251	11,467	11,114	704	818	801	833	1,087
Potatoes	5,279	5,264	5,994	5,468	5,238	57	80	60	81	51
Fruits	2,020	3,548	3,349	3,716	3,440	44	91	92	113	115

Source: RNR Statistics 2013-2017

2.3. Land holding and farming population

As per the report of PHCB, 2017, an average land holding of Bhutanese farmers is 2.22 acres per household. In 2017, a total of 220,271 Bhutanese people were recorded to reside on-farm doing farming, whereas in 2012, a total of 296,418 people resided on farm (Agriculture Statistics, 2012-2017). These figures indicate the declining trend in the farming population and during the last plan period, it has decreased by about 26%. Drudgery in farming, crop damage by wildlife, better opportunities in the urban cities, limited land holding, insufficient

[2] Cardamom, Citrus, Potato, Vegetables, Apple
[3] Rice, Maize, Vegetables, Cooking oils, Potatoes, Fruits and Nuts

irrigation facilities, pests and diseases, limited market access, low margin from the sale of agricultural produce are some of the contributing factors for decreasing farming population.

A total of 46,704 acres from 145,838 acres of total estimated dry land were left fallow. Likewise, 7,820 acres from 59,188 acres of total estimated wetland have been left fallow (Agriculture Statistics, 2017). This offers huge potential to increase agriculture area and production in the 12th plan.

2.4. Per capita consumption and self sufficiency

The estimated per capita dietary energy consumption for the period from 2006 to 2014 was estimated at 3,211.20 kcal/person/day. The combined dietary energy supply from Cereals, Oilseeds and Grain Legumes and Pulses is 87% and that from Fruits and Vegetables is 7% (SSR draft report, 2015). The per capita consumption of Rice is calculated at 140 kg.

Bhutan is now self-sufficient in Fruits and Potato with the Self-Sufficiency Rate (SSR) of 132% and 162% respectively in 2016, while Cereal and Vegetable Self-Sufficiency level stands at 61.16% and 95.54% respectively.

2.5. Organic farming

The progress of organic agriculture until 11th FYP has been impressive with 5,560 acres of agricultural land brought under organic management by 2,680 households. In collaboration with National Certification Body (BAFRA) and International Certification Body (IMO) for organic certification, 10 products have been certified which are Potato, Garlic and Carrot from Gasa, Turmeric from Zhemgang, Sea buckthorn, Chamomile, Mint from Bumthang, Green Tea from Trongsa, and Rhododendron & Lemongrass essential oils from Mongar. Three organic manure production plants had been established to supply bio-inputs for organic production.

2.6. Agriculture infrastructure

During the 11th plan period, about 10,982 acres of land were brought under farm mechanization. To improve rural accessibility and develop agriculture land, all 20 Dzongkhags were provided with a hydraulic excavator and a backhoe loader. Similarly, to minimize drudgery in farming, 1,200 power tillers and mini tillers had been distributed, with each Geog owning at least a power tiller (MoAF, 2018). These power tillers are available for farmers at a subsidized rate for hiring. Besides these, 5,363 Km of farm road were constructed and renovated bringing the total length to 11,196 Km.

Out of total length of 2617 Km of irrigation channel, 90.47 Km of new irrigations channels were constructed and 2405 Km renovated in last plan period. The area under assured irrigation in 2017 was recorded at 67,955 acres. In an effort to reduce irrigation water scarcity, 212 water harvesting reservoirs were constructed on cost sharing basis at various locations.

Human wildlife conflict is one of the serious issues faced by farming communities. Hence, to reduce crop damage by wildlife, 3492 Km of electric fencing were installed across the country. A total of 841 different post production structures were established to reduce post harvest losses and add value to agricultural produce.

2.7. School agriculture program

As of December 2017, 315 schools were brought under School Agriculture Program. A total 110 educated youths and 323 Focal Agriculture Teachers were trained on agriculture farming technologies. With the sporadic malnutrition incidences in schools in recent year, the SAP had also been supplementing the nutritional needs of the school children through introduction of 3 eggs per child per week program. Further, with the support from World Food Program, the Department recently initiated rice fortification program with an objective to improve nutritional status of the students. As of now, 162 schools had been supplied with fortified rice.

2.8. Employment

Agriculture has huge potential to generate employment opportunities as the demand for agriculture produce increases with growth in population. Moreover, the system of farming has shifted from subsistence to commercial and enterprise based farming, hence, the human resource required throughout the value chain will be more.

During the 11th FYP, Farm Machinery Corporation Limited was created which employed 299 staff. As the company progresses and grows, the employment created will increase and its expected to double by the end of plan period. Similarly, Mountain Hazelnut Venture Private Limited, an agriculture based FDI company is employing 800 Bhutanese. In addition by the end of 2017, 150 Bhutanese were employed in various agri-based cottage and small industries spread across the country. In 12th FYP, the Department targets to create an additional employment of about 140 numbers through support to establishment of various agriculture based enterprises.

2.9. Human resource profile

Department of Agriculture is one of the biggest Departments under the MoAF with 812 regular staffs. The Department constitutes of three divisions; Agriculture Research and Extension Division, Agriculture Production Division and Agriculture Engineering Division. There are four Agriculture Research and Development Centers and five sub-centers spread across the different parts of the country. There are seven central programs delivering support services for crop production.

The Department of Agriculture has 20 Specialists, specializing in crops like Potato, Maize, Rice and Mushroom. Some are experts in the field of plant protection, farm mechanization and soil fertility management. Most of the specialists are working in the central programs and Agriculture Research and Development Centers. However, five senior Specialists will be retiring during the plan period.

The Department has six officials with Doctorates, 57 with Master's qualification, 199 with Bachelor degree, 23 staff with Post Graduate Diploma and 302 are Agriculture Diploma holders. There are 227 staffs with certificate level qualification. In addition, the Department also employed 30 staff on contract. There are 371 support staffs constituting of lab technicians, farm attendants and drivers. The technical capacity in the central programs and research centers are adequate but need to strengthen their capacity. Conversely, there is lack of uniformity in staffing structure in the centers.

The technical capacity of the Dzongkhags remains weak with only two staff at the Dzongkhag headquarters. Therefore, the implementation and coordination of national and regional programs by the Dzongkhags including supervising and monitoring has not been as desired. All the Geogs only have one staff each overseeing all the activities related to agriculture irrespective of the population, geographical size and intensity of crop farming system. Some of the bigger Geogs covering more than 200 households has remained a challenge for one staff to deliver services effectively.

The Department lacks the expertise in the field of agriculture economics, plant breeding, biotechnology, climate change and architecture. These are some of the emerging needs to be addressed for effective technical services. There is also shortage of technical staff in the research centers, Dzongkhags and Geogs.

2.10. Challenges

There are several challenges faced by the agriculture sector in Bhutan. Some of the key issues as listed in the Agriculture Statistics, 2017 are described in the table below:

Table 6: Challenges faced by the agriculture sector in Bhutan

Issues	Description
Labour shortage	➢ Shortage of able bodies to grow crops is the major problem faced by the farming population (53% HHs)
Crop damage by wild animals	➢ The crop damage by wild animals is also another major challenge confronting the crop production sector (49% HHs).
Inadequate irrigation water	➢ 27% of the households faced irrigation water shortage in farms.
Crop damage by pests and diseases	➢ Pests and diseases management is an impending factor to increase agriculture crop production (22% HHs).
Unproductive land	➢ Owing to the steep gradient and loss of soil fertility, the productivity of the farmland is reduced (14% HHs).
Shortage of land	➢ Due to land fragmentation, the small plots of land cannot be utilized for economic production of crops as per 14% of farming households.
Limited access to market	➢ Unavailability of market information and the proper logistics in place (12% HHs)

Limited access to seeds	➢ Easy access to seeds is limited as there is only one Agriculture Sales and Service Representative (ASSR) in most of the Dzongkhags supplying agriculture inputs, including seeds (5% HHs).
Hail storm/wind	➢ In the year 2016, 5% of the households reported that they have been affected by hail storm or wind.
Drought	➢ The crop production is also affected by drought (4% HHs)
Excessive rain	➢ During the monsoon season, heavy rainfall had affected the crop production (4% HHs).
Limited skills/lack of technology	➢ Farmers lack technical skills to manage the farms properly which are aggravated by lack of appropriate technologies. 4 % of the HHs reported to be affected by this problem.
Limited access to tools and equipment	➢ As in case of seeds supply, the supply of farm tools and equipment is also managed by ASSRs, which is limited.

3. STRATEGIC FRAMEWORK FOR 12TH FYP

The guiding theme for Ministry's 12th FYP is *"Enhancing Food Self Sufficiency and spurring RNR Sector transformation while ensuring sustainable natural resource management"*, with broad thrust areas to increase food self sufficiency, commercialization, enterprise development and maintaining environmental sustainability through climate smart and disaster resilient development. Based on these guiding principles, the strategic framework for Department of Agriculture was drawn.

3.1. Vision

A self-reliant, productive, diverse, resilient and sustainable agriculture food system

3.2. Mission

Achieve food and nutrition security, agricultural transformation through innovative and sustainable technologies, diversified and competitive economic/production options, inclusive and sustainable policies and programs.

3.3. Mandates

1. Ensure attainment of food self sufficiency
2. Generate and promote appropriate agriculture technologies
3. Develop sustainable irrigation and water management system
4. Promote income generation, employment opportunities and enterprise development
5. Promote sustainable utilization of agriculture land
6. Promote farm mechanization and labour saving technologies
7. Promote sustainable and climate resilient agriculture development
8. Establish commodity value chains

9. Develop and promote effective measures to protect crops from wild life damage
10. Delivery of essential agriculture inputs and services (farm infrastructure, technical, advisory and administrative)
11. Provide support services on soil, plant protection, post-harvest and other agricultural services
12. Liaise with national and international institutions for program coordination

3.4. Objectives

1. To increase crop production for enhancing food self sufficiency, income and nutrition security
2. To generate and promote climate resilient agriculture technologies
3. To promote organic farming for sustainable agriculture, safe food, and environment conservation
4. To develop functional farm infrastructures and facilities (irrigation channel, farm roads, post-harvest facilities, etc.)
5. To promote agriculture enterprise development
6. To enhance effective and efficient delivery of agricultural services

4. KEY RESULT AREAS

The expected outcome for the Department by end of 12th FYP are:

- At the end of the plan period, the Self Sufficiency Rates of Rice, Maize and Vegetables are targeted to be increased to 60%, 92% and 100% respectively. An average of 21% increase in the total production volume of agriculture crops is targeted by 2023.
- In addition, the organic food production will be enhanced. The area under organic agriculture management by the end of 12 FYP will be 9039 acres with 17 organic certified agriculture products developed.
- By the end of the plan period, 11 agriculture-based enterprises would be established engaging private sector and generating an employment of 140 numbers. In addition, value chain for three commodities will be established.
- Land development will be one of the thrust areas for the Department and by end of 12th FYP a total of 10,000 ac will be developed and 5339 ac fallow land (*Chuzhing*) will be brought under cultivation.
- An additional land of 6746 acres will be brought under farm mechanization reducing farm drudgery and labour costs through supply of gender friendly, geographically suitable farm machineries.
- Apart from irrigation schemes constructed/renovated by Local Government (LG), six major irrigation schemes totaling up to 180 Km will be constructed/renovated centrally to reduce farm water scarcity.

5. 12TH FYP PROGRAMS

There are seven programs under the Ministry, out of which the Department will directly contribute towards achievement of targets sets for the following six programs. Among the six programs, the major contribution will be towards achieving the targets set for Food and Nutrition Security Program.

1. Food Self-sufficiency and Nutrition Security Program
2. Value Chain and Enterprise Development Program
3. Climate Smart and Disaster Resilient Development Program
4. Research and Extension Services Program
5. Highland Development Program
6. Coordination and Support Services Program

6. KEY STRATEGIES

Although much has been achieved in the past plan periods, challenges still remain in achieving food and nutrition security, promotion of agriculture enterprises, poverty reduction, transformation of agriculture from subsistence to commercial farming, markets and availability of quality agricultural inputs. The Department of Agriculture will continue to strategize its effort for food security, improved nutrition and livelihood of the people in the country through various research and development programs.

For this, it is essential to enhance production using the best practices, making efficient use of resources and appropriate technologies including land development and farm mechanization so that the primary objective of food security is met. Climate resilient agricultural practices will also be adopted to enhance production with minimal impact on nature and the environment. Efforts will be made to commercialize agriculture production through investment and involvement of farmers' groups, State Owned Enterprises, private sectors and Foreign Direct Investment.

To achieve the above objectives, following 14 broad strategies will be adopted for 12th Five Year Plan:

6.1. Sustainable agriculture

Sustainable agriculture in Bhutan is an important factor for socio-economic development and growth. The Royal Government of Bhutan had always adopted the policy of development without destroying the environment and the ecosystem. Accordingly, agricultural production system has evolved within a broad framework of Low External Input Sustainable Agriculture (LEISA) and MoAF has always advocated sustainable approach to agriculture sector development. For instance, the Forest and Nature Conservation Act, Biodiversity Act, Food and Nutrition Security Policy, Integrated Pest Management program, Sustainable Land Management, and regulation on agro-chemicals are strong illustration of sustainable approach to development.

In a move towards sustainable agriculture, organic agriculture will be promoted on a landscape approach, focused on few identified crops. The Ministry has drafted the "Flagship Program on Up-Scaling Organic Sector for Sustainable Socio-Economic Development" with the overall goal to "produce safe and nutritious foods on sustainable basis in environmentally clean production systems".

The import and sale of chemical pesticides is solely authorized to the Department as per the Pesticide Rules and Regulations of Bhutan 2017. So, it is a conscious policy decision to control overuse and prohibit use of hazardous chemicals which would have irreversible negative impacts on human health and the environment on a longer run. The farmers in general practice integrated pest management, using chemical as last resort to control pests and diseases as advocated vigorously.

6.2. Commodity focus approach

The commodity program-based approach planning and implementation was instituted in 2010 with eight commodities (Paddy, Maize, Citrus, Vegetables, Mushroom, MAP, Fruits and Nuts, and Potato) to consolidate resources, improve coordination mechanism, harmonize strategies, coherence, and focus delivery for maximizing program output and impacts. Over the period, the commodity program has evolved to 12 national commodities while only six commodities (Rice, Maize, Fruits & Nuts, Citrus, Potato and Vegetables) have been prioritized for 12 FYP based on their contribution to food security, nutrition, import substitution, export potential, income and employment opportunities. However, remaining six commodities (Oilseed, grain legumes & pulses, wheat & other cereals, mushroom, MAPS and Floriculture) will not be neglected but implemented under normal planning and budgeting system.

6.3. Sustainable soil fertility management and land development

Even as the country intends to gradually shift from subsistence agricultural farming to commercial farming; small land holdings, inability to mechanize farms, drudgery, shortage of farm labours, land degradation, and low land productivity continue to remain as major challenge. These factors attribute in making agriculture farming unattractive especially for youths who aspire to take up agricultural farming as a vibrant enterprise. Hence, Department has prioritized agriculture land development as one of the thrust area for 12 FYP.

Programs and activities of soil services would be geared towards agriculture land development, meeting the nutrient requirements of the identified commodities for optimum crop productivity while maintaining or enhancing soil health. Agricultural land on slopes and narrow valleys should be terraced or developed to facilitate farm mechanization and for efficient utilization of available soil nutrients. Efforts would be made for efficient use of all available nutrient sources such as crop residues, straw, animal manure, compost, green manure and mineral fertilizers, where accessible and affordable. Technologies like intercropping with leguminous crop, pre-rice Sasbenia, crop-rotation with legumes, large scale production of organic manures should be up-scaled beyond trials and demonstrations so that the technologies are accessible to the farmers.

The National Soil Services Centre (NSSC) will spearhead programs and activities for technical implementation and coordination with research centres, central program, Dzongkhags, Geogs, farmers and other land users. Central Machinery Unit will support the agencies with machineries for agriculture land development.

6.4. Climate smart farming and green technologies

Agriculture sector is hugely affected by climate change and climate induced disasters. One of the interventions towards making agriculture sector resilient to climate change and its related disaster is through a range of climate smart farming technologies such as drip and other piped irrigation in the case of droughts; adoption and innovation of new management practices; organic farming; development of pest/disease and stress tolerant varieties and improve soil fertility (nutrient management) to ensure increased productivity even during the incidences of severe drought, erratic rainfalls and new pest and disease outbreaks.

Additional and adequate investment will be made on research and technology development based on the needs of farmers. The other important interventions would be to develop the national agri-climate change adaptation plan, disaster management strategy and promote public awareness to adapt to climate change and manage disasters. In an effort to increase the preparedness in face of unpredictable climate, agriculture agro-met services program will be established under the Department. This program along with forecasting of the weather will also provide agro-meteorological advisory services on the agriculture activities.

6.5. Sustainable on-farm water resources management

The productivity of agricultural systems is dependent on the availability of adequate water at critical crop growth stages. In many parts of the country, farmers continue to depend on the monsoon rains, which have become ever more erratic and unreliable. Issue of irrigation water is aggravated by the location of farmlands in water-scarce areas for which an appropriate irrigation system such as drip or other piped water conveyance is required. Though the country is blessed with many river systems, its use in agriculture had been limited due to unavailability of appropriate technology to tap its potential.

Interventions to address water shortage in the 12th plan would be through the development of large-scale irrigation schemes, research and development in pump irrigation system, enhanced on-farm and off-farm water storage facilities and water efficient utilization & management such as:

- Drip and sprinkler irrigation facilities for cash crops
- Rainwater harvesting techniques
- Smart irrigation system coupled with weather data
- Construction of new irrigation schemes for potential production sites
- Renovation of non-functional irrigation channels
- Groundwater and water harvesting schemes
- Water storage structures
- Strengthen water users groups

The Irrigation Master-plan will be used to expand irrigation and water management in Bhutan.

6.6. Research & innovation

Agriculture development is faced with emerging challenges such as depleting natural resources, scarcity of water, declining soil fertility and land degradation, increasing cost of inputs, scarcity of human resources for farming, and unpredictable weather patterns. In light of the above challenges and as the country shifts from subsistence to commercial farming, a vibrant and dynamic National Agriculture Research System (NARS) is required to generate appropriate agriculture technologies for boosting agriculture production.

After the dissolution of the erstwhile Council of RNR Research of Bhutan (CoRRB) and realignment of research centres under different technical departments in 2009, it is believed that agriculture research is weakened and focus diluted. It is estimated that currently researchers at the Agriculture Research and Developments Centers (ARDC) dedicate only 20-40% of their time for research while 60%-80% of the time is spent on development activities. Realizing the pivotal role of agriculture research for agriculture development, Agriculture Research and Extension Division (ARED) under the Department of Agriculture was created in 2016 to oversee national agriculture research. To revive and strengthen NARS, Agriculture Research Strategy, 2018-2028 has been developed, to help guide, coordinate and form a basis for both short and long-term research in Bhutan. Further, for effective coordination and implementation of agriculture research activities, each ARDC is provided with national, regional and commodity mandates (Table 7). Clients Dzongkhags are assigned to each ARDCs to address regional agriculture technology gaps and for effective coordination and linkage with the Dzongkhag agriculture sectors.

Besides ARDCs, the six central programs (NPHC, AMC, NSC, NSSC, NPPC, NMC) also undertakes largely adaptive research to generate technologies in their respective disciplines. Central programs work in close collaboration with ARDCs for technology generation. The Research works are also done in collaboration with National Biodiversity Centre (NBC) for conducting research on land races that has implications on crop improvement. Beyond the MoAF, initiating linkage with the College of Natural Resources (CNR) under the Royal University of Bhutan (RUB) is imperative in taking up collaborative research in thrust areas and related disciplines.

Table 7: Mandates of ARDCs

	MANDATE		
	4 Regions	National	Commodity
AGRICULTURE RESEARCH AND DEVELOPMENT CENTRES	Bajo	Field crop	Rice, Wheat and other cereals and Citrus
	Samtenling	Sub-tropical agriculture	Spices, Grain legumes & pulses
	Wengkhar	Horticulture	Maize and Fruits & Nuts
	Yusipang	Organic agriculture	Potato, Apple and Vegetables, MAP

The agriculture research areas are field crops, horticulture, organic, climate change adaptation and mitigation, efficient water management, soil fertility and sustainable land management, pest management, farm mechanization, seed science and technology, agro-meteorology, biotechnology, post-harvest, indigenous food crops, policy and socio-economic research.

6.7. Enterprise development

Medium and small scale enterprises are seen as one of the key driving force for economic development of the country and huge potential to create employment. As of August, 2017 there were 41 numbers of licensed agri-based cottage and small enterprises employing 150 individuals. In the 12th Five Year plan period, Department will establish 11 different enterprises (Eight enterprises under value chain and enterprise development program: Protected agriculture, Mushroom spawn production, Mushroom production, Organic-fertilizer plant, Vermin-compost, Bio-pesticide plant, Cereal based processing & product development, and Floriculture and three MAPS enterprise under Highland development program) and MAPS enterprises. These enterprises have been identified after assessing the current demand and the potential to generate viable business venture. The Department will support an individual or group of private entities with focus on youth to take the enterprise with equity investment for shared responsibility and ownership. Department will also provide continued technical assistance for ensuring better success. Department of Agricultural Marketing and Cooperatives (DAMC) would also play crucial role in finding reliable markets for the produce.

6.8. Commercialization

In continuation to earlier plans, the focus in 12th FYP will be in promoting commercialization of agriculture farming. Commercialization of agriculture requires area expansion, improvement in crop productivity, specialization of crop production techniques, consolidation of production units, input and market outlets and services.

To achieve this, support would be rendered to State Owned Enterprise (SOE), Public Private Partnership (PPP), Foreign Direct Investment (FDI), Enterprise establishment for youth and women, Contract Farming, Farmers groups and cooperatives. Similarly, emphasis will be given to connect agricultural production areas with markets through improved rural roads, transport, market network and market infrastructure such as improved storage and collection centers in collaboration with DAMC.

6.9. Agriculture input services

Agriculture inputs such as seeds and planting materials, fertilizers, pesticides are basic requirement for agriculture farming. Concerted efforts from the relevant agencies will make available of these inputs in adequate quantities and at affordable price to the farmers as and when required. National Agriculture Research system had officially released 263 different varieties of field and horticultural crops with superior agronomic traits since its establishment in 1982. Seeds and planting materials of these released varieties is being produced and supplied by government and private seed agencies to the farmers. However, seed replacement

ratio for both horticultural and field crops still remains low due to the week national seed system. In addition, availability of quality seeds, seedlings and other agriculture inputs is also an issue.

The first Agriculture Research Coordination Meeting recommended National Seed Centre (NSC) as the national technical authority to coordinate and monitor seed and planting materials production in the country including private nurseries and seed companies to strengthen national seed system. In this respect, the national seed production and supply strategy outlining the roles and responsibilities of both NSC and private seed companies/growers will be developed and implemented. NSC will also initiate and lead robust system of seed research in the country.

Ministry will continue to regulate the supply of fertilizers and pesticides, limiting to import and distribution by government agencies as practiced currently to ensure availability and supply of quality products. As we gradually shift farming from conventional to organic, bio-inputs production and supply will be promoted through proper assessment.

6.10. Modernization and mechanization of agriculture farming

i. Farm mechanization

The increasing number of farmers and youths migrating out of villages has led to farm labour shortages. This has significantly impacted agricultural production capacity and household food security. Many households leave their land fallow or grow few crops due to farm labour shortage and drudgery. Realizing these constraints, the government has established Farm Machinery Corporation Limited (FMCL) for the supply farm machineries and labour saving tools. However, such support from the government has not been adequate to meet new and emerging challenges. Farm mechanization entails more than the supply of machinery and labour-saving tools and implements. We need to institutionalize and develop the capacity of the whole value chain from supply to after sales services such as operation of machinery/tools/implements, maintenance and management.

Farm mechanization is expensive for farmers or private individuals in Bhutan. The past experience under this program has indicated that without the support from the government in the form of subsidy or the cost-sharing mechanism, farm mechanization is difficult to implement. Therefore, farm machinery hiring services has to be strengthened with adequate fleet of farm machineries and the subsidy for hiring has to be continued to reduce farm labor shortage, enhance the efficiency of farming and upscale the volume of agricultural produces. Besides farmers, private sector operators will be assisted to operate tractor dealerships based on a leasing scheme with appropriate subsidy from the government. Government will support farm mechanization based on the number of beneficiaries and production. Therefore, farmer groups and cooperatives will receive priority support in terms of farm mechanization while marginal and smallholder farmers will be appropriately supported through One Stop Farmers Shop (OSFS) centers.

ii. Protected agriculture

Traditional agriculture farming is labour intensive and not attractive, especially for the youths. It is, therefore, important to introduce and promote appropriate protected and intensive modern agriculture technologies such as hydroponics, aeroponics, vertical gardens, greenhouses, shade nets and mulching for optimal crop growth, reducing manual labour and maximizing crop production per unit area. In the past years, Department has promoted greenhouses on cost-sharing basis which has enabled farmers to produce crops during the off-season and in areas with relatively extreme climatic conditions where crop production is not feasible in the open field. Hydroponics, aeroponics and vertical gardens will be promoted in peri-urban areas and for farmers with less landholding under intensive agriculture.

iii. Information and Communication Technology (ICT) in agriculture

There is a huge opportunity to use ICT in agriculture, also known as e-agriculture, in providing solutions to a wide range of emerging agricultural challenges and needs. With agriculture technology advancement, use of ICT will enable generation of real time crop data, thereby supporting science based policy decisions. The system will also be used for precision farming in piloted areas which will be gradually upscaled to cover the whole farmland. ICT will be used for agriculture research and development as labour saving technology, innovative ways for effective and efficient water management, forecasting pest and diseases outbreaks, advisory services to the farmers for agricultural extension, early warning system for disaster prevention to enhance agriculture production.

6.11. Farm infrastructure development

Development of the following infrastructure shall be a priority during the 12th plan and will include construction and maintenance of farm roads particularly to address concerns in rural access and to help enhance market connectivity.

i. Construction and maintenance of irrigation channels

As per the National Irrigation Policy (Revised NIP 2012) article 9: Implementation Arrangements; The MoAF is mandated with irrigation development in the country. Irrigation is not only about building infrastructures but encompasses management of irrigation systems by water users for enhanced crop productivity to achieve food security and livelihood goals. Therefore, the implementation requires a multi-sectoral approach combining the inputs of engineering, agriculture extension, water and agricultural research.

As a result, there is a delineation of roles and responsibilities of various stakeholders at different levels especially the contribution and support of the lined agencies like GNHC, NEC, MoAF, DoA, ARDCs, and Local Governments (). In 12th FYP, only 6 major schemes will be renovated and constructed centrally while rest will be carried out on need basis.

ii. Construction and maintenance of farm road

The emphasis on rural access to food, market and services will be continued. The fleet of machineries available with the Local Government will help achieve construction and maintenance of farm roads.

iii. Post-production infrastructures

Studies point out that postharvest loss of as high as 45% in crop production are due to inadequate storage, improper handling, and inferior packaging systems. Cold stores in strategic locations can help maintain quality, extend shelf life and reduce import dependency while collection and market sheds promote efficient trading of farm produce and better pricing options. Potential exists in improving local storage systems and existing cold storage facilities to make them user-friendly and affordable.

Strengthening of food incubation centers at strategic locations equipped with food processing and value addition equipment will help farmers' group, youth cooperatives and entrepreneurs to value add their products as well as form a platform for training them.

Market sheds and grading facilities are important for commercially important commodities like Citrus, Apple, and Potatoes. Such facility helps to fetch better prices by maintaining uniform quality of produces for market and to capture different segments of markets based on consumer capacity and preferences. Therefore, additional facilities including equipment required for value additions and marketing will be developed in collaboration with DAMC and FCBL.

iv. Service delivery facilities

Service delivery facilities are critical for smooth functioning and efficient service delivery to the clients. Vital infrastructures like offices, extension centers, laboratories and research facilities will be constructed and maintained on priority basis.

6.12. Participatory extension

Promotion of technologies is one of the primary responsibilities of the agriculture extension sector. However, adoption of the technologies has been low due to the weak extension system which is why crop agriculture growth over the years has been slow. Participatory extension approach needs to be pursued aggressively for creating awareness on improved technologies. So, a national agriculture extension strategy and guideline will be developed to provide a broad extension perspective and guide extension officials for smooth implementation of extension activities.

In pursuit of strengthening the extension system, annual regional coordination workshop was revived in 2017 to serve as a platform for extension, research and central programs to discuss, plan and review collaborative activities. However, there has been no representation from the Geog officials. A platform would be created to engage and table out their issues. Such a platform will be strengthened and continued to foster coordination, linkage and collaboration among the agencies under the department.

The capacity of the extension officers will continue to be enhanced through trainings and exposure visits. Basic extension tools and equipment will be provided. To enable the officials to showcase the success stories and their contribution in the field, various platforms like Sanam Drubdey, Agriculture Journal, Agriculture Research and Development highlights has been created. Due recognition is accorded to well performing individuals to further motivate them.

6.13. Human resources development

Human resource is the most critical capital for any plans to be realized. Effective and efficient delivery of services entails skilled, knowledgeable and conducive environment. As a technical Department, it has a strata of technical human capital assigned different roles and responsibilities at various levels, working cohesively to improve the lives of farming communities.

The number of the human resource in the central programs and research centers are reasonable, however, there is lack of uniformity in the number of staff in each center and the capacity of the staff needs to be strengthened. The technical capacity of the dzongkhags remains weak with only two staff in the dzongkhag headquarters. Implementation and coordination of several national programs by the dzongkhags including supervising and monitoring has not been as desired due to shortage of staff. In all the Geogs, there is only one staff each, overseeing all the activities related to agriculture irrespective of the population, geographical size and diversity of cropping system. Some of the bigger Geogs with more than 200 households has remained a challenge for one staff to deliver services effectively. So, there is need to review and revise the staff in the dzongkhags and geogs for greater impact at local government.

The Department had put in continuous effort to train and enhance the capacity of the agriculture officials as per emerging needs and technological advances in crop sector. The support for capacity development, especially those outside country had been mostly through the funding support of our development partners. Nonetheless, there still exists gap of expertise and knowledge in areas like soil microbiology, grain quality testing, nutrient analysis of fertilizers and organic fertilizers, landscaping and designing, plant breeding, climate change and crop modelling, biometrics, vertical farming, farm economics and strategic planning. Knowledge and expertise in these areas are critical for efficient and effective service delivery; keeping in pace with the emerging growth and development in crop sector at a global scale. The best investment is investment in human resource building for all other resources will be wasted in hands of those who lack the required competence to achieve results.

For the 12 FYP, separate human resource development master plan will be developed by Directorate Services, MoAF for the Ministry.

6.14. School agriculture program

School Agriculture Program (SAP) under the Department of Agriculture is a collaborative program with Department of School Education, Ministry of Education. The program provides agriculture education and awareness on self-employment opportunities in Renewable Natural Resources sector while creating awareness on food and nutrition security. The Department is mandated to provide technical and financial support while DSE, MoE provides manpower and policies supports.

Agriculture education is provided through SAP clubs and Agriculture and Food Security Curriculum (AgFSC) that has been formalized since the beginning of 2019 academic year in all Middle and Higher Secondary Schools.

Every year, new member schools are financially and technically supported to establish most viable activities based on their proposals, while old SAP schools are monitored through annual action plans and progress reports. SAP schools are supported with both agriculture activities such as organic vegetable gardens, mushroom production, fruit trees plantations and small scale livestock activities such as poultry for eggs and piggery for meat.

For constant monitoring and progress of SAP activities, a teacher is identified from each school as a Focal Agriculture teacher whose capacities are built through trainings and exposure visits. In addition, the extension officials based in the Geogs also provide technical backstopping wherever required. There is also a system of awarding the best SAP schools through annual assessment to encourage and promote SAP activities.

Currently 315 schools have SAP activities, which brings the coverage to 56% out of the total schools. In 12th FYP, additional 60 schools will have SAP activities which will accordingly benefit more students with knowledge of science behind farming.

SAP will further accelerate its collaboration in school feeding programme, linking farmers' natural local products (domestic production) inclusive of 10% maize gratis (Kharang) towards food diversification efforts and reduce rice import. It will also coordinate rice fortification program for school feeding. Through such interventions SAP intends to contribute to agriculture development and socio economic development among our farmers. During 12th FYP SAP intends to continue maintaining 20% of vegetables from their garden and 53% of livestock products to the school feeding program.

7. PROGRAM PROFILE

7.1. Food Self-Sufficiency and Nutrition Security

Rationale

The Food and Nutrition Security Policy of Kingdom of Bhutan, 2014 envisions that all people living in Bhutan at all times have physical, economic and social access to safe and adequate nutritious food for a healthy and active life contributing to realization of Gross National Happiness. Vision 2020 prioritizes on the improvement of nutritional status of the rural population. Food Act of Bhutan 2005 provides protection to human health through

ensuring safe food. Maintaining food and nutrition security corresponds to national security for small and landlocked country.

Currently, country is 46.7% self-sufficient in Rice, 86% in Maize and Vegetables (average production of 2015-17). The country is self-sufficient in fruits as there is low internal consumption and 80% of what is produced is exported. The prevalence of hidden hunger or malnutrition is quite high; 21.2% of children below age of 5 years are stunted and 9% underweight. Stunting is high in poor and rural households, concentrated in eastern part of the country. Further about 44% of children (below 5 years and 35% of non-pregnant women between 15-49 years) are suffering from iron deficient anemia. Similarly, 22% of pre-school children and 17% pregnant women are vitamin A deficient (DPH, National Nutrition Survey, 2015).

Considering the gap in food and nutrition security in the country, a concerted effort to enhance food and nutrition security through multiple strategic interventions are proposed for the 12th FYP as follows:

Strategies

- Sustainable agriculture
- Commodity focus approach
- Sustainable soil fertility management and land development
- Sustainable on-farm water resources management
- Research & Innovation
- Enterprise development
- Commercialization
- Climate smart farming and Green technologies
- Agriculture input services
- Modernization of agriculture farming
- Farm infrastructure development
- Participatory extension
- Incentivization of agriculture farming

Status of Readiness

- There are total of 263 number of high yielding varieties of cereals, Vegetables and fruits, spices and condiments released
- 2617 Km irrigation schemes operational, 180 Km ready with design and drawing
- Organized production through cooperatives and farmers group operational
- An excavator and backhoe each for agriculture land development and farm road maintenance in dzongkhags.
- Hiring system of farm machineries in place through FMCL in addition to 1200 power tillers distributed
- Focus commodity approach in place

Pre-requisite to Facilitate Program Implementation

- Assured irrigation for crop production
- Provision for agriculture incentives
- Access to inputs (seeds, tools & equipment, technical services)
- Additional climate smart technologies
- Strengthening of human resource and capacity at all levels
- Adequate fund availability
- Better coordination, collaboration and linkages

Implementing Agency: (*Responsible/implementing agency)*	Source of Funding: (*Indicative source of funding)*
APD/AED/ARDC/CP/LG/Private sector/SOE/	RGoB, Existing Area Development Projects

Table 8: Program linkage to NKRAs and AKRAs-food self sufficiency and nutritional security

NKRAs	AKRAs	KPI
Water, food and nutrition security ensured	National Food Self-sufficiency enhanced	1. Rice self-sufficiency 2. Maize self-sufficiency 3. Vegetable self-sufficiency 4. Fruits production 5. Area under assured irrigation 6. Fallow land (chuzhing) brought under cultivation 7. Area under Organic management 8. Certified Organic products developed

Table 9: Program matrix- result level

Result level (AKRAs/ Outcome/ Output)	Indicators	Unit	Base Year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Outcome 1: Food Self-sufficiency Enhanced	Rice self-sufficiency	Percent	2015-17	46.7	60	49	51	54	57	60
	Maize self-sufficiency	Percent	2015-17	86	92	87.2	88.4	89.6	90.8	92
	Vegetable self-sufficiency	Percent	2015-17	86.1	100	87	89	93	95	100
	Fruit production	MT	2015-17	53961	75855	58340	62719	67097	71476	75855
	Area under assured irrigation	Acre	2017	39163	48350	39363	39663	39963	40463	48350
	Fallow-land brought under cultivation (Chuzhing)	Acre	2017	120	5339	500	700	1500	2639	5339
Outcome 2: Organic Farming for Sustainable Development Enhanced	Area under organic agriculture management	Acre	2017	5560	9039	6256	6952	7648	8343	9039
	Certified organic products developed	Number	2017	4	17	5	6	11	14	17
Output 1.1: Cereal production enhanced	Paddy production	MT	2015-17	83913	102827	87696	91479	95261	99044	102827
	Maize production	MT	2015-17	86289	96535	88338	90387	92437	94486	96535
Output 1.2: Other cereals production enhanced	Quinoa production	MT	2017	2.3	311	64	126	188	249.3	311.03
	Wheat production	MT	2015-17	3086	3526	3270	3454	3638	3822	3526
	Buckwheat production	MT	2015-17	3091	3442	3162	3232	3302	3372	3442
	Millet production	MT	2015-17	1560	2129	1657	1774	1890	2007	2123
	Barley production	MT	2015-17	1684	1839	1715	1746	1777	1808	1839
Output 1.3: Oil seed and grain legumes production enhanced	Oil seeds production (Mustard, sunflower, soyabean)	MT	2015-17	918	1153	965	1012	1059	1106	1153
	Grain Legumes production (Rajma, Mung bean, Lentil)	MT	2015-17	1565	2213	1694	1824	1954	2083	2213
Output 1.4: Horticulture production enhanced	Vegetable production	MT	2015-17	58697	69435	60845	62992	65140	67287	69435
	Fruit production	MT	2015-17	25063	30114	26073	27083	28094	29104	30114
	Potato production	MT	2015-17	55134	66211	57350	59565	61780	63996	66211
	Citrus production	MT	2015-17	28898	45741	32267	35635	39004	42372	45741

Result level (AKRAs/ Outcome/ Output)	Indicators	Unit	Base Year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Output 2.1: Area brought under organic agriculture	Area under organic agriculture management	Acre	2017	5560	9039	6256	6952	7648	8343	9039
Output 2.2: Increased organic production	Organic agriculture production	MT	2017	966	4323	1637	2308	2979	3650	4323
Output 2.3: Organic guarantee and certification system developed	Organic guarantee and certification system developed	Date	2017	n/a	2019	-	-	-	2019	-

Table 10: Departmental program activities and plan outlay

Program Output	Program activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
Output 1.1: Cereal production enhanced	Commercialization through contract farming/PPP/FDI/SoE model	DoA	FMCL/BCD/Karma Feed/DAMC	20.00		20.00	High
	Production Support to improved seeds	DoA	Private sector	10.00		10.00	
Output 1.2: Oil seed and grain legumes production enhanced	Adaptation of improved post-harvest technologies for grain legumes and oil seed	DoA	FMCL/Private Sector		10.00	10.00	Medium
Output 1.3: Horticulture production enhanced	Establishment of germplasm repositories	DoA	Private sector		8.00	8.00	Medium
	Support and promote Vegetable production	DoA	FMCL/Private sector	10.00		10.00	High
	Area brought under large scale commercial fruit production (500 ac)	DoA	FMCL/Private sector	30.00		30.00	High
	Promotion of intensive cultivation and enterprising agriculture technologies	DoA	RDTC//Private sector	10.00		10.00	High
	Production of ornamental plants	DoA	Private sector	5.00		5.00	High
Output 1.4: Agriculture	Maintenance of pressurized irrigation systems	DoA	LG/Private Sector	10.00		10.00	High

Result level (AKRAs/ Outcome/ Output)	Indicators	Unit	Base Year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Output 2.1: Area brought under organic agriculture	Area under organic agriculture management	Acre	2017	5560	9039	6256	6952	7648	8343	9039
Output 2.2: Increased organic production	Organic agriculture production	MT	2017	966	4323	1637	2308	2979	3650	4323
Output 2.3: Organic guarantee and certification system developed	Organic guarantee and certification system developed	Date	2017	n/a	2019	-	-	-	2019	-

Table 10: Departmental program activities and plan outlay

Program Output	Program activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
Output 1.1: Cereal production enhanced	Commercialization through contract farming/PPP/FDI/SoE model	DoA	FMCL/BCD/Karma Feed/DAMC	20.00		20.00	High
	Production Support to improved seeds	DoA	Private sector	10.00		10.00	
Output 1.2: Oil seed and grain legumes production enhanced	Adaptation of improved post-harvest technologies for grain legumes and oil seed	DoA	FMCL/Private Sector		10.00	10.00	Medium
Output 1.3: Horticulture production enhanced	Establishment of germplasm repositories	DoA	Private sector		8.00	8.00	Medium
	Support and promote Vegetable production	DoA	FMCL/Private sector	10.00		10.00	High
	Area brought under large scale commercial fruit production (500 ac)	DoA	FMCL/Private sector	30.00		30.00	High
	Promotion of intensive cultivation and enterprising agriculture technologies	DoA	RDTC//Private sector	10.00		10.00	High
	Production of ornamental plants	DoA	Private sector	5.00		5.00	High
Output 1.4: Agriculture	Maintenance of pressurized irrigation systems	DoA	LG/Private Sector	10.00		10.00	High

Program Output	Program activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
infrastructure & farm mechanization enhanced	Maintenance and Establishment of Citrus repository	DoA	Private sector	10.00		10.00	High
	Strengthening of seed production facilities	DoA	Private sector	7.00		7.00	High
	Strengthening of lab facilities and equipment	DoA	Private sector	25.00		25.00	High
	Capacity Building of farm machinery operators	DoA	FMCL/TTI	8.00		8.00	High
	Promote farm mechanization through supply of machineries and hiring services	DoA	FMCL/Private Sector	50.00		50.00	High
	Construction of irrigation (Zhungkhar and Yabrang, (Spillover budget)	DoA	LG/Private Sector	48.93		48.93	High
	Construction and maintenance of agriculture service delivery infrastructures	DoA	Private sector	185.00		185.00	High
	Renovation of late Dasho Nishoka's office at ARDSC Panbang	DoA	Private sector	8.00		8.00	High
	Operationalization of National Food Security Reserve	DoA	FCBL/LG/GNHC/ DAMC		497.00	497.00	Medium
	Maintenance of CMU machines for land development	DoA	LG/Private sector	20.00		20.00	High
Output 1.6: School Agriculture Program (SAP) enhanced	Promotion program on integrated approach (Gardens, Wash & Nutrition)	DoA	DSE	4.00		4.00	High
	Promotion of EM technology for organic farming	DoA	MoE/DoL		2.00	2.00	Medium
	Establishment of blending facility for fortified Rice	DoA	FCBL/MoE/WWF	1.00		1.00	High
	Training of FAT teachers on SAP	DoA	DSE/CNR/RDTC	5.00		5.00	High
Output 2.1: Organic agriculture promoted	Promote organic agriculture production inputs	DoA	LG/Private sector	5.00		5.00	High
Output 3.3: Organic guarantee and certification system developed	Develop organic guarantee and certification system	DoA	BAFRA	1.00		1.00	High
Total				472.93	517.00	989.93	

Table 11: Program monitoring and evaluation matrix

Result level (AKRAs/Outcome/ Output)	Indicators	Lead Agency	Collaborating Agency	Data source	Reporting frequency	Reporting responsibility
Outcome 1: Food Self-sufficiency Enhanced	Rice self-sufficiency	DoA	LG/Private Sectors/FMCL	Administrative data /DoA annual highlights/	Annual	APD
	Maize self-sufficiency	DoA	LG/Private Sectors/FMCL	Administrative data /DoA annual highlights	Annual	APD
	Vegetable self-sufficiency	DoA	LG/Private Sectors/FMCL	Administrative data /DoA annual highlights	Annual	APD
	Fruit production	DoA	LG/Private Sectors/FMCL	Administrative data /DoA annual highlights	Annual	APD
	Area under assured irrigation	DoA	LG/Private Sectors	Administrative data /DoA annual highlights	Annual	APD
	Fallow-land brought under cultivation (Chuzhing)	DoA	LG/Private Sectors/FMCL	Administrative data/DoA annual highlights	Annual	APD
Outcome 2: Organic Farming for Sustainable Development Enhanced	Area under organic agriculture management	DoA	LG/Private Sectors/FMCL/DoL/DoFPS/	Administrative data/annual report	Annual	APD
	Certified organic products developed	DoA	LG/Private Sectors/BAFRA	Administrative data/annual report	Annual	APD
Output 1.1: Cereal production enhanced	Paddy production	ARDC Bajo	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	production	ARDC Wengkhar	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
Output 1.2: Other cereals production enhanced	Quinoa production	ARDC Yusipang	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	Wheat production	ARDC Bajo	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	Buckwheat production	ARDC Bajo	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	AED
	Millet production	ARDC Bajo	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	Barley production	ARDC Bajo	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
Output 1.3: Oil seed and grain legumes	Oil seeds production (Mustard, sunflower,	ARDC Wengkhar	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD

Result level (AKRAs/Outcome/ Output)	Indicators	Lead Agency	Collaborating Agency	Data source	Reporting frequency	Reporting responsibility
production enhanced	soyabean)					
	Grain Legumes production (Rajma, Mung bean, Lentil)	ARDC Samtenling	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
Output 1.4: Horticulture production enhanced	Vegetable production	ARDC Yusipang	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	Fruit production	ARDC Wengkhar	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	Potato production	ARDC Yusipang	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	Citrus production	ARDC Bajo	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	MAPs production	ARDC Yusipang	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	AED
	Mushroom production	NMC	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
	Ornamental plants production	FACL	APD/ARED/AED/ARDC/LG	Agriculture Statistics	Annual	APD
Output 1.5: Agriculture service delivery facilities established /improved	Length of major irrigation channels constructed/ renovated	AED	APD/ARED/AED/ARDC/LG	Administrative data/annual highlight	Annual	AED
	Length of farm roads constructed/ maintained	AED	APD/ARED/AED/ARDC/LG	Administrative data/annual highlight	Annual	AED
	Service delivery facilities constructed/renovated	AED	ARDC/CPs/ARED/APD/AED	Administrative data/annual highlight	Annual	AED
Output 1.6: Agriculture land developed	Fallow land (chuzhing) brought under cultivation	NSSC	LG/ARDC/CMU	Administrative data/annual highlight	Annual	APD
	Agriculture land developed	NSSC	LG/ARDC/CMU	Administrative data/annual highlight	Annual	APD
Output 1.7: Soil	Area under green	NSSC	LG/ /ARDC	Administrative data/annual	Annual	APD

Result level (AKRAs/Outcome/ Output)	Indicators	Lead Agency	Collaborating Agency	Data source	Reporting frequency	Reporting responsibility
fertility enhanced	manuring			report		
	Area under IPNM	NSSC	LG/ /ARDC	Administrative data/annual report	Annual	APD
Output 1.8: Human wildlife mitigation enhanced	Length of electric fencing	NPPC	LG/ /ARDC	Administrative data/annual report	Annual	APD
Output 1.9: Farm mechanization services enhanced	Number of operators and mechanics trained	AMC	LG/ Private sector/TTI	Administrative data/annual report	Annual	APD
Output 1.10: Schools with SAP increased	Number of schools with Agriculture Program	SAP	DSE/ARDC	Administrative data/annual highlight	Annual	APD
Output 2.1: Area brought under organic agriculture	Area under organic agriculture management	ARDC Yusipang	ARDC/Private sector/LG	Administrative data/annual report	Annual	APD
Output 2.2: Increased organic production	Organic agriculture production	ARDC Yusipang	ARDC/Private sector/LG	Administrative data/annual report	Annual	APD
Output 2.3: Organic guarantee and certification system developed	Organic guarantee and certification system developed	ARDC Yusipang	APD/BAFRA	Administrative data/annual report	Annual	APD

7.2. RNR Value Chain & Enterprise Development Program

Rationale

The value chain design and market integration during 11th FYP did not occur as envisaged for focused value chain development perspective as it was not adequately facilitated and implemented. Production and marketing interventions were delinked and marketing was mostly focused on infrastructure development (e.g. farm roads, market sheds, farm shops, etc.). There had been little incentives for smallholder farmers to form marketing groups, cooperatives and agriculture enterprise which is crucial for the transformation from a primarily agrarian economy to an industrial society, pulling Bhutanese agriculture into global value chains and attracting private investment. Therefore, it has become important for the 12th FYP to be designed and implemented through strategic value chain and enterprise development program. This requires identification of upstream and downstream value chain partners and strengthening forward and backward linkage for success of the whole agri-business thereby improving employment and income opportunities.

Strategies

- Enterprise development and youth engagement
- Commercialization
- Incentivization of agriculture farming

Status of Readiness

- Availability of value addition technologies
- Availability of access to credit through Priority Sector Lending and REDCL

Pre-requisite to Facilitate Program Implementation

- Interested and forth coming individual/group/cooperative
- Access to production inputs (seeds, tools & equipment, technical services, financial, land)

Implementing Agency: (*Responsible/implementing agency)*	Source of Funding: (*Indicative source of funding)*
DAMC, LG, Private sector, CP/APD	RGOB, Existing Area Development Projects

Table 12: Program linkage to NKRAs and AKRAs-RNR value chain & enterprise development program

NKRAs	AKRAs	KPI
NKRA 8. Water, food and nutrition security ensured	RNR marketing and value chain development enhanced	1. Commodity value chain for RNR products established 2. Agro-based enterprises established
NKRA 2. Economic Diversity and Productivity Enhanced	Increased RNR Sector Contribution to National Economy	3. Average annual RNR sector growth rate 4. Increased productive and gainful employment generated in Agriculture

Table 13: Program matrix- result level

Result level (AKRAs/Outcome / Output)	Indicators	Unit	Base year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Outcome 1. RNR Marketing & Value Chain Enhanced	Commodity value chain for RNR products established	Number	2017	6	15	7	9	11	13	15
	RNR-based enterprises established (Agriculture, Livestock, Forestry)	Number	2017	n/a	20	4	8	12	16	20
Outcome 2. Increased RNR Sector Contribution to National Economy	RNR sector contribution to national GDP	Nu Mil	2017	22008	30900	23700	25400	27100	28800	30900
	Annual RNR Sector growth rate	Percent	2013-15	2.9	4	3	3.1	3.5	3.5	4
	Increased productive and gainful employment generated in RNR Sector	Number	2016	3906	6600	4400	4900	5400	5900	6600
Output 1.1. Commodity value chain for agriculture produce established	Value chain for agriculture produce developed	Number	2017	n/a	3	1	0	2	0	3
Output 1.2. Agriculture based enterprises established	Agriculture Enterprises established	Number		n/a	8	1	2	4	6	8
	Post-harvest infrastructures developed	Number	2017	11	40	15	22	29	36	40
Output 2.1. Employment created	Agriculture Enterprise based Employment	Number	2017	0	140	28	56	84	112	140
	Employment generated through SoEs	Number	2017	588	538	107	107	108	108	108
	Employment through FDI	Number	2017	799	201	40	40	40	40	41
Output 2.2 : Value added products developed	Product development and value addition	Number	2017	90	190	110	130	150	170	190

Table 14: Departmental program activities and plan outlay

Program Output	Program Activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
Output: 1.1 Commodity value chain for RNR produce established	Develop Value Chain for prioritized commodities	DoA	DAMC/FMCL		25	10	Medium
Output: 1.2, 2.1 & 2.1 Agriculture based enterprises/ Employment/value added product developed	Establish Agriculture Enterprise	DoA	LG/FMCL	46.04		46.04	High
	Strengthening of food incubation centers	DoA	LG/Private Sectors	9		9	High
	Support to private sector, enterprises, NGOs for product development	DoA	LG/Private sectors	5		5	High
	National Events and exhibitions (Flower shows and displays, mushroom exhibition, Organic food festival, World food day)	DoA	LG/Private Sectors/NBC/DSE	22		22	High
Total				82.04	25	107.04	

Table 15: Program monitoring and evaluation matrix

Result level (AKRAs/Outcome/ Output)	Indicators	Lead Agency	Collaborating Agency	Data Source	Reporting Frequency	Reporting Responsibility
Outcome 1. RNR Marketing & Value Chain Enhanced	Commodity value chain for RNR products established	DoA	DAMC/FMCL/LG	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD
	RNR-based enterprises established (Agriculture)	DoA	DAMC/LG/Private sectors	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD
Output 1.1. Commodity value chain for agriculture produce established	Value chain for agriculture produce developed	APD	ARDC/DAMC/FMCL/LG	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD
Output 1.2. Agriculture based enterprises established	Agriculture Enterprises established	APD	Central Program/ARDC/ /FMCL/LG/DAMC	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD
	Post-harvest infrastructures developed	NPHC	ARDC/LG	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	NPHC
Output 2.1. Employment created	Agriculture Enterprise based Employment	APD	ARDC/LG	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD
	Employment generated through SoEs	APD	FMCL	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD
	Employment through FDI	APD	FDIs	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD
Output 2.2 : Value added products developed	Product development and value addition	NPHC	Central program/ARDC/LG,	Agriculture Highlights Agency annual Reports/ Adm. data	Annually	APD

7.3. Climate Smart and Disaster Resilient Development

Rationale

Crop production system is exposed to the several climatic conditions and in Bhutan the farming is mostly dependent towards seasonal monsoons. On a global scale too, climate change is seen to have negative impact on food production. The erratic rainfall, change in mean temperatures and extreme weather patterns will pose a serious threat to agriculture farming.

In recent years, several incidences of flash floods in the south, hailstones and unprecedented rainfall during paddy harvest seasons have been recorded. Such incidences demand more preparedness towards mitigation of climate related hazards. It has never been as important as at this juncture to make our farming system climate resilient to enable sustainable and economically viable production of food and fiber.

Strategies

- Climate smart and Green technologies
- Sustainable Agriculture
- Sustainable soil fertility management and land development
- Sustainable on-farm water resources management
- Research & Innovation
- Farm infrastructure development
- Participatory extension
- Incentivization of agriculture farming

Implementing Agency: (*Responsible/implementing* agency)	Source of Funding: (*Indicative source of funding)*
ARED/ARDC/CP	RGoB, Existing Area Development Projects

Table 16: Program linkage to NKRA and AKRAS-climate smart and disaster resilient development

NKRAs	AKRAs	KPI
Carbon Neutral, Climate and Disaster Resilient Development Improved	Enhanced Climate Smart and Disaster Resilient Development	1. Area brought under micro efficient irrigation schemes 2. Climate resilient technologies released and adopted 3. Area brought under sustainable land management 4. Functional RNR sector DMU instituted

Table 17: Program matrix- result level

Results Level (AKRAs/Outcome/ Output)	Indicators	Unit	Base Year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Outcome 1: Enhanced Climate Smart and Disaster Resilient Development	Climate resilient technologies released and adopted	Number	2017	24	35	26	28	31	33	35
	Area brought under sustainable land management	Acre	2017	7321	8231	7431	7731	7931	8131	8231
	Area brought under micro-efficient irrigation schemes	Acre	2017	875	2875	1275	1675	2075	2475	2875
Output 1.1: Alternate water source explored	Number of Groundwater assessment	Number	2017	n/a	5	1	2	3	4	5
Output 1.2: Climate Smart irrigation and water efficient technologies adopted	Water use efficient technologies promoted	Number	2017	2	7	3	4	5	6	7
	Water harvesting structures constructed	Number	2017	7	24	10	13	16	19	24
Output 1.3: Climate smart technologies released and adopted	Climate smart technologies released and adopted	Number	2017	24	35	26	28	31	33	35
	Bio-digester and composting	Number	2017	3554	8554	4554	5554	6554	7554	8554
Output 1.4: Knowledge management, education and awareness in DM enhanced	Agro-met Advisory program established	Timeline	2017	n/a	2019	-	2019	-	-	-
Output 1.5: Agriculture Disaster management institution strengthened	SOP for crops diseases	Number	2017	n/a	5	1	2	3	4	5
Output 1.6: Pest and diseases risk reduction on agriculture hazards strengthened	E-pest and diseases surveillance system	Number	2017	1	2	0	0	1	2	0
	IPM for agricultural commodities (Rice, Maize, Vegetables, Citrus, Potato, Fruits & Nuts)	Number	2017	6	12	7	8	9	10	12

Table 18: Departmental program activities and plan outlay

Program Outputs	Program Activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/ Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
Output 1.1. Alternative water source explored	Conduct study on groundwater extraction in potential Dzongkhags	DoA	Private sector/LG		10.00	10.00	Medium
	Construct water harvesting in catchment area	DoA	DoFPS/Private sector/LG		10.00	10.00	Medium
Output 1.2. Climate Smart irrigation and water efficient technologies adopted	Promote water efficient irrigation technologies	DoA	LG/ Private sector	270.00		270.00	High
	Promote pressurized irrigation systems	DoA	LG/ Private sector		100.000	100.00	Medium
Output 1.3. Climate smart technologies released and adopted	Release and promote climate resilient agriculture technologies	DoA	LG	21.00		21.00	High
	Improvement of crop land races through breeding	DoA	LG	4.00		4.00	High
	Release and promote climate resilient crop varieties	DoA	LG	13.00		13.00	High
	Characterization of indigenous fruit crops (walnut, pear, peach, kiwi & berries)	DoA	LG	5.00		5.00	High
	Establishment and conservation of indigenous fruit crops in germplasm	DoA	LG	5.00		5.00	High
	Characterization and purification of crop land races	DoA	NBC/LG	5.00		5.00	High
	Conduct study on crop phenology due to impact of climate change	DoA	NBC/LG	5.00		5.00	High
Output 1.4: Knowledge management, education and awareness in DM enhanced	Establish functional Agro-met advisory program	DoA	NCHM/DDM/ DITT	15.00		15.00	High
	Provide agro-met advisory services	DoA	NCHM/LG	8.00		8.00	High
Output 1.5: Agriculture Disaster management institution strengthened	SOPs for crop diseases	DoA	LG	3.00		3.00	High

Output 1.6: Pest and diseases risk reduction on RNR hazards strengthened	Functional e-pest surveillance system and IPM for major commodities	DoA	LG	3.00		3.00	High
	Total			357.00	120.00	477.00	

Table 19: Program monitoring and evaluation matrix:

Results Level (AKRAs/Outcome/ Output)	Indicator	Lead Agency	Collaborating Agency	Data Source	Reporting Frequency	Reporting Responsibility
Outcome 1: Enhanced Climate Smart and Disaster Resilient Development	Climate resilient technologies released and adopted	DoA	LG/Private Sectors	DoA Annual Highlights, VRC meeting minutes	Annually	ARED
	Area brought under sustainable land management	DoA	LG/Private Sectors	Administrative Data, DoA Annual Highlights	Annually	APD
	Area brought under micro-efficient irrigation schemes	DoA	LG/Private Sectors	Administrative Data, DoA Annual Highlights	Annually	AED
Output 1.1: Alternate water source explored	Number of Groundwater assessment	AED	ARDCs/APD/LG/Private Sectors	Administrative Data, DoA Annual Highlights	Annually	AED
Output 1.2: Climate Smart irrigation and water efficient technologies adopted	Water use efficient technologies promoted	AED	ARDCs/APD/LG/Private Sectors	Administrative Data, DoA Annual Highlights	Annually	AED
	Water harvesting structures constructed	AED	ARDCs/APD/LG/Private Sectors	Administrative Data, DoA Annual Highlights	Annually	AED
Output 1.3: Climate smart technologies released and adopted	Climate smart technologies adopted	ARDCs	ARED/APD/Central Programs/LG	Central Program Annual Report, DoA Annual Highlights	Annually	ARED
	Bio-digester and composting	ARDC Yusipang	ARED/APD/Central Programs/LG	Central Program Annual Report, DoA Annual Highlights	Annually	APD
Output 1.4: Knowledge management, education and awareness in DM enhanced	Agro-met Advisory Program established	ARED	NCHM/DITT/ICTD	DoA Annual Highlights	Annually	ARED
Output 1.5: RNR Disaster management institution	SOP for crop diseases	NPPC	ARDCs/APD/LG	Reports	Annually	APD

strengthened						
Output 1.6: Pest and diseases risk reduction on agriculture hazards strengthened	E-pest and diseases surveillance system	NPPC	ARDCs/APD/ICTD	Annual Report, Administrative Data	Annually	APD
	IPM for agricultural commodities (Rice, Maize, Vegetables, Citrus, Potato, Fruits & Nuts)	NPPC	ARDCs/APD/LG	Annual Report, Administrative Data	Annually	APD

7.4. Research and Extension Services

Rationale

Agriculture research and extension services are major driving forces in agriculture development through generation of suitable farming technology options and transferring technologies to the client - farmers. The science based technologies are also quintessential for support to policy makers.

The Agriculture extension services primarily facilitate agriculture development programs through technology dissemination. They work closely with farmers providing technical assistance and acting as a bridge between the government and the people.

Strategies

- Commodity focus approach
- Research & Innovation
- Climate smart and Green technologies
- Agriculture input services
- Modernization of agriculture farming
- Farm infrastructure development
- Participatory extension
- Incentivization of agriculture farming

Status of Readiness

- Institutional set up at region, Dzongkhags and Geogs in place
- Established linkages with Regional and International Agriculture institutes
- Research policy and strategy in place

Pre-requisite to Facilitate Program Implementation

- Adequate human capacity at regional, central, Dzongkhag and Geog level
- Adequate financial resource allocation
- Strengthened research facilities in place

Implementing Agency: (*Responsible/implementing agency)*	Source of Funding: (*Indicative source of funding)*
ARED/CP/ARDC/LG	RGoB, Existing Area Development Projects

Table 20: Program linkage to NKRAs and AKRAs research and extension Services

NKRAs	AKRAs	KPI
Water, Food and Nutrition Security Ensured	RNR Research Services Strengthened	1. RNR Policy Research Conducted 2. RNR research conducted 3. RNR technologies generated and adopted

Table 21: Agriculture research and extension services

Results Level (AKRAs/Outcome/ Output	Indicators	Unit	Base Year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Outcome 1: RNR Research Services Strengthened	RNR research conducted	Number	2017	307	734	392	477	562	674	734
	RNR technologies adopted	Number	2017	117	200	40	80	120	160	200
Output 1.1: Agriculture research conducted	Number of Agriculture research conducted	Number	2017	307	734	392	477	562	674	734
Output 1.2: Agriculture technologies generated	Number of agriculture technologies generated	Number	2017	255	580	320	385	450	515	580
Output 1.3: Agriculture Technologies adopted	Number of agriculture technologies adopted	Number	2017	117	279	149	181	213	245	279
Output 1.4: Awareness on improved agricultural technologies enhanced	Number of demonstration sites and outreach programs on improved technologies established	Number	2017	507	1568	719	931	1143	1355	1568
Output 1.5: Agricultural knowledge and information management improved	Number of reports, articles, leaflets and journals on agriculture published/produced	Number	2017	59	173	81	103	125	147	173

Table 22: Departmental program activities and plan outlay

Program Outputs	Program Activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
Output 1.1 & 1. 2: Agriculture research conducted and technology generated	Conduct research on Rice and Maize	DoA	LG	20.000		20.00	High
	Conduct research on Wheat and other cereals	DoA	LG		20.000	20.00	Medium
	Conduct research on Vegetables, Potato, Citrus, Fruits and Nuts	DoA	LG	8.000		8.00	High
	Conduct Organic Agriculture Research	DoA	LG	6.000		6.00	High
	Conduct Farm mechanization research	DoA	LG	5.000		5.00	High
	Conduct Plant Protection Research on Rice and Maize, Vegetable, Potato , Citrus, Fruits and Nuts	DoA	LG	5.000		5.00	High
	Conduct Plant Protection Research on other crops	DoA	LG		10.000	10.00	Medium
	Conduct Soil fertility and nutrient management research on Rice, Maize, Vegetables, Citrus, , Fruits and Nuts	DoA	LG	2.000		2.00	High
	Conduct Soil fertility and nutrient management research on other crops	DoA	LG		10.000	10.00	Medium
	Conduct floriculture and amenity landscape research	DoA	LG	3.000		3.00	High
	Conduct Post-Harvest research on Rice and Maize, Vegetable, Potato, Citrus, Fruits and Nuts	DoA	LG	3.000		3.00	High
	Conduct Post-Harvest research on other crops	DoA	LG		10.000	10.00	Medium
	Conduct seed research on Rice and Maize, Vegetable, Potato, Citrus, Fruits and Nuts	DoA	LG	3.000		3.00	High
	Conduct seed research on other crops	DoA	LG		10.000	10.00	Medium
	Conduct socio economic research	DoA	LG	3.000		3.00	High
Output 1.3: Enhanced adoption of RNR Technologies	Adopt technologies on Rice and Maize , Vegetables, Potato, Citrus, Fruits and Nuts	DoA	LG	3.000		3.00	High
	Adopt technologies on other crops	DoA	LG		10.000	10.00	Medium
	Adopt Organic Agriculture technologies	DoA	LG	1.000		1.00	High

Program Outputs	Program Activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
	Adopt farm mechanization technologies	DoA	LG	3.00		3.00	High
	Adopt Plant Protection technologies on Rice and Maize , Vegetables, Potato, Citrus, Fruits and Nuts	DoA	LG	3.00		3.00	High
	Adopt Plant Protection technologies on other crops	DoA	LG		10.00	10.00	Medium
	Adopt Soil fertility and nutrient management technologies on Rice and Maize , Vegetables, Potato, Citrus, Fruits and Nuts	DoA	LG	5.00		5.00	High
	Adopt Soil fertility and nutrient management technologies on other crops	DoA	LG		5.00	5.00	Medium
	Adopt post harvest technologies and , vegetable, , citrus, fruits and nuts	DoA	LG	3.00		3.00	High
	Adopt post harvest technologies on other crops	DoA	LG		5.00	5.00	Medium
	Adopt seed technologies on Rice and Maize , Vegetables, Potato, Citrus, Fruits and Nuts	DoA	LG	3.00		3.00	High
	Adopt seed technologies on other crops	DoA	LG		5.00	5.00	Medium
	Adopt floriculture and landscaping technologies	DoA	LG	1.00		1.00	High
Output 1.4 & 1.5: Research knowledge and information enhance	Awareness on improved agricultural technologies	DoA	LG	3.00		3.00	High
	Agricultural knowledge and information management	DoA	ICTD	3.00		3.00	High
	Knowledge on HWC and mitigation measures	DoA	LG	2.00		2.00	High
	Knowledge on impacts of climate change on crops biodiversity and ecosystem	DoA	LG/NBC	5.00		5.00	High
Total				93.00	95.00	188.00	

Table 23: Program monitoring and evaluation matrix

Results Level (AKRAs/Outcome/ Output)	Indicators	Lead Agency	Collaborating Agency	Data Source	Reporting Frequency	Reporting Responsibility
Outcome 1: RNR Research Services Strengthened	RNR research conducted	DoA	LG/Private Sector	Agriculture Highlights report/Journal/Adm. data	Annually	ARED
	RNR technologies adopted	DoA	LG/Private Sector	Agriculture Highlights report/Journal/Adm. data	Annually	ARED
Output 1.1: Agriculture research conducted	Number of Agriculture research conducted	ARDCs/Central Programs	ARED	Agriculture Highlights report/Journal/Adm. data	Annually	ARED
Output 1.2: Agriculture technologies generated	Number of agriculture technologies generated	ARDCs/Central Programs	ARED	Agriculture Highlights report/Journal/Adm. data	Annually	ARED
Output 1.3: Agriculture Technologies adopted	Number of agriculture technologies adopted	ARDCs/Central Programs	ARED/LG	Agriculture Highlights report/Journal/Adm. data	Annually	ARED
Output 1.4: Awareness on improved agricultural technologies enhanced	Number of demonstration sites and outreach programs on improved technologies established	ARDCs/Central Programs	ARED/LG	Agriculture Highlights report/Journal/Adm. data	Annually	ARED
Output 1.5: Agricultural knowledge and information management improved	Number of reports, articles, leaflets and journals on agriculture published/produced	ARED/CPs/ARDCS	ARDCs/Central Programs/APD	Agriculture Highlights report/Journal/Adm. data	Annually	ARED

7.5. Highland Development Program

Rationale

Though the importance of highland development was well recognized, it did not receive priority in the past due to remoteness, scattered settlements and low literacy rate. However in the past few years, highland areas had received support to supplement food and nutrition. Nonetheless, the support from the government was not adequate to enhance their food and nutritional requirement, therefore, there is need to focus and expand areas under agriculture (cereals), horticulture (Vegetables) and cultivated medicinal plants. Thus, in the 12th FYP, agriculture sector will work in conjunction with livestock sector to implement the highland development program which has been identified as 'Flagship program' of the Ministry of Agriculture and Forests.

The agriculture sector will focus on promoting protected Vegetable cultivation and development of Medicinal Aromatic Plant and Species enterprises. Besides expanding the area under the existing crops new nutrient rich crops like quinoa will be promoted.

Strategies

- Commodity focus approach
- Sustainable soil fertility management and land development
- Research & Innovation
- Enterprise development
- Modernization of agriculture farming
- Farm infrastructure development
- Participatory extension
- Incentivization of agriculture farming

Status of Readiness

- Availability of modern agriculture technologies for high altitude areas
- Access to inputs

Implementing Agency: (*Responsible/*implementing *agency)*	Source of Funding: (*Indicative source of funding)*
APD/Private Sector/ LG	RGoB and Existing Project Development Area

Table 24: Program linkage to NKRAs and AKRAs-highland development program

NKRAs	AKRAs	KPI
Water, food and nutrition security ensured	Enhanced Efficiency and Effectiveness of RNR Service Delivery	1. Highland enterprise established

Table 25: Program matrix- result level

Results Level (AKRAs/Outcome/ Output	Indicators	Unit	Base year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Outcome 1: Livelihoods of highlanders improved and sustained	Highland Enterprise established	Number	2017	N/A	6	1	3	2	0	0
Output 1.1: Highland enterprise promoted and sustained	Medicinal and Aromatic plants enterprise established	Number	2017	N/A	3	0	0	1	1	1
Output 1.2: Highland agriculture farming promoted and sustained	Support highland protected agriculture (green house)	Number	2017	100	550	150	250	350	450	550
	Quinoa promotion	Acre	2017	16.5	25	18	20	22	24	25

Table 26: Departmental program activities and plan outlay

Program Outputs	Program Activities	Lead Agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 1 Activities	Total	
Output 1.1: Highland enterprise promoted	Support to medicinal and aromatic enterprise establishment	DoA	DAMC/Private Sector/DTMS/LG	8.840		8.840	High

Table 27: Program monitoring and evaluation matrix

Results Level (AKRAs/Outcome/ Output	Indicators	Lead Agency	Collaborating Agency	Data Source	Reporting Frequencies	Reporting Responsibility
Outcome 1: Livelihoods of highlanders improved and sustained	Highland Enterprise established	DoA	DAMC/ARDCs/ DoFPS/Private sector/LG	Annual Report/ Administrative Data	Annually	APD
Output 1.1: Highland enterprise promoted and sustained	Medicinal and Aromatic plants enterprise established	APD	DAMC/Private sector/LG/DTMS	Agriculture Highlights /Annual Report	Annually	APD

7.6. Coordination and Support Service

Rationale

Strong coordination amongst different stakeholders for effective service delivery is essential for achieving the targets. Therefore, the plans and programs will be mainstreamed with the Ministry's core concept of 'Triple C approach' (Coordination, Consolidation and Collaboration) for effective and efficient coordination. Strong coordination and collaboration is required for providing strategic policy direction, enhancing cross-sectoral dialogues, harmonization and synchronization of plans, disseminating timely information, mobilizing and efficient utilization of available resources including human resources.

Various coordination and collaboration platforms have been re-instituted like Regional Review and Planning workshops, Program Coordination and Committee meeting, Agriculture Research Coordination meeting and Agriculture Conference.

Strategies

- Participatory extension
- Human Resource Development

Status of Readiness

- Established institutions with monitoring and evaluation system in place
- Various platforms for coordination and collaboration instituted

Implementing Agency: (*Responsible/implementing agency)*	Source of Funding: (*Indicative source of funding)*
ARED/APD/CPs/ARDCS	RGoB and Existing Project Development Area

Table 28: Program linkage to NKRAs and AKRAs- coordination and support service

NKRAs	AKRAs	KPI
Water, food and nutrition security ensured Healthy Eco-system sustained	Enhanced Efficiency and Effectiveness of RNR Service Delivery	1. Annual performance rating 2. Frameworks/ Guidelines/ Standards developed 3. Budget utilization

Table 29: Program matrix-result level

Results Level (AKRAs/Outcome/ Output	Indicators	Unit	Base Year	Baseline	Target	Projected Annual Target				
						2018-19	2019-20	2020-21	2021-22	2022-23
Outcome 1: Enhanced efficiency and effectiveness of RNR service delivery	Annual performance rating	Percent	2016	91.6	>95	>95	>95	>95	>95	>95
Output 1.1 Policy and legislation strengthened	Frameworks/ Guidelines/ Standards developed	Number	2017	6	10		7	8	9	10
Output 1.2. Planning and monitoring system strengthened	DoA Annual performance rating	Percent	2016	91.6	>95	>95	>95	>95	>95	>95
	Budget utilization	Percent	2016	90	>95	>95	>95	>95	>95	>95
	Regional and National Coordination meetings conducted.	Number	2017	7	35	7	7	7	7	7
	Regional database developed	Date	2017	n/a	2019	0	2019	0	0	0

Table 30: Departmental program activities and plan outlay

Program Outputs	Program Activities	Lead agency	Collaborating Agency	Plan Outlay in Nu (M) Capital			Priority (High/Medium)
				Priority 1 Activities	Priority 2 Activities	Total	
Output 1.1. Policy and legislation strengthened	Develop agriculture research and development strategy	DoA	DoL, DoFPS, DAMC, BAFRA, PPD		1.00	1.00	Medium
	Develop agriculture vision 2045	DoA	DoL, DoFPS, DAMC, BAFRA, PPD	0.37		0.37	High
	Develop need based agriculture frameworks and guidelines	DoA	PPD		5.00	5.00	Medium
	Develop standard for machineries, seeds and laboratories	DoA	BSB		2.00	2.00	Medium
			Total	0.37	8.00	8.37	

Table 31: Program monitoring and evaluation matrix

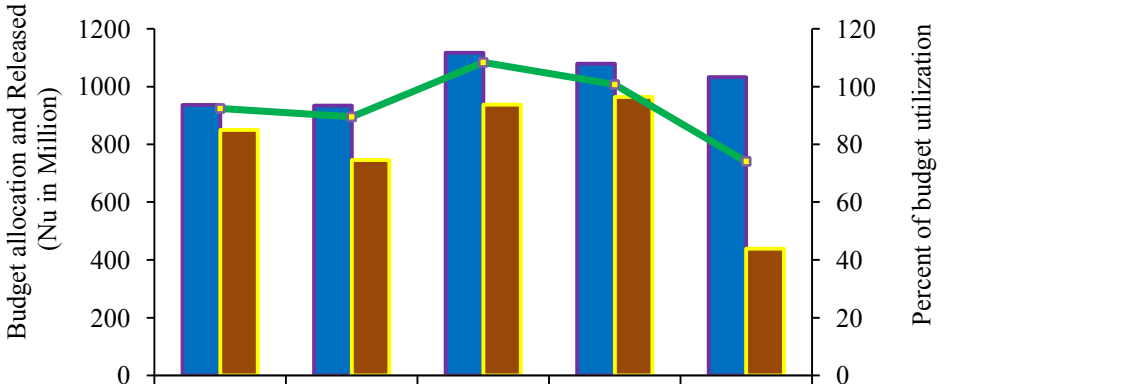
Results Level (AKRAs/Outcome/ Output	Indicators	Lead agency	Collaborating Agency	Data Source	Reporting Frequency	Reporting responsibility
Outcome 1: Enhanced efficiency and effectiveness of RNR service delivery	Annual performance rating	DoA	All Agencies under DoA	APA Evaluation Report	Annually	DoA
Output 1.1 Policy and legislation strengthened	Frameworks/Strategies/ Guidelines/ Standards developed	ARED	All Agencies under DoA	Reports	Annually	ARED
Output 1.2. Planning and monitoring system strengthened	DoA Annual performance rating	DoA	All Agencies under DoA	APA Evaluation Report	Annually	DoA
	Budget utilization	DoA	DS &All Agencies under DoA	Expenditure Report	Annually	DoA
	Regional and National Coordination meetings conducted.	APD/ARED	All Agencies under DoA	Minutes of the Meetings Proceedings, Annual Reports	Annually	APD/ARED
	Regional database developed	ARED	ARDCs	Administrative Data	Annually	ARED

8. FINANCING

The budget proposed for various activities had been worked out in accordance with the resources required to achieve the target. The activities are directly linked to expected outputs and the corresponding outcomes at a higher level. In the 12th FYP too, the activities will be funded through RGoB and donor supported area development projects.

8.1. Budget allocation and utilization trend

Analysis of budget utilization trend of both current and capital of the 11th Five Year Plan showed that the budget spending has been good with an average of 95.65% against the released budget. On an average, the utilization of capital budget had been more than that of current budget. Of the total allocated budget of Nu 5100.05 Million for last five fiscal years, only Nu 3935.718 Million was released which equates to 77.17%.



	2013-14	2014-15	2015-16	2016-17	2017-18
Budget allocated	936.238	934.605	1117.399	1079.315	1032.494
Budget Released	849.459	745.391	937.593	964.077	439.198
% of Budget utilized	92.41	89.51	108.39	100.71	74.04

Source: Administrative data, AFD, MoAF

Figure 1: Allocated and utilized budget in 11th Five Year plan

8.2. Proposed budget for 12 FYP

The budget proposed under RGoB amounts to Nu 1779.18 Million against the allocated budget of Nu 1025.04 Million with highest budget share proposed under Food Self Sufficiency and Nutrition Security program. The fund difference of Nu 754.14 Million would be sourced through Area Development Projects.

9. IMPLEMENTATION FRAMEWORK

9.1. Institutional arrangement

Department of Agriculture is comprised of three divisions; Agriculture Research and Extension Division (ARED), Agriculture Production Division (APD) and Agriculture Engineering Division (AED). The department also has the Land Management Section (LMS) under directorate services (Figure 2).

Agriculture Research & Extension Division (ARED) is supported technically through its four Agriculture Research and Development Centres (ARDCs) and five Agriculture Research and Development Sub-Centres (ARDSCs) located at different strategic locations. Similarly, Agriculture Production Division (APD) is supported technically by its five central programs and Agriculture Engineering Division (AED) with two central programs.

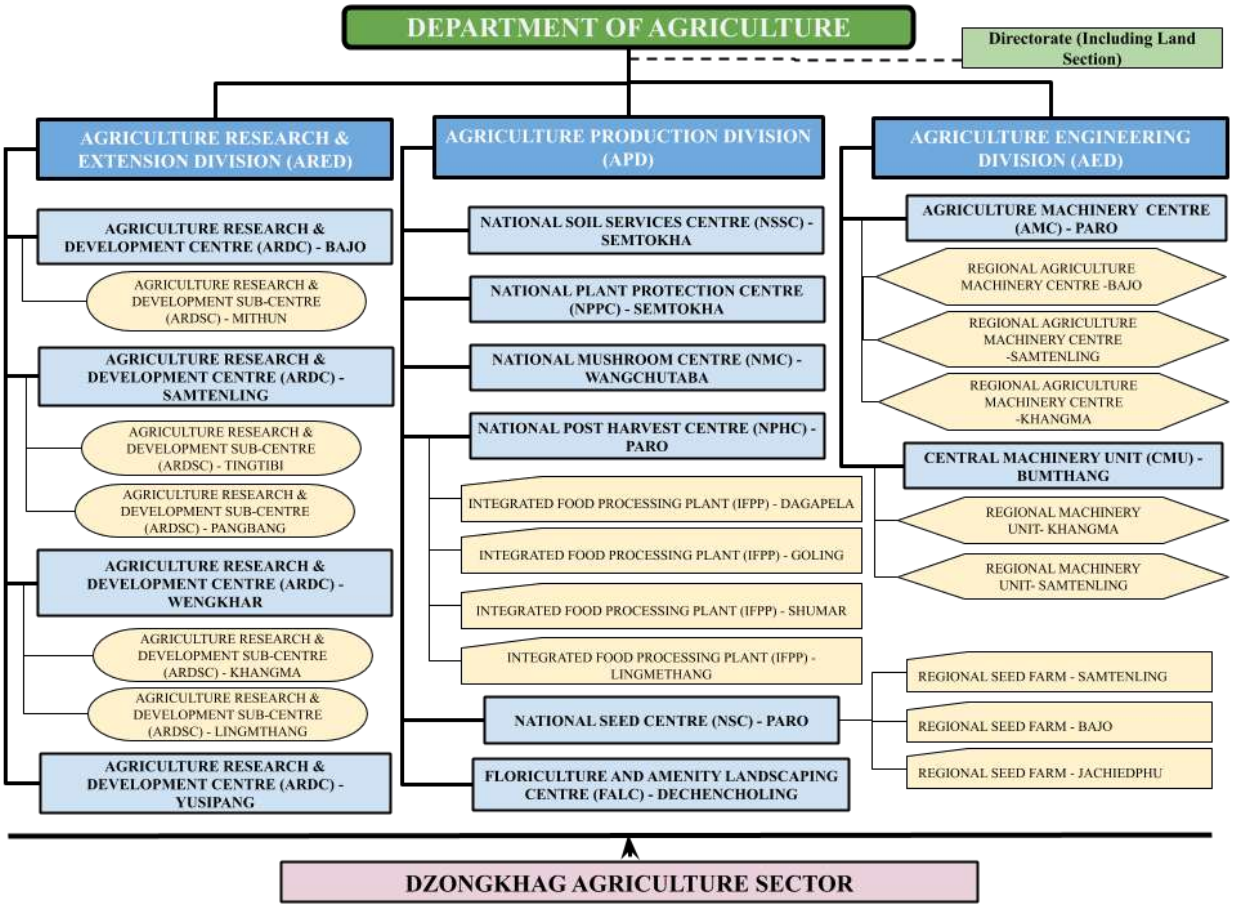


Figure 2: Implementation framework

9.2. Implementation modality

The vision of "Self-reliant, Productive, Diverse, Resilient and Sustainable Agriculture food system" would be achieved through the join implementation of major activities by the respective agencies under the Department. Following mandates and implementation mechanisms would be put in place.

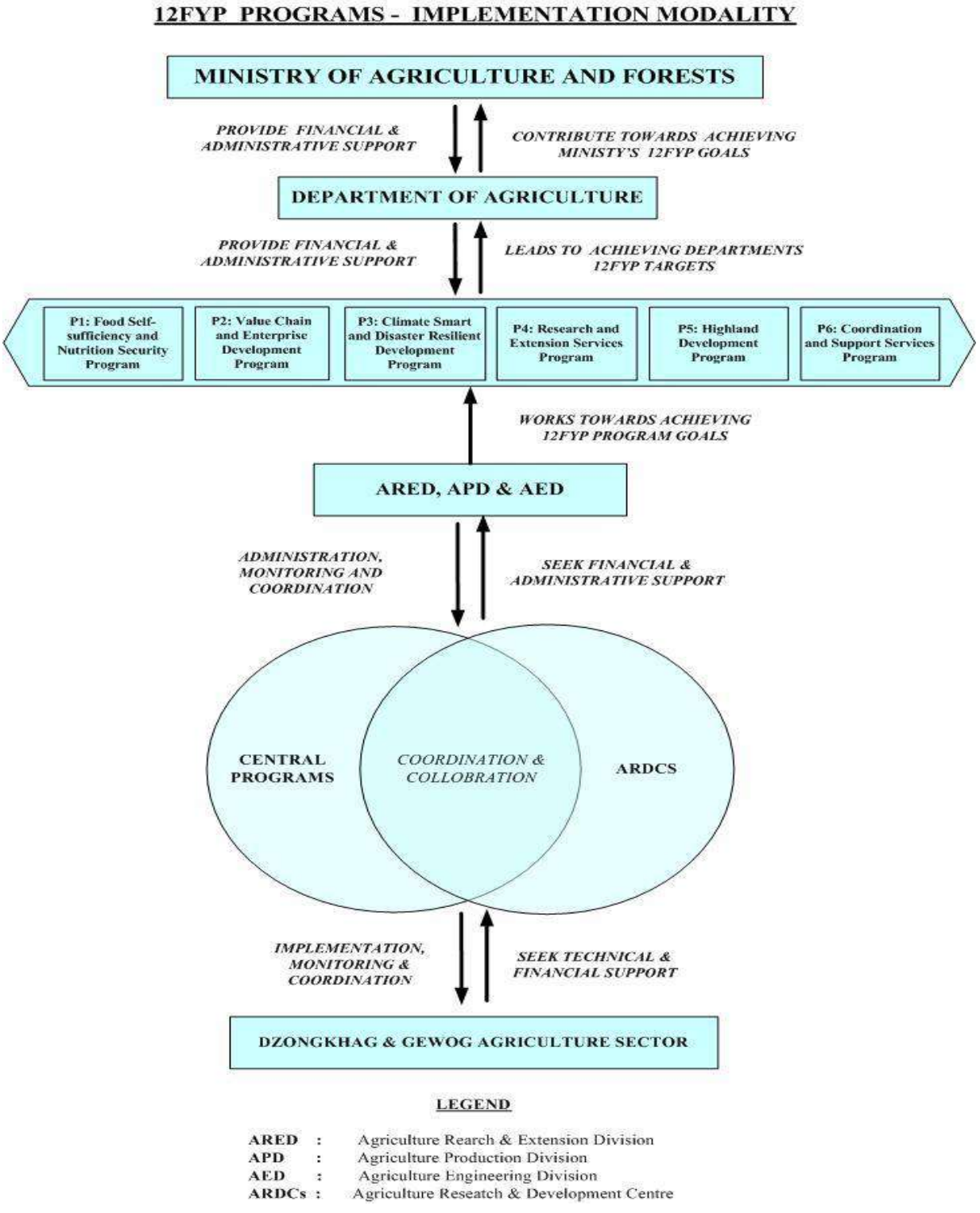


Figure 3: 12th FYP-Implementation modality

9.3. Agriculture Research & Extension Division (ARED)

ARED is mandated to coordinate, lead and facilitate the implementation and monitoring of all Research and Extension based activities in the country. It will also house the Agro-meteorology Program to provide timely agro-met advisory services.

Furthermore, the mandates and activities of the Division would be implemented and monitored by Research and Development established in four regions.

9.3.1. Agriculture Research and Development Centre (ARDC) – Bajo

ARDC Bajo has the National Mandate of Field Crop Research and Development covering five central and western dzongkhags i.e. Wangdue Phodrang, Punakha, Tsirang, Dagana and Gasa. Further, it has commodity mandates of research and development in Rice, Other Cereals and Citrus.
ARDC Bajo is supported by the following Sub-Centre:

i. Agriculture Research and Development Sub-Centre (ARDSC) – Mithun

ARDSC Mithun in Tsirang will be the implementation wing of ARDC Bajo responsible for implementation of both national and regional mandates. Apart from those mandates, ARDSC Mithun will house the National Citrus and Cardamom Repository for enhanced conservation, research and multiplication of the commodity.

9.3.2. Agriculture Research and Development Centre (ARDC) – Samtenling

ARDC Samtenling will have the National Mandate of Sub-tropical Crop Research and Development covering the Southern and South-eastern region of the country i.e., five Ddzongkhag *viz.* Sarpang, Samtse, Zhemgang, Trongsa and Samdrup Jongkhar. Along with its national mandate, it has commodity mandates of research and development in Oilseeds, Legumes and Spices Commodity.
ARDC Samtenling is supported by the following Sub-Centre:

i. Agriculture Research and Development Sub-Centre (ARDSC) – Tingtibi

ARDSC Tingtibi in Zhemgang will be the implementation wing of ARDC Samtenling responsible for implementation of both national and regional mandates specifically subtropical crops.

ii. Agriculture Research and Development Sub-Centre (ARDSC) – Panbang

ARDSC Panbang in Zhemgang will be the implementation wing of ARDC Samtenling responsible for implementation of both national and regional mandates specifically subtropical crops.

9.3.3. Agriculture Research and Development Centre (ARDC) – Wengkhar

ARDC Wengkhar will have the National Mandate of Horticultural Crop Research and Development covering the eastern and east-central region of the country i.e., six dzongkhag *viz.* Mongar, Lhuentse, Trashigang, Trashi Yangtshe, Pema Gatshel and Bumthang. Along with its national mandate, it has commodity mandates of research and development in Maize and Fruit & Nuts Commodity.
ARDC Wengkhar is supported by the following Sub-Centre:

ii. Agriculture Research and Development Sub-Centre (ARDSC) – Khangma

ARDSC Khangma in Trashigang will be the implementation wing of ARDC Wengkhar responsible for implementation of both national and regional mandates. ARDSC Khangma will basically conducting High altitude field crops and Horticultural crops research.

iii. Agriculture Research and Development Sub-Centre (ARDSC) – Lingmethang

ARDSC Lingmethang in Mongar will be the implementation wing of ARDC Wengkhar responsible for implementation of both national and regional mandates. ARDSC Lingmethang will basically conducting low and mid altitude field crops and Horticultural crops research.

9.3.4. Agriculture Research and Development Centre (ARDC) – Yusipang

ARDC Yusipang will have the National Mandate of Organic Agriculture Research and Development covering the western and west-central region of the country *viz.* Chukha, Paro, Thimphu and Haa. Along with its national mandate, it has commodity mandates of research and development in Vegetables, Apple, Medicinal & Aromatic Plants (MAPs) and Potatoes.

9.4. Agriculture Production Division (APD)

APD with its overall mandate to coordinate, lead and facilitate the implementation and monitoring of all the crop production and service based activities in the country. Along with its mandate APD also has its commodity based mandate with the commodity coordinators placed under the division.

APD also houses a special program *viz.* School Agriculture Program (SAP) to impart knowledge and skills to school children on basic agriculture, food and nutrition security and climate smart agriculture technologies.

Following central programs placed at different locations with its respective mandates will help implement its mandates:

9.4.1. National Soil Services Centre (NSSC)

The Centre aims to lead, co-ordinate and implement all the soil/land management research and development activities of the country with support from its four units/sections:

1. Soil and Plant Analytical Laboratory (SPAL):

2. Soil Survey Unit (SSU)
3. Soil Microbiology Unit (SMU)
4. Soil Fertility Unit (SFU)
5. Land Management Unit (LMU)

In addition to the above mentioned mandates NSSC is also required to come up with the Nation Soil Fertility Strategy in the 12FYP.

9.4.2. National Plant Protection Centre (NPPC)

The centre aims to generate pest management technologies that are safe for human health and environment, to disseminate pest management technologies for effective adoption by farmers and to reduce crop losses to pest organisms, with support from its following units:

1. Plant Pathology Section
2. Entomology Section
3. Weed Science & Vertebrate pest management Section
4. Plant Protection Product Section
5. Pest Surveillance Section
6. Laboratory Section

9.4.3. National Mushroom Centre (NMC)

NMC is responsible for overall Research and Development for Mushroom commodity in the country. It is also responsible to produce and supply clean and quality spawns for both household and commercial levels. It also collected and domesticates wild mushrooms apart from its core mandates.

9.4.4. National Seed Centre (NSC)

The Centre is mandated to function as the "National Seed Grid" to meet the in-country farmers' demand for quality certified seeds and plants of recommended and released varieties, and other agricultural inputs including fertilizers and herbicides in adequate quantities at a price affordable to the Bhutanese farmers.

The centre is support by following Regional seed farms and other sub-regional farms located at different strategic locations:

1. Regional Seed Farm – Bajo, WangduePhodrang
2. Regional Seed Farm – Samtenling, Sarpang
3. Regional Seed Farm – Jachedphu, Trashi Yangtse

9.4.5. National Post Harvest Centre (NPHC)

The centre is mandated to generate and provide effective and efficient post production technologies & services. The centre would also be involved in streamlined research and service dissemination to farmers and entrepreneurs.

NPHC is also backed up by its regional food processing units located at four different locations:

1. Integrated Food Processing Plant (IFPP) – Dagapela, Dagana
2. Integrated Food Processing Plant (IFPP) – Goling, Zhemgang
3. Integrated Food Processing Plant (IFPP) – Shumar, Pema Gatshel
4. Integrated Food Processing Plant (IFPP) – Lingmethang, Mongar

9.4.6. Floriculture and Amenity Landscaping Centre (FALC)

FALC is centre mandated to maintain and multiple exotic and domestically available flowers and ornamental plants with an added responsibility of landscaping and amenity development at various important locations.

FALC apart from its regular mandates will be collecting, maintaining and evaluating germplasm of wild and local flowers, orchid and ornamental plants.

9.5. Agriculture Engineering Division (AED)

AED with its overall mandate to coordinate, lead and facilitate the implementation and monitoring of all the Farm mechanization and infrastructure development activities in the country. Though being under the Department of Agriculture, AED is also involved with all infrastructures related activities of the ministry. AED's major activities towards crop production and rural development are Irrigation and Farm-roads.

AED is supported at all the regional levels with its staffs attached with all four Agriculture Research & Development Centre (ARDC).

AEDs farm mechanization and service dissemination mandates are provided by its machinery centres located at two different locations:

9.5.1. Agriculture Machinery Centre (AMC)

Agriculture Machinery Centre (AMC) aims to become the centre for environmentally friendly, safe and quality farm mechanization technology source and usage for industry and society. AMC will be conducting basic farm machinery researches and also technology demonstration and technology development for the improvement of farming system in the country.
AMC is support by its regional centres which are as follows:

i. Regional Agriculture Machinery Centre (RAMC) – Bajo

It acts as the implementation wing for the AMC in the central region, thereby catering the needs and providing services to the farmers of central region of the country.

ii. Regional Agriculture Machinery Centre (RAMC) – Samtenling

It acts as the implementation wing for the AMC in the southern region, thereby catering the needs and providing services to the farmers of southern region of the country.

iii. Regional Agriculture Machinery Centre (RAMC) – Khangma

It acts as the implementation wing for the AMC in the eastern region, thereby catering the needs and providing services to the farmers of eastern region of the country.

9.5.2. Central Machinery Unit (CMU)

Central Machinery Unit (CMU) is mandated to provide and deploy machineries for maintenance and construction of major farm roads and other agricultural infrastructures as per the requirement of the client Dzongkhags and Geogs.

10. MONITORING AND EVALUATION APPROACH

The monitoring and evaluation process will comprise four-level log-frame layer approaches separately outlined in detail below. However, in light of the recent re-alignment within the Department subsequent to the Organizational Development (OD) exercise, the following general reporting structure is recommended. While the time frame, format, and aspects of M&E are outlined in detail, the overall reporting structure for the department will be summed up as follows:

Table 32: General recommended progress reporting structure, DoA

Agency Staff	Reporting Parameter	Report to	Reporting Tools/Platform	Reporting Frequency
Geog Extension	Progress	GT & Dzongkhag Agriculture	IWP, APA, Annual Meet, Review Meet	Quarterly, Biannually, Annually
Dzongkhag Agriculture	Progress	DT & ARDCs, APD	IWP, APA, Review Meet, Regional Review & Coordination Workshop	Biannually, Annually
Central Programs	Administrative other Program-based	APD & AED	IWP, APA, Regional Review & Coordination Workshop, Research Coordination Workshop, PCCM, DoA Conference	Biannually, Annually
	Research Program	ARED		
ARDCs	Administrative	ARED & AED	IWP, APA, Regional Review & Coordination Workshop, Research Coordination Workshop, PCCM, VRC, Agriculture Conference	Biannually, Annually
	Program	Commodity Focal (APD)		
Department	Progress	MoAF	IWP, APA, Review Meet	Biannually, Annually

10.1. Monitoring

Monitoring levels has been classified into four different log-frame layers: Financial (input), physical progress (activity), effect & result (sub-program) and Impact (objective/program/goals) monitoring. These layers form the basis for review of all the programs.

Table 33: Levels of monitoring

Level	What to monitor	Frequency	Means of verification	Responsible
NKRA	Impact	Every 5 year	Terminal report	GNHC
AKRA	Performance	Every 2.5 and 5 year	Mid and terminal report	PPD, MoAF
Outcomes	KPIs	Mid-term review	Mid-term review report	Department
Outputs	Success Indicators	Annual	PCCM, APA, IWP, Annual statistics, Annual reports, Review and Coordination Workshops, ARCM, Agriculture Conference, Field visits	Department, ARDCs, Central Programs
Activities	Activities and budget	Quarterly	Field visits, progress report, bi-annual meeting, GT, DT	Dzongkhag, ARDCs, Central Programs

i. Input & Activity Monitoring

Input monitoring refers to financial monitoring allocated against activity, while the activity progress monitoring carries out specific action or work to achieve a sub-program objective. Activity monitoring will be done based on the activity indicators set during the planning stage on an annual basis. This entails translation of the five-year plan into annual work-plans by all agencies. The programs to be implemented should have a list of activities generated to be monitored and reported using the prescribed forms. The planning form ensures a strong link between the work-plan, activity implementation, achievement and result.

The activity progress report that is filled up at the field level should be submit in hard copy to the sector heads for geogs/sections/field offices/Dzongkhag/central units on a quarterly basis, where consolidation/analysis at the sub-program level will take place. To supplement the activity progress report, the implementing agency will maintain relevant registers and datasheets, which will be the source of information during the monitoring visit and evaluation. This highlights the crucial role of the implementing agencies in planning and monitoring.

Table 33: Biannual progress report format

S.N.	Activity	Target	Achievement		Source of fund (Nu in M)	Remark (justify under achievement /over achievement)
			Physical	Financial		

Table 34: Annually Progress report format

S.N.	Output	Activity	Target	Achievement		Status	Source of fund (Nu in M)	Remark (justify under achievement /over achievement)
				Physical	Financial			

ii. Impact monitoring

Impact monitoring is to check whether the sectoral and sub-sectoral objectives & goals have been fulfilled. The outcome of such an exercise should be used to review implementation strategies and procedures. This will be done against set indicators (or proxy indicators) at the program and objective level. In the framework, impact monitoring will be done at program level. Information for impact monitoring will come from Dzongkhags and ARDCs. For impact monitoring, supplementary information will be collected from secondary sources such as: RNR census, benchmark surveys, soil surveys.

iii. Monitoring Visits

The purpose of monitoring visit is to verify information collected through the activity monitoring form. It is also to authenticate the progress reported in consultation with the beneficiaries. This authentication process will not only ensure accountability and transparency but also confirm the need for back-up services and validity of requests made for follow up action in the activity progress monitoring form.

Table 35: Recommended schedule of monitoring visits

Agency staff	Frequency of visits	Actions during site visits	Report to	Frequency of reporting
Geog Extension staff	Weekly	Monitor and Supervise and submit progress report	GT, Dzongkhag Agriculture Officer	Monthly
Dzongkhag Agriculture Officer	Monthly	Validation of progress reported	DT, Dasho Dzongdag, ARDCs, Central programs	Quarterly
ARDCs and Central programs	Quarterly	Validation of Results reported	APD, ARED & AED (Department)	Quarterly
Department	Bi-annually	Validation of Results reported	MoAF	Bi-annually

In conjunction with the above suggested site visits, activities like field visits, crop-cuts, farmers meetings, beneficiary contacts and others can be taken up by the extension staff.

10.2. Evaluation

In the M&E framework (Table 9), evaluation is proposed twice, once as the mid-term and the other as post FYP. However, the relevant institutions can decide to conduct evaluation when following situations arises.

- Monitoring indicates or shows an unexpected result
- Information is needed for a key management decision
- Reviews identify key questions to be resolved
- Stakeholders feedback indicates a problem or concern
- Breakdown in a critical assumption or immediate result
- Extract of lesson learned warrants major interventions.

i. Levels of Evaluation

Four levels of evaluation, in the framework are as reflected in the table below:

Table 36: Levels of evaluation

Level	Type of evaluation	When to evaluate	Responsible
NKRA	AKRAs	Terminal review	GNHC
AKRA	KPIs	Mid and terminal review	PPD, MoAF
Outcomes	KPIs	Mid-term review	PPD, Department
Outputs	SIs	Annual	Department
Activities	Activities	Bi-annual	DAOs, ARDCs, CPs

ii. Aspects of Evaluation

The four main aspects of evaluation are explained in Table 37

Table 37: Aspects of program evaluation

Aspects	Issues
Implementation and management	➢ How planned activities are carried out and inputs delivered?
Technical success	➢ Did the technical design work as expected? ➢ What were the main strengths and weaknesses in the design? How were they followed? ➢ How did the costs and benefits compare with those predicted? ➢ Were there any consequences of the project that were overlooked at the time of plan formulation?
Economic and Social Impact	➢ What were the wider impacts of the projects? ➢ What was the impact of programs on resources availability and use, household incomes, nutrition, household food security, community-based organizations, economic opportunities, and institutional developments? ➢ What are the beneficiaries' responses? ➢ Assessment of lessons/experiences and suggestions for reformulating/reorientation of the plan.
Adequacy and validity of the project plan	➢ Recommendations from both mid-term and terminal reviews should be used for reorienting the next phase of the development.

iii. Personnel & Institutional Performance Evaluation

Institutional performance evaluation will be done by way of assessment and appraisal. The submission and analysis schedule will be alongside parameter, which will be kept track by the supervising agency. All individuals who are implementing activity will also need to develop work plans. Activity progress of the individual will be linked with the Annual Moderation Exercise.

ANNEXURE 1: INDICATOR DESCRIPTION

1.1: Food self-sufficiency and nutrition security program

Outcome	Indicators	Unit	Description
Outcome 1: National Food Self-sufficiency and Nutrition Security Enhanced	Rice self-sufficiency	Percent	The indicator measures the volume of rice produced in the country as a proportion of requirement for national consumption (inclusive of population aged between age of 5-80 years)
	Maize self-sufficiency	Percent	The indicator measures the volume of maize produced in the country as a proportion of requirement for national consumption
	Vegetable self-sufficiency	Percent	The indicator measures the volume of vegetables (19 different vegetables identified) produced in the country as a proportion of requirements for national consumption
	Fruits production	MT	The indicator measures the annual production of fruits produced in the country with focused investment in prioritized fruits like apple, citrus, avocado, kiwi, pear, persimmon, walnut, passion fruit, banana, mango, watermelon, strawberry and peach
	Area under assured irrigation	Acre	The indicator measures the total area of Chhuzhing under assured irrigation with perennial water source (reliable water source, intake and stable irrigation channels and an irrigable command area)
	Fallow-land brought under cultivation	Acres	The indicator measures the total area of *fallow-Chhuzhing* (Wet-land) brought back to cultivation
Outcome 2: Organic Farming for Sustainable Development Enhanced	Area under organic management	Acres	The indicator measures the total area under organic management (Agriculture, Forestry-lemon grass)
	Certified organic products developed	Number	The indicator measures the number of RNR products (Agriculture, Livestock and Forestry products) certified as organic for domestic and international markets
Output 1.1: Cereal production enhanced	Paddy production (including spring rice)	MT	The indicator measures the quantity of paddy production in MT at National level
	Maize production (including spring maize)	MT	The indicator measures the quantity of maize production in MT at National level
Output 1.2: Other cereals production enhanced	Quinoa production	MT	The indicator measures the quantity of quinoa production in MT at National level
	Wheat production	MT	The indicator measures the quantity of wheat production in MT at National level

	Buckwheat production	MT	The indicator measures the quantity of buckwheat production in MT at National level
	Millet production	MT	The indicator measures the quantity of millet production in MT at National level
	Barley production	MT	The indicator measures the quantity of barley production in MT at National level
Output 1.3: Oil seeds and legumes production enhanced	Oil seeds production	MT	The indicator measures the quantity of Mustard, Soya Bean, Sunflower And Pyrilla production in MT at National level
	Grain Legumes production	MT	The indicator measures the quantity of Rajma Beans, Mung Bean and Lentils production in MT at National level
Output 1.4: Horticulture production enhanced	Vegetables production	MT	The indicator measures the quantity of Vegetables production in MT at National level
	Fruits and nuts production	MT	The indicator measures the quantity of fruit production in MT at National level
	Potato production	MT	The indicator measures the quantity of Potato production in MT at National level
	Citrus production	MT	The indicator measures the quantity of Citrus production in MT at National level
	Medicinal Aromatic Plants and Spices (MAPS) production	MT	The indicator measures the quantity of MAPs production in MT at National level
	Mushroom production	MT	The indicator measures the quantity of mushroom production in MT at National level
	Ornamental plant production	Number	The indicator measures the numbers of Ornamental plant produced at National level
Output 1.5: Agriculture service delivery facilities established/ improved	Length of major irrigation channels constructed/renovated	Km	The indicator measures the cumulative length of irrigation channels constructed/renovated by department
	Farm roads constructed/maintained	Km	The indicator measures the cumulative length of farm roads constructed/renovated by and technically supported by department
	Service delivery facilities established/ improved	Number	The indicator measures the numbers of services delivery facilities established and improved
Output 1.6: Agriculture land developed	Fallow land (Chuzhing) brought under cultivation	Acre	The indicator measures the area of fallow land (wetland) brought under cultivation by LG and technically supported from the department
	Agriculture land developed	Acre	The indicator measure the area (absolute figure) of land developed for farming by the LG and

			technically supported from the department
	Area under farm mechanization	Acre	The indicator measures the total area brought under farm mechanization
Output 1.7: Soil fertility enhanced	Area under green manuring	Acre	The indicator measures the total area brought under green manuring by LG with technical support from DoA
	Area under IPNM	Acre	The indicator measures the total area brought under IPNM by LG
Output 1.8: Human wildlife mitigation enhanced	Electric/solar fencing established	Km	The indicator measures the length of electric/solar fencing installed by LG with technical support from department
Output 1.9: Farm Mechanization service enhanced	Number of operators and mechanics trained	Number	The indicator measures the number of operators and mechanics trained by AMC
Output 1.10: School SAP enhanced	Number of schools with agriculture program	Number	The indicators measures the numbers of schools initiated and established with the agriculture program
Output 2.1: Organic agriculture promoted	Area brought under organic agriculture	Acre	This indicator measures the area brought under organic agriculture management
Output 2.2 Increased Organic Production	Organic agriculture production	MT	This indicator measures the quantity of organic agriculture produced
Output 2.3: Organic guarantee and certification system developed	Organic guarantee and certification system developed	Timeline	The indicator measures development of organic guarantee and certification system by year 2019

1.2: RNR value chain and enterprise development program

Results (Outcome)	Indicator	Unit	Description
Outcome 1. RNR Marketing & Value Chain Enhanced	Commodity value chain for RNR products established	Number	The indicator measures the number of value chains for agriculture commodities established for products with required logistics chains.
	Agriculture-based enterprises established	Number	The indicator measures the number of agriculture-based enterprises established
Outcome 2. Increased RNR Sector Contribution to National Economy	RNR sector contribution to national GDP	Nu Mil	The indicator measures the absolute value of RNR Sector (Crops, livestock, Forestry and Logging) contribution to the national GDP at current prices
	Annual RNR Sector growth rate	Percent	The indicator measures the average rate at which in the RNR Sector annual growth rate changes/grows from one year to another by taking into account of inflation
	Increased productive and gainful employment generated in agriculture Sector	Number	The indicator measures the total number of employment generated through agriculture Sector based activities
Output 1.1: Commodity value chain for agriculture produce established	Agriculture Product Value Chain	Number	The indicator measures the number of agriculture commodities having a systematic line of movement across the entire value chain i.e., from production till end market
Output 1.2: Agriculture-based enterprises established	Post-harvest infrastructures developed	Number	The indicator measures the number of post-harvest infrastructures put in place
	Value added products developed	Number	The indicator measures the number of value added products developed
	Agriculture Enterprise established	Number	The indicator measure number of agriculture enterprise established
Output 2.1: Increased productive and gainful employment generated in agriculture Sector (Employed: any person employed and paid regular	Agriculture Enterprise based Employment	Number	The indicator measures number of people employed with paid regular monthly salary (equivalent to at least daily minimum wage rate of RGOB) by agricultural enterprises established by LG and department
	Employment generated through SoEs	Number	The indicator measures number of people employed with paid regular monthly salary (equivalent to at least daily minimum wage rate of RGOB) by SoEs (FMCl)

monthly salary by FGs/Coops whether or not he/she is a member of the group	Employment through FDI	Number	The indicator measures number of people employed with paid regular monthly salary (equivalent to at least daily minimum wage rate of RGOB) through FDI (MHV)
Output 2.2: Value added product developed	Product development and value addition	Number	The indicators measures number of the product developed and value addition by NPHC

1.3: Climate smart and disaster resilient development program

Outcome	Indicator	Number	Description
Outcome 1: Climate Smart and Disaster Resilient Development enhanced	Climate resilient technologies released and adopted	Number	This indicator measure the number of climate resilient technologies developed and adopted by the farmers
	Area brought under sustainable land management	Acre	The indicator measures the total land area within the country developed and managed through sustainable land management regimes and practices (eg. Bio-engineering, wood stone bunding)
	Area brought under micro-efficient irrigation schemes	Acre	The indicator measures the total cumulative area brought under micro-irrigation schemes at the national level by AED
Output 1.1: Alternate water source explored	Ground water assessment	Number	The indicator measures the availability of ground water for irrigation purposes as an alternative source to streams and rivers.
Output 1.2: Climate Smart Irrigation and water Efficient Technologies adopted	Water use efficient technology	Number	The indicator measures the number of water efficient technology adopted
	Water harvesting structure	Number	The indicator measures the numbers of water harvesting structures constructed for irrigating crops
Output 1.3: Climate smart technologies	Climate smart technologies released and adopted Soil fertility :	Number	The indicator measure the number of climate smart technologies released and adopted as per the plan target

released and adopted	1. Improvement technologies 2. Crop production technologies 3. Resilient local crop varieties released		1. Technologies which contribute to improvement in soil structure and fertility 2. climate resilient crop production technologies adopted 3. climate resilient crop varieties released
	Bio-digester and composting	Number	The indicator measures the number of bio-digester constructed by LG with the technical support from organic program
Output 1.4: Knowledge management, education and awareness in DM enhanced	Agro-met Advisory Unit	Timeline	The indicator measures the timeline by which the RNR related climate information dissemination system is instituted in the Ministry as a means to enhance climate smart choices (i.e. crop calendar and crop choice) and inform agricultural practices end-users in a climate friendly manner. The information will be coordinated in consultation with NCHM which will be further analyzed to inform the key users on possible risks
Output 1.5: Agriculture Disaster instituted strengthen	SOP for major crop diseases	Number	The indicator measures the number of SOP developed for major crop diseases by NPPC
Output 1.6: Pest and diseases risk reduction on agriculture hazards strengthened	E-pest and diseases surveillance system	Timeline	The indicator measures the e-pest surveillance system is functional and cater the needs of the country through collection of data from the field by second year of 12th FYP
	IPM for agriculture commodities developed (Rice, Maize, Vegetables, citrus, Potato, Fruits & Nuts)	Number	The indicators measures the numbers of IPM developed for the major agriculture commodities as per the plan target (NPPC)

1.4: Research and extension services program

Results (Outcome)	Indicator	Unit	Description
Outcome 1: RNR Research Services Strengthened	Agriculture research conducted	Number	The indicator measures number of agriculture research conducted to generate technologies
	RNR technologies adoption	Number	The indicator measures the number of Agriculture technologies that has been generated and adopted by farmers to improve productivity and production of agriculture commodities (technologies includes crop varieties, crop management practices…etc)
Output 1.1: Agriculture research conducted	Number of Agriculture research conducted	Number	The indicator measures the number of agriculture researches conducted by the ARDCs and Central Program agencies to improve productivity and production of agriculture commodities (technologies includes crop varieties and crop management practices) verified from the AWPB and Annual Reports of the ARDCs and Central Program Agencies.
Output 1.2: Enhanced generation and adoption of agriculture Technologies	Agriculture technologies	Number	The indicator measures the agriculture research technologies generated particularly crop varieties developed/introduced, packaged and released by the research and central program agencies during the plan period which will be verified from the Annual Reports of the ARDCs, Central Program agencies, and minutes of the Variety Release Committee Meeting and the updated list of released crops.
Output 1.3. Research knowledge and information enhanced	Demonstration trails	Number	The indicator measures the number of demonstration sites and research outreach programs established on improved varieties of field crops and horticultural crops, soil and nutrient management and organic agriculture farming sites which can be verified from annual reports of ARDCs and central programs.
Output 1.4: Awareness on improved agricultural technologies enhanced	Number of demonstration sites and outreach programs on improved technologies established	Number	The indicator measures the numbers of demonstration sites and outreach programs on improved technologies conducted and reported by ARDCs and central program which can be verified from agency annual reports.
Output 1.5: Agricultural knowledge and information management improved	Number of reports, articles, leaflets and journals on agriculture published/produced	Number	The indicator measures the number of reports, articles, leaflets and journals on agriculture published as per the plan target

1.5: High land development program

Results Level	Indicator	Unit	Description
Outcome 1: Livelihoods of highlanders improved and sustained	Highland Enterprise established	Number	The indicator measures the number of enterprises established to enhance the cash income and livelihoods of highlanders (NWFP, *cordyceps*, ecotourism, handicrafts, trekking)
Output 1.1: Highland Enterprise development	Medicinal and aromatic enterprise	Number	The indicator measures the number of MAP enterprises established to enhance the cash income and livelihoods of highlanders
Output 1.2: Highland agriculture farming promoted and sustained	Protected vegetable production	Number	The indicator measures the number of protected vegetable production promoted by LG with the technical support from department
	Quinoa promotion	Acre	The indicator measures the area of quinoa production bought under cultivation through budget with the technical support from Department

1.6: Indicator description for coordination and support services program

Results Level	Indicator	Unit	Description
Outcome 1: Enhanced efficiency and effectiveness of RNR service delivery	Annual performance rating	Percent	The indicator measure the rate the performance of RNR sector against the plan target as per specifications of GPMD on an annual basis
Output 1.1: Policy and legislation strengthened	Frameworks/ Guidelines/ Standards developed	Number	The indicator describes on the need of agriculture policy to execute the RNR activities consistently throughout the country. The indicator number of policy developed and revised as indicated in the projected annual targets.
Output 1.2: Planning and monitoring system strengthened	DoA Annual performance rating	Percent	The indicator measures the DoA annual performance rating to be maintained >95 % throughout the plan period
	Budget utilization	Percent	The indicator measures the DoA budget to be utilized >95 % in all the fiscal year
	Regional and National Coordination meetings conducted.	Number	The indicator measures the numbers DoA's coordination meetings to be held as per the DoA published calendars
	Regional database developed	Timeline	The indicator measures the development and maintaining of regional database in all the ARDCs annually

ANNEXURE 2: AGENCY PLANS

2.1: National Soil Service Centre

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency and nutrition security enhanced	Agriculture service delivery facilities established/improved	Construct Soil Microbiology Laboratory and Bio-fertilizer store	Timeline	2017	0	2021
		Equipment for soil, plant, compost, FYM & water analysis	Timeline	2017	0	2022
		Construction of display hall, preparation room and toilet at NSSC	Timeline	2017	0	2020
	Agriculture land developed	Consolidate existing small chhuzhing terraces to enable farm mechanization	Acre	2017	15	300
		Construct new terraces (Chhuzhing, kamzhing and orchard) for farm mechanization	Acre	2017	446	100
		Establish Hedgerows on steep slopes to control surface erosion	Acre	2017	2772	500
		Construct Contour stone bunds especially on steep slopes	Acre	2017	1097	200
		Construct Orchard basin on steep slopes	Acre	2017	0	100
		Remove Excess surface stone from cultivated areas	Acre	2017	0	50
		Construct check dams to prevent gullies and ravine formation.	Number	2017	100	300
		Area stabilization through bioengineering measures	Acre	2017	100	50
	Soil fertility enhanced	Promote green manuring in paddy	Acre	2017	60	300
		Promote Bio-fertilizer	MT	2017	0	40
		Promote IPNM practices in paddy	Acre	2017	400	700
		Promote IPNM practices in potato	Acre	2017	10	100
RNR research services strengthened	Agriculture Research conducted	Conduct research on soil and land management	Number	2017	1	2
		Research on isolation and identifying native earth worm for vermi composting	Number	2017	0	1
		Bio fertilizer research trials	Number	2017	0	1
		On-farm soil research trial on chili, beans, cauliflower & onion	Acre	2017	0	100
		On-farm soil research trial on citrus	Acre	2017	0	50
		On-farm soil research trial on apple	Acre	2017	0	50

	Agriculture technology generated	Generate IPNM technologies	Number	2017	0	2
	Agriculture technology adopted	Promote IPNM technologies	Number	2017	0	2
	Awareness on improved agriculture technologies enhanced	Celebrate world soil day	Number	2017	5	5
		Celebrate UNCCD Day	Number	2017	5	5
	Agriculture knowledge and information management improved	Establish SLM demo sites	Number	2017	0	1
		Publish annual report	Number	2017	1	5
		Update guide to fertilizer recommendation for agriculture and horticulture	Number	2017	1	1
		Update Bio-engineering manual in line with ALD Guidelines	Number	2017	1	1
		Land use and soil fertility management: strategic directions	Number	2017	1	1
		Publish research articles in BJA	Number	2017	2	5
		Produce Soil organic carbon (SOC) stocks map at Geog level	Number	2017	1	10
		Produce LULC maps at Geog level	Number	2017	25	18
		Produce Soil monolith	Number	2017	5	4
Enhanced efficiency and effectiveness of RNR service delivery	Agriculture service delivery enhanced	Carry out reconnaissance soil survey of cultivated/arable land	Number	2017	7	20
		Feasibility study for resettlement program and land use certificate (National Rehabilitation Project)	Number	2017	7	10
		Render Technical support for land conversion activities	Number	2017	296	400
		Investigate problematic soil/land (degradation, contamination, nutrient mining, flooding, etc)	Number	2017	21	15
		Analyze Soil, plant, compost, FYM and water samples	Number	2017	10000	11000
RNR marketing and value chain enhanced	Agriculture based enterprises established	Establishment of Organic-fertilizer enterprise	Timeline	2017	0	2022
		Establishment of vermi-compost enterprise	Timeline	2017	0	2021

2.2: National Plant Protection Centre

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency enhanced	Human wildlife mitigation enhanced	Human wild-life conflict management through safe system approach.	Number	2017	4	8
	Agriculture service delivery facilities established/improved	Establishment of bio-control lab at the Centre	Timeline	2017	0	2020
		Establishment of pesticide analytical laboratory	Timeline	2017	0	2021
		Renovate drinking water supply in the centre	Timeline	2017	0	2019
		Strengthen regional pesticide stores with state-of-the-art facilities	Timeline	2017	0	2020
		Construction and up-gradation of laboratory in the centre	Timeline	2017	0	2022
Enhanced Climate Smart and Disaster Resilient Development	Pest and diseases risk reduction on agriculture hazards strengthened	Mass campaign on citrus fruit drop collection and destruction in the major citrus growing areas	Number	2017	3	10
		Analysis of citrus orchards, nurseries and germplasms for detection of Huang long bing disease	Number	2017	3	15
		Pests and diseases surveillance & monitoring surveys	Number	2017	2	3
		Develop disease/pest forecasting system	Number	2017	0	1
		Management of PP products including procurement & supply	Number	2017	0	5
		IPM for prioritized agriculture commodities	Number	2017	6	6
	Agriculture Disaster management institution strengthened	Develop SoPs for crop disease	Number	2017	0	5
RNR Research Services Strengthened	Agriculture research conducted	Assessment of *Trichoderma* spp. & potassium phosphite as alternatives to synthetic fungicides to manage soil borne pathogens such as *Phytophthora* sp. in selected crops	Number	2017	0	2
		Study *Potamotegon distinctus* biology under greenhouse condition	Number	2017	0	2

		Study control of *Potamotegon distincts* using Sulfonylureas under greenhouse condition	Number	2017	0	2
		Control of *Potamotegon distinctus* using Sulfonylureas in transplanted rice	Number	2017	1	5
		Evaluate of resistance of weeds to Butachlor	Number	2017	0	1
		Survey of submerged weeds in transplanted rice	Number	2017	0	1
		Study parasitism of PTM & DBM by *Trichogramma* in fields treated & not treated with insecticides.	Number	2017	0	2
		Identification of fruit flies in vegetables & fruits other than citrus.	Number	2017	5	10
		Evaluate neem against diamond back moth as an alternative to Cypermethrin	Number	2017	0	1
	Agriculture technologies generated	Sulfonylurea as weed control technology in transplanted rice	Number	2017	0	1
		Alternative to fungicides against soil borne pathogens (Trichoderma spp. & potassium phosphite against Phytophthora sp.)	Number	2017	0	2
		Package of practices developed against diamond back moth control using bio pesticides.	Number	2017	0	1
	Agriculture technologies adopted	Sulfonylureas to control broad spectrum weeds in transplanted rice	Acre	2017	1	1
		Use of neem against diamond back moth as an alternative to Cypermethrin	Percent	2017	0	1
		Up-scaling of super-grain bags technology to minimize damage from storage pests	Number	2017	1442	3000
		Up-scaling of pheromone traps	Number	2017	1	5
	Awareness on improved agricultural technologies enhanced	Demonstration of pheromone traps	Number	2017	5	10
		Demonstration of super-grain bags technology to minimize damage from storage pests	Number	2017	3	10

		Demonstration on use of Trichoderma sp. & potassium phosphite against soil borne pathogen	Number	2017	0	2
		Establishment of demo sites	Number	2017	0	2
	Agriculture knowledge and information management improved	Revise and update 'The Weeds of Bhutan' publication	Timeline	2017	1	2021
		Publish Centre's annual reports	Number	2017	1	5
		Publish research article in BJA	Number	2017	1	5
		Review Pesticide Act of Bhutan 2000	Timeline	2017	n/a	2019
		Develop database for electric/solar fencing in Bhutan using Global Position System	Number	2017	1	1
RNR marketing and value chain enhanced	Agriculture based enterprises established	Establishment Bio-pesticide enterprise	Timeline	2017	0	2022

2.3: National Post Harvest Centre

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency and nutrition security enhanced	Agriculture service delivery facilities established/improved	Major renovation of existing building	Timeline	2017	0	2022
	Oil seed and grain legumes production enhanced	Adaptation of improved post-harvest technologies for grain legumes and oil seed	Number	2017	4	7
RNR Research Services Strengthened	Agriculture research conducted	Determine post-harvest losses of fruits and vegetables (Major cash crops and vegetables)	Number	2017	2	15
		Determine post-harvest losses of cereal crops	Number	2017	1	4
		Research and develop suitable packaging and labeling for	Number	2017	0	10

		processed and value-added food products				
	Agriculture technologies generated	Generate processed and value-added products from fruits, vegetables and cereals	Number	2017	90	100
		Generate appropriate post-harvest technologies	Number	2017	7	10
	Agriculture technologies adopted	Reduction of post-harvest losses in fruits and vegetables	Number	2017	0	10
		Promote value-added products of fruits vegetables and cereals	Number	2017	10	25
		Promote post-harvest technologies	Number	2017	7	5
	Awareness on agriculture technologies enhanced	Develop postproduction leaflets, booklets, brochures, pamphlets and posters	Number	2017	10	40
		Develop audio-visual aids for dissemination of postproduction technologies.	Number	2017	1	5
		Demonstration of post-harvest technologies	Number	2017	10	15
	Agriculture knowledge and information management improved	Publish annual report	Number	2017	5	5
		Publish research articles in BJA	Number	2017	3	5
RNR marketing and value chain enhanced	Value added products developed	Develop value added products of fruits, vegetables and cereals	Number	2017	90	100
		Procure processing and value addition machines, equipment and consumables	Number	2017	70	75
	Agriculture based enterprises established	Strengthening of food incubation centers	Number	2017	11	29
		Cereal based processing & value addition enterprise	Timeline	2017	0	2023

2.4: Agriculture Machinery Centre

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency and nutrition security enhanced	Farm mechanization services enhanced	Ensure Quality and safe farm machineries and spare parts	Number	2017	6	12
		Outsource technology	Number	2017	11	11
		Provide training courses on farm machineries operation for farmers and other stakeholders.	Number	2017	2350	3000
RNR Research Services Strengthened	Agriculture research conducted	Conduct research on farm mechanization	Number	2017	6	12
	Agriculture technologies generated	Generate farm mechanization technologies	Number	2017	6	10
	Agriculture technologies adopted	Promote farm mechanization technologies	Number	2017	0	6
	Awareness on agriculture technologies enhanced	Demonstration of farm mechanization technologies	Number	2017	11	20
	Agriculture knowledge and information management improved	Publication of annual reports	Number	2017	1	5
		Publication of research article in BJA	Number	2017	1	5
		Frame Farm mechanization policy & guidelines	Number	2017	1	2

2.5: Central Machinery Centre

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency and nutrition security enhanced	Agriculture service delivery facilities established/ improved	Maintenance of machines for land development	Timeline	2017	0	2023
		Deployment of machines for Agriculture Land development	Timeline	2017	0	2023
		Construction of new bridge and road widening at Nasephel	Timeline	2017	0	2020
		Maintenance of Road works at Khangma & Samtenling	Timeline	2017	0	2020
		Construction of scrap house at regional offices Samtenling & Khangma	Timeline	2017	0	2020

2.6: National Mushroom Centre

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency and nutrition security enhanced	Horticulture Production enhanced	Establish mushroom focus village	Number	2017	17	30
		Improve collection and Marketing of wild mushrooms	Number	2017	33	50
		Improve management of wild mushroom	Number	2017	5	7
		Promote organic mushroom cultivation	MT	2017	0	10
		Promote medicinal mushroom production	MT	2017	0	1
		Production of spawn and supply	bottle	2017	n.a.	90
	Agriculture service delivery facilities established/ improved	Construct laboratory	Timeline	2017	0	2019
		Water supply, chain linked fencing and approach road	Timeline	2017	0	2020
		Installation of new transformer	Timeline	2017	0	2020
		Strengthening of laboratory facilities for mother spawn production	Timeline	2017	0	2021

RNR Research and Extension Services Strengthened	Agriculture research conducted	Explore Truffles in Bhutan	Number	2017	0	2
		Conduct research on different mushroom cultivars	Number	2017	3	6
		Conduct research on mushroom post production practices	Number	2017	0	1
		Conduct research on mushroom pests and diseases management	Number	2017	1	1
		Domestication trial on edible wild mushrooms	Number	2017	1	6
	Agriculture technologies generated	PoP on mushroom cultivation (Button mushroom, Ganoderma)	Number	2017	2	3
		Selection of new mushroom strains	Number	2017	0	2
	Agriculture technologies adopted	Up-scaling of button mushroom cultivation	Number	2017	1	5
		Promotion of Ganoderma cultivation	Number	2017	0	2
	Awareness on improved agricultural technologies enhanced	Create awareness on sustainable wild mushroom collection and mushroom poisoning	Number	2017	na	25
		Demonstration of mushroom technologies	Number	2017	0	5
	Agriculture knowledge and information management improved	Identify and generate information on wild mushroom	Number	2017	300	1000
		Establish herbarium for mushroom	Number	2017	1	2
		Publish annual report	Number	2017	0	5
		Publish research article in BJA	Number	2017	0	5
		Develop clean spawn production and laboratory standards	Number	2017	0	2
RNR marketing and value chain enhanced	Agriculture based enterprises established	Establish mushroom spawn production enterprise	Timeline	2017	0	2021
		Establish mushroom production enterprise	Timeline	2017	0	2021

2.7: National Seed Centre

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency enhanced	Cereal production enhanced	Produce and supply improved paddy seeds	MT	2017	70	414
		Produce and supply improved maize seeds	MT	2017	50	330
	Other cereal production enhanced	Produce and supply improved wheat seeds	MT	2017	40	230
	Oil seed and grain legume production enhanced	Produce and supply oilseeds	MT	2017	10	48
	Horticulture production enhanced	Produce and supply vegetable seeds	MT	2017	10	61.5
		Produce and supply seed potato	MT	2017	350	1420
		Produce and supply temperate fruit plants	Number	2017	35000	185000
		Produce and supply sub-tropical fruit plants	Number	2017	70000	345000
		Produce and supply citrus seedlings/grafts	Number	2017	25000	295000
		Produce and supply cardamom seedlings	Number	2017	100000	500000
		Produce and supply asparagus seedlings	Number	2017	10000	50000
		Produce and supply strawberry seedlings	Number	2017	1000	13000
		Import and supply fertilizers	MT	2017	3200	13821
	Agriculture land developed	Develop land at Phobjikha farm	Acre	2017	0	20
	Agriculture service delivery facilities established/ improved	Construction of seeds and seedlings stores at Jephu farm	Timeline	2017	0	2020
		Establish citrus repository in Jachedphu	Timeline	2017	0	2019
		Construction of irrigation facilities at Pobjikha	Timeline	2017	0	2020
		Installation of misting irrigation in glasshouse at Chhundudingkha farm	Timeline	2017	0	2020

		Construction of office and meeting hall at Jachedphu farm	Timeline	2017	0	2023
		Construction of water reservoir and water pump installation at Bondey farm	Timeline	2017	0	2022
		Construction of drinking water supply at Samtenling farm	Timeline	2017	0	2023
		Installation of drip irrigation system at Samtenling farm	Timeline	2017	0	2020
		Construction of compost collection shed at Samtenling farm	Timeline	2017	0	2020
		Construction of irrigation facilities at Bajo farm	Timeline	2017	0	2022
		Expansion of tissue culture laboratory	Timeline	2017	0	2022
		Major renovation of structures (office, staff quarter, glasshouses)	Timeline	2017	0	2021
RNR Research and Extension Services Strengthened	Agriculture research conducted	Conduct seed research on major crops	Number	2017	0	2
		Conduct seed research on other crops	Number	2017	0	1
	Agriculture technologies generated	Generate clean seeds and seedlings production technologies	Number	2017	0	4
	Agriculture knowledge and information management improved	Publish annual reports	Number	2017	5	5
		Publish research articles in BJA	Number	2017	0	2
		Publish strategy on strengthening seed sector	Number	2017	0	1
Enhanced efficiency and effectiveness of RNR service delivery	Agriculture service delivery enhanced	Strengthen and support registered seed growers	Groups	2017	0	4
		Support to private nursery operators	Number	2017	0	4
		Support to seed production companies	Number	2017	0	2

2.8: Agriculture Research & Development Centre – Bajo

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency enhanced	Cereal production enhanced	Increase in rice productivity in the region	MT/acre	2017	1.54	1.72
		Production and marketing of parboiled rice	MT	2017	0	15
		Increase area under upland rice in the region	Acre	2017	n.a.	1200
		Increase area under direct seeded rice	Acre	2017	0	1000
	Other cereal production enhanced	Promote HYV of buckwheat, millet, wheat and Barley	MT	2017	n.a.	5
	Horticulture production enhanced	Promote protected cultivation for vegetables	Acre	2017	0	20
		Promote commercial production of vegetables in the region	HHs	2017	4	20
		Produce spawn and supply to farmers	Number	2017	12000	20000
		Produce spawn mother culture	Number	2017	0	2000
		Area under improved MAPS technology	Acre	2017	0	10
		Produce flowers and ornamental plants	Number	2017	0	35000
	Agriculture land developed	Develop new terraces in the potential Dzogkhags for paddy production.	Acre	2017	0	3000
	Agriculture service delivery facilities established/improved	Maintenance of citrus germplasm repository	No. of varieties	2017	91	140
		Construction of irrigation pump house and renovation of internal irrigation facilities in Bajo	Timeline	2017	0	2022
		Construction of Farm house in Bajo	Timeline	2017	0	2022
RNR research services	Agriculture research conducted	Conduct study on traditional rice varieties and maintain pure seeds for market and conservation (special & pigmented varieties)	Number	2017	0	15

strengthened		Evaluate climate resilient upland rice varieties	Number	2017	0	2
		Evaluate climate resilient wheat varieties	Number	2017	3	1
		Introduce and evaluate rice varieties	Number	2017	6	10
		Introduce and evaluate of bio-fortified and low GI rice varieties	Number	2017	0	3
		Introduce and Evaluate maize varieties	Number	2017	0	2
		Nutrient profiling and crop nutrient budgeting of field crops	Number	2017	0	5
		Introduce and Evaluate wheat varieties	Number	2017	3	6
		Evaluate Quinoa variety	Number	2017	0	2
		Evaluate fruits & Nuts varieties	Number	2017	6	7
		Introduce and evaluate new fruits and nuts varieties	Number	2017	16	5
		Initiate breeding trials programs	Number	2017	0	1
		Evaluate high yielding vegetable varieties	Number	2017	12	20
		Evaluate high nutrient content vegetable varieties	Number	2017	1	3
		Conduct soil fertility survey, land and nutrient management research	Number	2017	1	5
		Trial on pest and diseases management in crops	Number	2017	0	2
		Study the impact of research out-reach program in the focus villages.	Number	2017	0	3
		Study the impact on electric fencing, bio-digester, water harvesting, and SLM	Number	2017	0	5
		Yield gap analysis for Rice in Bhutan	Number	2017	0	1
		Yield gap analysis for Citrus in Bhutan	Number	2017	0	1
		Yield gap analysis for wheat and other cereals	Number	2017	0	1

	Agriculture technologies generated	Release bio-fortified and low GI rice varieties	Number	2017	0	3
		Release wheat varieties	Number	2017	3	2
		Release quinoa variety	Number	2017	0	2
		Release rice varieties	Number	2017	23	6
		Release maize varieties	Number	2017	0	2
		Identify & release high value fruits and nuts varieties	Number	2017	3	3
		Release off-season vegetable varieties	Number	2017	0	3
		Release vegetables varieties	Number	2017	22	5
		Generate information on Soil fertility, land and nutrient management technologies	Number	2017	1	3
		Generate technologies on Pest and diseases management in crops	Number	2017	5	2
	Agriculture technologies adopted	Promote improved maize varieties	MT	2017	2	10
		Intensify and promotion of oil seeds	Acre	2017	0	1000
		Intensify demonstration and promotion of pulses and grain legumes	Acre	2017	1194	1750
		Promote high value fruits and nuts varieties	Acre	2017	4	40
		Promote IPNM technologies	Number	2017	2	3
		Promote IPM technologies	Number	2017	3	5
		Promote user, gender and environment friendly machineries	Number	2017	0	2
	Awareness on improved agricultural technologies enhanced	Maintain fruits and nuts germplasm	Number	2017	6	10
		Establish demonstration sites and research outreach program on field crop technologies	Number	2017	20	300
		Establish demonstration sites and research outreach program on horticultural technologies	Number	2017	31	50

		Establish demonstration and outreach program on organic technologies	Number	2017	0	5
		Maintain germplasm for ginger and cardamom	Number	2017	0	5
	Agriculture knowledge and information management enhanced	Publish annual reports	Number	2017	5	5
		Produce technical papers on research conducted, leaflets and compendium on improved technologies	Number	2017	100	10
		Publish research articles in BJA	Number	2017	6	10
		Generate regional agriculture database	Number	2017	0	1
		Publish regional cost of production on major commodities	Number	2017	0	1
Enhanced climate smart and disaster resilient development	Climate smart technologies released and adopted	Release climate resilient rice varieties	Number	2017	0	2
		Release climate smart wheat variety	Number	2017	0	1
		Climate resilient crop management technologies	Number	2017	3	7
		Release stress tolerant vegetables varieties	Number	2017	0	1

2.9: Agriculture Research & Development Centre – Samtenling

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency enhanced	Cereal production enhanced	Increase rice productivity in the region	MT/acre	2017	1.1	1.3
	Other cereal production enhanced	Promote quinoa production in the region	MT	2017	0	20
	Horticulture production enhanced	Develop commercial production sites for vegetable	Number	2017	0	5
		Supply of mushroom spawn	Number	2017	2000	10000
		Establish on-station floriculture nursery	Number	2017	0	1
		Collect and maintain indigenous ornamental plants	Number	2017	0	50
	Oil seed and grain legumes production enhanced	Promote grain legume production	MT	2017	0	10
	Agriculture land developed	Develop land for commercial farming	Acre	2017	0	10
Organic farming for sustainable development	Increased organic production	Study on use of organic methods for pest and disease management in vegetables	Number	2017	0	1
		Study on use of organic methods for nutrient management in vegetables	Number	2017	0	1
		Establishment of Good Agriculture practice (GAP) block on-station	Number	2017	0	1
RNR Research and extension Services Strengthened	Agriculture research conducted	Seed purification of traditional rice varieties	Number	2017	3	5
		Crossing local and improved rice varieties	Number	2017	0	3
		Crossing local and improved maize varieties	Number	2017	0	3
		Characterization of Cardamom, Ginger, Black pepper, turmeric	Number	2017	0	4

		Initiate breeding trial for vegetables	Number	2017	0	2
		Evaluate, characterize and screen group of local vegetable types	Number	2017	0	2
		Study the potential impact of climate change on crops	Number	2017	0	2
		Conduct research on sustainable irrigation system	Number	2017	0	1
		Introduce and evaluate grain legumes & pulses varieties	Number	2017	0	5
		Yield gap analysis for grain legumes and pulses	Number	2017	0	1
		Yield gap analysis for spices in Bhutan	Number	2017	0	1
	Agriculture technologies generated	Release spring paddy variety	Number	2017	0	2
		Release Quinoa variety	Number	2017	0	1
		Release/identify fruits and nuts variety	Number	2017	6	10
		Release vegetables varieties	Number	2017	0	5
		Release grain legumes varieties	Number	2017	0	1
		Release spices varieties	Number	2017	0	3
	Agriculture technologies adopted	Promote protected cultivation for vegetables	Acre	2017	0	3
		Promote improved kitchen garden technologies	Number	2017	300	350
	Awareness on agriculture technologies enhanced	Maintain released varieties of paddy (Breeder seed)	Number	2017	4	5
		Maintain fruit and nut varieties germplasm	Number	2017	6	10
		Establish demo orchards	Number	2017	40	200
		Maintain ginger, cardamom, turmeric & black pepper germplasm	Number	2017	0	4
		Promotion of black pepper in Aerecanut plantation	Number	2017	0	20000
	Agriculture knowledge and information management improved	Generate reports on crop phenology	Number	2017	0	2
		Publish annual reports	Number	2017	5	5
		Publish research articles in BJA	Number	2017	2	10
		Generate regional agriculture database	Number	2017	0	1

		Publish regional cost of production on major commodities	Number	2017	0	1
	Agriculture service delivery facilities established/improved	Construction of staff quarter and ESP quarter in Panbang	Timeline	2017	0	2022
		Renovation of late Dasho Nishoka's office at Panbang	Timeline	2017	0	2020
		Construction of office and meeting hall (packaged with office furniture) at the centre	Timeline	2017	0	2019
		Construction of mushroom cropping house at Samtenling	Timeline	2017	0	2020
		Construction seedling hardening shed	Timeline	2017	0	2023
		Procurement of machineries	Timeline	2017	4	2020
		Procurement of diesel cum motor self-starter generator	Timeline	2017	0	2023
		Major renovation of monsoon affected irrigation channel at ARDC Samtenling	Timeline	2017	0	2022
		Construction of Balukhola to Samtenling irrigation channel	Timeline	2017	0	2023
		Maintenance of water supply at ARDSC Tingtibi	Timeline	2017	0	2020
Enhanced climate smart and disaster resilient development	Climate smart technologies released and adopted	Report on Ingenious fruits	Number	2017	0	5
		Release drought tolerant paddy varieties	Number	2017	0	1
		Release of short duration vegetable varieties	Number	2017	0	1
		Release "No Till" or "Zero-Tillage" vegetable cultivation	Number	2017	0	1
		Staggered vegetable cultivation technology	Number	2017	0	1

2.10: Agriculture Research & Development Centre – Wengkhar

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency and nutrition security enhanced	Cereal production enhanced	Increase rice productivity	MT/acre	2016	1.35	1.5
		Increase rice milling recovery	Perce	2017	55	60
		Produce basic seeds of mid and high-altitude rice varieties	Kg	2017	200	400
		Promote community based upland paddy seed production groups	Number	2017	1	2
		Increase maize productivity	MT/acre	2017	1.4	1.6
		Increase production of quality maize seeds	MT	2017	67	100
		Promote community based maize seed production groups	Number	2017	6	8
		Reduce post-harvest loss of maize	Percent	2017	35	15
	Other cereal production enhanced	Increase other cereals production in the region	MT	2017	61	70
		Produce basic seeds of high-altitude wheat varieties	Kg	2017	0	200
		Crop intensification and promotion of Quinoa	Acres	2017	10	50
	Oil seed and grain legumes production enhanced	Increase groundnut production	MT	2017	41	50
		Promote HYV of mustard	Number	2017	1	2
		Promote oil seeds intensification	Number	2017	0	5
	Horticulture production enhanced	Develop commercial production sites for vegetables	Number	2017	6	36
		Support vegetable seed growers in the region	Number	2017	19	30
		Establish protected cultivation for vegetable production	Number	2017	0	5
		Develop citrus village	Number	2017	29	60
		Establish commodity focused villages	Number	2017	6	30

		Support to private nurseries in the region	Number	2017	10	20
		Supply spawn for mushroom cultivation	Number	2017	125000	450000
		Establish mushroom villages	Number	2017	5	25
		Support to commercial mushroom farms	Number	2017	7	25
		Up-scale chirata cultivation	Number	2017	35	45
		Establish floriculture nursery	Number	2017	0	1
		Collect and maintain local ornamental plants	Number	2017	10	30
		Strengthen floriculture germplasm collection	Number	2017	88	200
	Agriculture service delivery facilities established/improved	Strengthening of National Referee Seed Testing laboratory	Timeline	2017	0	2020
	Agriculture land developed	Develop land for commercial farming	Acre	2017	80	300
		Initiate sustainable land management	Acre	2017	0	15
	Soil fertility enhanced	Promote green manuring in paddy	Acre	2017	0	20
		Promote maize legume intercropping		2017	0	6
	Human wildlife mitigation management enhanced	Explore alternative materials for wooden poles used in current electric fence system	Number	2017	0	1
	Schools with SAP increased	Reintroduce quality kharang supply to school feeding program	MT	2017	0	1000
Organic farming for sustainable development enhanced	Increased organic production	Promote use of organic methods for pest and disease management in vegetables	Number	2017	5	5
		Strengthen production of organic manure	m^3	2017	130	700
		Establish EM production facility	Number	2017	0	1

RNR Research and extension Services Strengthened	Agriculture research conducted	Seed purification of traditional rice varieties	Number	2017	5	15
		Compare effectiveness of direct seeding and transplanted rice	Number	2017	1	3
		Evaluate SRI in farmer's field	Number	2017	1	3
		Conduct yield gap analysis of rice in eastern Bhutan	Number	2017	1	6
		Evaluate climate resilient maize varieties	Number	2017	5	9
		Evaluate fortified and quality protein maize	Number	2017	0	1
		Conduct yield gap analysis of Maize in Bhutan	Number	2017	1	6
		Study effect of storage structures on moisture content of maize	Number	2017	1	2
		Evaluate popcorn variety	Number	2017	0	4
		Study improvement of maize processing and product development	Number	2017	1	2
		Evaluate local germplasm of groundnut, sunflower and mustard	Number	2017	5	7
		Evaluate oil recovery percentage of oil seed crop	Number	2017	5	15
		Evaluate climate resilient quinoa varieties	Number	2017	3	5
		Study best management practices for quinoa cultivation	Number	2017	0	2
		Evaluate different grain legume varieties	Number	2017	0	5
		Breed citrus varieties for biotic and abiotic stress tolerance	Number	2017	0	1
		Evaluate and maintain citrus germplasm	Number	2017	80	95
		Study citrus phenology trend	Number	2017	0	1
		Conduct survey for potential clean planting materials of citrus in the region	Number	2017	0	1
		Study viability of protected citriculture in the centre	Number	2017	0	1
		Conduct research on clean citrus planting material production	Number	2017	0	1

		Evaluate and maintain germplasm of fruits & nuts	Number	2017	84	90
		Study fruits and nuts phenology trend	Number	2017	0	1
		Study potential impact of climate change on fruits and nuts	Number	2017	1	3
		Initiate plant propagation through tissue culture	Number	2017	0	1
		Initiate breeding through emasculation in fruits and nuts	Number	2017	0	1
		Evaluate and maintain MAPS germplasm	Number	2017	30	40
		Introduce and study new mushroom strains	Number	2017	2	4
		Evaluate climate resilient potato varieties	Number	2017	6	9
		Evaluate and maintain vegetable germplasm	Number	2017	85	90
		Study local vegetable diversity	Number	2017	1	3
		Initiate breeding program for vegetables	Number	2017	0	1
		Collect and study wild mushroom	Number	2017	40	50
		Study effectiveness of bio-pesticides	Number	2017	1	5
		Assessment of physiochemical properties of different organic fertilizers			1	1
		Identify potential pest management practices in horticulture crops	Number	2017	0	1
		Study plant pathogen isolation, preservation and bio-assy	Number	2017	0	2
		Explore and study performance of electric ultrasound pest repellent	Number	2017	1	1
		Research on electric fence design, material improvement, and behavior studies to improve the efficacy of the current electric fence system	Number	2017	1	2
		Research on bioacoustics system with electric fence to repel wild animals from agricultural farm	Number	2017	0	1
		Study earthworm diversity and intensity in different land use system	Number	2017	0	3

		Maintain and study soil erosion	Number	2017	4	4
		Identify ambient temperature and humidity for potting mixture sterilization	Number	2017	0	1
		Study on use of online monitoring system for stream sources for irrigation	Number	2017	0	1
		Conduct research to improve the efficiency of SMART irrigation system	Number	2017	0	1
	Agriculture technologies generated	Release quality protein maize (QPM) varieties	Number	2017	1	3
		Release hybrid maize variety	Number	2017	0	1
		Release Quinoa varieties	Number	2017	0	3
		Release upland paddy varieties	Number	2017	3	5
		Identify promising citrus varieties (PAVs, Local and Rootstocks)	Number	2017	9	14
		Generate improved technology on citrus nursery, orchard, pest & disease, and nutrient management	Number	2017	4	8
		Release new varieties of vegetables	Number	2017	9	11
		Generate staggered vegetable production technology	Number	2017	0	1
		Release new fruit and nut varieties	Number	2017	14	16
		Develop POP for high altitude rice	Number	2017	4	6
		Develop PoP for sunflower	Number	2017	0	1
		Release citrus processing varieties	Number	2017	0	2
		Generate technologies in fruits and nuts management	Number	2017	9	15
		Generate technologies in citrus management	Number	2017	4	8
		Develop manual on product development	Number	2017	0	3
		Generate technologies of oyster cultivation in different substrates	Number	2017	0	1
		Develop new MAPs product	Number	2017	5	7

		Develop model on use of weather data for automated irrigation	Number	2017	0	1
	Agriculture technologies adopted	Promote solar dryer using greenhouses	Number	2017	0	5
		Promote protected citriculture	Number	2017	0	2
		Promote protected vegetable production	Number	2017	0	5
		Promote floriculture amenity and landscape activities	Number	2017	2	7
	Awareness on improved agricultural technologies enhanced	Demonstration through fruit and nut germplasm maintenance	Number	2017	84	90
		Collect and maintain local ornamental plants	Number	2017	10	30
		Demonstration through citrus germplasm maintenance	Number	2017	80	95
		Demonstration through vegetable germplasm maintenance	Number	2017	85	90
		Establishment of demo orchards	Number	2017	20	100
		Demonstration through MAPS live gene bank maintenance	Number	2017	30	40
		Demonstration through commodity focus villages	Number	2017	6	12
	Agriculture knowledge and information management improved	Publish annual reports	Number	2017	5	5
		Publish research articles in BJA	Number	2017	5	10
		Generate regional agriculture database	Number	2017	0	1
		Produce manuals on product development	Number	2017	0	7
		Reports on crop phenology	Number	2017	1	3
		Generate information on edible indigenous fruits, vegetables	Number	2017	0	2
		Report on cost benefit analysis of potential crops	Number	2017	1	2
		Publish extension materials on crop management technologies (citrus, fruits & vegetables)	Number	2017	19	34
		Publish compendium on ornamental plants	Number	2017	1	2
		Report on soil fertility status of orchards in eastern Bhutan	Number	2017	0	1
		Report on cost of production of compost manure	Number	2017	0	1

		Report on physiochemical properties of organic fertilizers	Number	2017	0	1
		Soil map of the centre	Number	2017	0	3
		Impact assessment reports (SLM and Irrigation channel)	Number	2017	0	2
		Publish regional cost of production on major commodities	Number	2017	0	1
Enhanced climate Smart and Disaster resilient development	Climate smart irrigation and water efficient technologies adopted	Area under micro efficient irrigation schemes for vegetable	Acre	2017	0	50
		Develop low cost SMART irrigation system based on the open source IT technologies	Number	2017	0	1
		Up scale the installation of low-cost SMART irrigation system in commercial agricultural farms	Acre	2017	1	20
		Promote drip and sprinkler irrigation system	Number	2017	0	5
		Install and maintain agrometeorological stations	Number	2017	3	8
	Climate smart technologies released and adopted	Release climate resilient maize varieties	Number	2017	0	2
		Release heat tolerant varieties of vegetables.	Number	2017	0	5
		Conduct survey on wild fruits and generate report	Number	2017	0	1
		Study the potential impact of climate change on crops(long term)	Number	2017	0	5
		Scale up installation of online weather and soil moisture/temp stations in different agricultural potential areas	Number	2017	3	10
		Utilize local climate data in weather forecast	Timeline	2017	0	1

2.11: Agriculture Research & Development Centre, Yusipang

Outcome	Output	Activities	Unit	Base year	Baseline	Target
Food self-sufficiency enhanced	Cereal production enhanced	Increase rice productivity in the region	MT/acre	2017	1.54	1.72
		Production of basic seed of high-altitude rice varieties	Kg	2017	200	400
		Promote community based maize seed production groups	Number	2017	1	3
		Produce basic seed potential rice lines	Number	2017	25	25
	Other cereal production enhanced	Basic seed production of high-altitude wheat varieties	Kg	2017	0	200
		Basic seed production of quinoa varieties	Kg	2017	1000	4000
		Promote quinoa	Acre	2017	1.5	205
	Horticulture Production enhanced	Produce micro and mini potato tuber	Kg	2017	15	200
		Promote apple production in other Dzongkhags	Number	2017	0	3
		Promote commercial vegetable production sites in the region	Number	2017	3	10
		Promote winter vegetable production	Acre	2017	20	50
		Promote fruits and nuts	Number	2017	8	12
		Produce basic vegetable seeds	Number	2017	6	12
	Agriculture service delivery facilities established/improved	Major renovation of road	Timeline	2017	0	2020
Organic farming for sustainable development enhanced	Area brought under organic management	Supply of seeds and seedlings for organic production	Acre	2017	5560	9039
	Increased organic production	Support to organic production	MT	2017	966	4323
	Organic guarantee and certification system developed	Develop organic guarantee and certification system	Timeline	2017	0	2019
		Develop certified organic products	Number	2017	4	17

RNR Research and extension Services Strengthened	Agriculture research conducted	Evaluate climate resilient high-altitude rice varieties	Number	2017	25	25
		Evaluate organic rice production technologies	Number	2017	0	2
		Evaluate high yielding stress tolerant maize varieties	Number	2017	0	1
		Evaluate climate resilient wheat varieties	Number	2017	0	1
		Evaluate HYV of mustard	Number	2017	5	2
		Evaluate other oil crops for diversification	Number	2017	1	2
		Evaluate climate resilient quinoa varieties	Number	2017	9	3
		Evaluate different grain legume varieties	Number	2017	0	5
		Evaluate fruits & nuts varieties	Number	2017	6	13
		Collect and evaluate berry varieties	Number	2017	3	5
		Conduct trials on improved production and management practices	Number	2017	0	2
		Conduct trials on propagation of seedlings from stone fruits and local persimmon seeds	Number	2017	1	3
		Evaluate vegetable varieties	Number	2017	5	8
		Collection and evaluate indigenous vegetable varieties	Number	2017	1	5
		Evaluate off season vegetable production	Number	2017	0	10
		Conduct research on domestication of important MAP species	Number	2017	3	7
		Develop sustainable harvesting practices for important medicinal plants	Number	2017	0	10
		Develop sustainable harvesting practices of MAP	Number	2017	0	15
		Introduce and evaluate new potato clones	Number	2017	20	50
		Evaluate climate resilient potato clones	Number	2017	0	20
		Conduct multi-location potato varietal trials	Number	2017	3	15

		Evaluate bio fertilizers in rice production	Number	2017	0	2
		Evaluate Organic weed control methods in irrigated rice	Number	2017	0	2
		Evaluate efficacy of bio-pesticides for control of Leaf Miner on Quinoa	Number	2017	0	2
		Evaluate efficacy of bio-pesticides for control of Aphids in Oilseeds and Quinoa	Number	2017	0	2
		Conduct study on Vermi-composting technologies using different raw materials	Number	2017	1	3
		Identify effective bio-fertilizers for enhancing vegetable productivity	Number	2017	0	2
		Identify effective bio-pesticides for organic vegetable production	Number	2017	0	2
		Study the efficacy of wood vinegar for the control of pest and diseases of vegetables	Number	2017	0	1
		Evaluate efficacy of Bio-fertilizers on Potato	Number	2017	0	1
		Evaluate efficacy of Bio-pesticides on Potato blight management	Number	2017	0	1
		Evaluate efficacy of Bio-fertilizers in Nutrient management for MAPs	Number	2017	0	2
		Evaluate efficacy of bio pesticides for the control pest and diseases of MAPs	Number	2017	0	2
		On-station trial on organic weed management in horticulture, field crops and MAPs.	Number	2017	1	3
		On-station trial on different composting methods	Number	2017	0	2
		Conduct Soil fertility, survey, land and nutrient management research	Number	2017	1	5
		Conduct floriculture and amenity landscape research	Number	2017	0	1

		Yield gap analysis of vegetables in Bhutan	Number	2017	0	1
		Yield gap analysis of apple in Bhutan	Number	2017	0	1
	Agriculture technologies generated	Generate PoP for high altitude rice	Number	2017	4	3
		Release of HYV of mustard	Number	2017	2	1
		Generate PoP for sunflower	Number	2017	0	1
		Release sunflower variety	Number	2017	0	1
		Generate PoP for quinoa	Number	2017	0	1
		Generate PoP for grain legumes	Number	2017	0	1
		Release Fruits and nuts varieties	Number	2017	8	12
		Release high yielding vegetable varieties	Number	2017	5	8
		Release blight resistant tomatoes and chillies	Number	2017	0	2
		Generate PoP for important MAP species	Number	2017	4	6
		Release cultivar of potato	Number	2017	5	2
		Generate sustainable harvesting practices for medicinal plants	Number	2017	0	10
		Identify bio-fertilizer for use in cole crops	Number	2017	0	1
		Identify bio-fertilizers for use in field crops	Number	2017	0	1
		Natural pesticides formulation based on locally materials available	Number	2017	0	4
		Generate PoP for plant protection and nutrient management of soil	Number	2017	0	4
		Different methods of weed control technology	Number	2017	0	2
		Technology on Pest and diseases management in crops including potato	Number	2017	0	2
		Generate Soil fertility, survey information, land and	Number	2017	1	3

		nutrient management technologies				
		Generate technology on floriculture and amenity landscaping	Number	2017	0	1
	Agriculture technologies adoption	Promote HYV of mustard	Number	2017	1	2
		Use of bio-fertilizers and bio-pesticide in MAPs	Number	2017	0	3
		Promote oilseeds diversification activities	Number	2017	1	2
		Promote protected cultivation for vegetables	Acre	2017	0	5
		Promote MAP cultivation technologies	Number	2017	3	3
		Promote MAP sustainable harvesting practices	Number	2017	0	10
		Technology transfer on package of practice on newly released cultivars in farmers' fields	Number	2017	9	50
		Promote use of bio-fertilizers on cole crops	Number	2017	0	50
		Promote vermin-composting technologies	Number	2017	0	25
		Promote technology on Pest and diseases management in crops	Number	2017	0	50
		Promote Quinoa processing machines	Number	2017	1	2
		Promote Soil fertility, survey, land and nutrient management technologies	Number	2017	1	2
	Awareness on improved agricultural technologies enhanced	Demonstration through MAP germplasm maintenance	Number	2017	50	150
		Demonstration through temperate fruit plant germplasm maintenance	Number	2017	50	55
		Demonstration through potato germplasm maintenance	Number	2017	5	7
		Seed multiplication of newly released potato cultivars for technology transfer through demonstrations	MT	2017	5	30
		Establish floriculture and amenity landscaping block in the center	Number	2017	0	1

		Demonstration of efficacy of different compost technologies	Number	2017	0	3
		Awareness and educational programs through mass media	Number	2017	4	8
		Develop awareness and information materials on Quinoa	Number	2017	0	2
		Demonstration of Quinoa cultivation to farmers	Number	2017	300	1000
		Demonstration and promotion of grain legumes and pulses	Number	2017	0	4
		Establish demonstration sites	Number	2017	2	4
	Agriculture knowledge and information management improved	Develop organic knowledge management product	Number	2017	0	5
		Develop potato knowledge management product	Number	2017	0	5
		Publish annual report of the centre	Number	2017	5	5
		Publish research articles in BJA	Number	2017	2	10
		Generate regional agriculture database	Number	2017	0	1
		Publish regional cost of production on major commodities	Number	2017	0	4
Enhanced climate smart and disaster resilient development	Climate smart technologies released and adopted	Release climate resilient Rice varieties	Number	2017	4	3
		Release climate resilient Quinoa varieties	Number	2017	0	2
		Release climate resilient vegetable varieties	Number	2017	0	3
		Climate resilient vegetable management technologies	Number	2017	0	2
		Release climate resilient potato varieties	Number	2017	0	2
RNR marketing and value chain enhanced	Agriculture based enterprises established	Develop Medicinal and Aromatic Plants Enterprise	Number	2017	0	3

ANNEXURE 3: DZONGKHAG WISE PRODUCTION TARGET

3.1: Paddy production

Dzongkhag	Unit	Baseline (2015-17)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Bumthang	MT	238	253	241	244	247	250	253
Chhukha	MT	2611	3700	2829	3046	3264	3482	3700
Dagana	MT	5361	6745	5638	5915	6192	6468	6745
Gasa	MT	268	350	284	301	317	334	350
Haa	MT	217	237	221	225	229	233	237
Lhuentse	MT	3606	3760	3637	3667	3698	3729	3760
Monggar	MT	1212	1222	1214	1216	1218	1220	1222
Paro	MT	8668	8820	8698	8729	8759	8790	8820
Pemagatshel	MT	209	367	241	272	304	335	367
Punakha	MT	13564	14663	13784	14004	14224	14443	14663
Samdrupjongkhar	MT	3565	4227	3697	3830	3962	4095	4227
Samtse	MT	9642	12749	10264	10885	11506	12128	12749
Sarpang	MT	6447	9004	6958	7470	7981	8493	9004
Thimphu	MT	1326	1353	1332	1337	1342	1348	1353
T/gang	MT	5142	6270	5367	5593	5819	6044	6270
T/yangtse	MT	3747	4200	3838	3928	4019	4109	4200
Trongsa	MT	2861	3200	2929	2996	3064	3132	3200
Tsirang	MT	4966	6000	5173	5380	5587	5793	6000
Wangdue	MT	8540	11717.5	9176	9811	10447	11082	11718
Zhemgang	MT	1722	2201	1818	1914	2010	2105	2201
FMCL	MT	83913	1500	-	-	-	-	-
Govt. farm	MT	-	288	-	-	-	-	-
Total	MT	83913	102827	87696	91478	95261	99044	102827

3.2: Maize Production

Dzongkhag	Unit	Baseline (2015-17)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Chhukha	MT	3652	3653	3652	3653	3653	3653	3653
Dagana	MT	6477	7530	6688	6898	7109	7319	7530
Haa	MT	158.0	189	164	170	177	183	189
Lhuentse	MT	3927	4200	3981	4036	4091	4145	4200
Monggar	MT	15958	17106	16188	16417	16647	16876	17106
Pemagatshel	MT	5284	7500	5727	6170	6613	7057	7500
Samdrupjongkhar	MT	7636	8357	7780	7925	8069	8213	8357
Samtse	MT	7019	8206	7256	7494	7731	7969	8206
Sarpang	MT	4777	5297	4881	4985	5089	5193	5297
Trashigang	MT	13183	15500	13647	14110	14573	15037	15500
Trashiyangtse	MT	3428	3500	3442	3457	3471	3486	3500
Trongsa	MT	1452	1600	1482	1511	1541	1570	1600
Tsirang	MT	7120	7295	7155	7190	7225	7260	7295
Wangdue	MT	438.3	707	492	546	600	653	707
Zhemgang	MT	5779	5895	5802	5826	5849	5872	5895
Total	MT	86289	96535	88338	90387	92437	94486	96535

3.3: Quinoa Production

Dzongkhags	Baseline (Kg)	Target (Kg)	Annual Increase (Kg)	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Bumthang	20	2000	396	416	812	1208	1604	2000
Chukha	300	5500	1040	1340	2380	3420	4460	5500
Dagana	200	7530	1506	1500	2500	4000	5500	7530
Gasa	20	2000	396	416	812	1208	1604	2000
Haa	300	3000	540	840	1380	1920	2460	3000
Lhuentse	50	4000	790	840	1630	2420	3210	4000
Mongar	300	8500	1640	1940	3580	5220	6860	8500
Paro	100	5000	980	1080	2060	3040	4020	5000
Pemagatshel	100	5500	1080	1180	2260	3340	4420	5500
Punakha	50	5500	1090	1140	2230	3320	4410	5500
Samdrupjongkhar	50	5500	1090	1140	2230	3320	4410	5500
Samtse	200	7500	1460	1660	3120	4580	6040	7500
Sarpang	50	6000	1190	1240	2430	3620	4810	6000
Thimphu	50	4000	790	840	1630	2420	3210	4000
Trashigang	200	3000	560	760	1320	1880	2440	3000
Trashiyangtse	100	4000	780	880	1660	2440	3220	4000
Trongsa	20	2500	496	516	1012	1508	2004	2500
Tsirang	20	6000	1196	1216	2412	3608	4804	6000
Wangdue	100	7500	1480	1580	3060	4540	6020	7500
Zhemgang	50	4000	790	840	1630	2420	3210	4000
FMC	0	50000	10000	2000	10000	10000	13000	15000
ARDCs (including Euglena comp. & LUC Groups	0	162500	32500	12500	37500	37500	37500	37500
Bhutan	2280	311030	61790	35864	87648	106932	129216	151030

3.4: Wheat and other cereals (Barley, Millet, Buckwheat)

Dzongkhag	Unit	Baseline (2015-17)	Target	Y1 2018-19	Y2 2019-20	Y3 2020-21	Y4 2021-22	Y5 2022-23
Bumthang	MT	1376	1556	1412	1448	1484	1520	1556
Chhukha	MT	750	802	760	771	781	792	802
Dagana	MT	516	429	498	481	464	447	429
Gasa	MT	265	262	265	264	263	262	262
Haa	MT	639	918	695	751	806	862	918
Lhuentse	MT	76	81	77	78	79	80	81
Monggar	MT	938	950	940	943	945	948	950
Paro	MT	416	736	480	544	608	672	736
Pemagatshel	MT	261	85	226	190	155	120	85
Punakha	MT	519	713	558	597	636	674	713
Samdrupjongkhar	MT	494	754	546	598	650	702	754
Samtse	MT	486	536	496	506	516	526	536
Sarpang	MT	421	52	347	274	200	126	52
Thimphu	MT	199	203	200	200	201	202	203
Trashigang	MT	378	543	411	444	477	510	543
Trashiyangtse	MT	224	51	189	155	120	85	51
Trongsa	MT	758	867	779	801	823	845	867
Tsirang	MT	215	85	189	163	137	111	85
Wangdue	MT	1106	1268	1138	1171	1203	1235	1268
Zhemgang	MT	384	345	376	368	361	353	345
Total	MT	10421	11235	10584	10746	10909	11072	11235

3.5: Oilseed Production (Mustard, Sunflower & Soyabean)

Dzongkhags	Unit	Baseline (2015-17)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Bumthang	MT	10	15	11	12	13	14	15
Chukha	MT	149	212	162	174	187	199	212
Dagana	MT	122	290	156	189	223	256	290
Gasa	MT	4	5	4	4	5	5	5
Haa	MT	14	17	14	15	16	16	17
Lhuentse	MT	12	12	12	12	12	12	12
Mongar	MT	38	43	39	40	41	42	43
Paro	MT	36	55	40	44	47	51	55
Pemagatshel	MT	15	19	16	17	17	18	19
Punakha	MT	28	28	28	28	28	28	28
SamdrupJongkhar	MT	122	87	115	108	101	94	87
Samtse	MT	128	83	119	110	101	92	83
Sarpang	MT	55	67	57	60	62	65	67
Trashigang	MT	70	91	74	78	82	87	91
TrashiYangtse	MT	3	4	3	3	4	4	4
Trongsa	MT	16	18	17	17	17	18	18
Tsirang	MT	30	30	30	30	30	30	30
Wangdue	MT	47	57	49	51	53	55	57
Zhemgang	MT	19	20	19	19	19	20	20
Total	MT	918	1153	965	1012	1059	1106	1153

3.6: Grain legumes production (Rajma, Mungbean & Lentil)

Dzongkhag	Unit	Baseline (2015-17)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Chhukha	MT	25	38	27	30	33	35	38
Dagana	MT	347	600	397	448	499	549	600
Haa	MT	4	5	4	4	4	5	5
Lhuentse	MT	5	20	8	11	14	17	20
Mongar	MT	487	585	506	526	546	565	585
Pemagatshel	MT	109	200	128	146	164	182	200
Punakha	MT	1	2	1	2	2	2	2
SamdrupJongkhar	MT	78	152	93	108	122	137	152
Samtse	MT	44	100	55	66	77	89	100
Sarpang	MT	100	65	93	86	79	72	65
Thimphu	MT	0	0	0	0	0	0	0
Trashigang	MT	201	250	210	220	230	240	250
Trashiyangtse	MT	24	33	26	28	29	31	33
Trongsa	MT	0.14	3	1	1	2	2	3
Tsirang	MT	106	123	110	113	116	120	123
Wangdue	MT	1	3	2	2	2	3	3
Zhemgang	MT	33	34	33	33	34	34	34
Total	MT	1565	2213	1694	1824	1954	2083	2213

3.7: Vegetable production

Dzongkhag	Unit	Baseline	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Bumthang	MT	1005	1302	1064	1124	1183	1243	1302
Chukha	MT	2654	3124	2748	2842	2936	3030	3124
Dagana	MT	1646	1888	1694	1743	1791	1840	1888
Gasa	MT	274	314	282	290	298	306	314
Ha	MT	2905	3119	2947	2990	3033	3076	3119
Lhuentse	MT	2451	3031	2567	2683	2799	2915	3031
Mongar	MT	3232	4018	3389	3546	3704	3861	4018
Paro	MT	4379	5455	4594	4809	5024	5240	5455
Pemagatshel	MT	1801	2158	1872	1943	2015	2086	2158
Punakha	MT	2997	3658	3129	3261	3394	3526	3658
Samdrupjongkhar	MT	3119	3702	3235	3352	3469	3586	3702
Samtse	MT	2472	2752	2528	2584	2640	2696	2752
Sarpang	MT	1227	1425	1266	1306	1346	1385	1425
Thimphu	MT	3408	4128	3552	3696	3840	3984	4128
Trashigang	MT	4066	4893	4232	4397	4563	4728	4893
Trashiyangtse	MT	3606	4424	3770	3933	4097	4260	4424
Trongsa	MT	1989	2451	2081	2174	2266	2358	2451
Tsirang	MT	3747	4547	3907	4067	4227	4387	4547
Wangdue	MT	10939	12131	11178	11416	11654	11892	12131
Zhemgang	MT	782	914	808	835	861	887	914
Total	MT	58697	69435	60845	62992	65140	67287	69435

3.8: Fruits and Nuts Production

Dzongkhag	Unit	Baseline (2015-17)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Bumthang	MT	103	149	112	121	130	140	149
Chhukha	MT	1013	1323	1075	1137	1199	1261	1323
Dagana	MT	1638	1700	1650	1663	1675	1688	1700
Gasa	MT	9	18	11	12	14	16	18
Ha	MT	324	468	353	382	410	439	468
Lhuentse	MT	333	338	334	335	336	337	338
Mongar	MT	642	775	669	695	722	748	775
Paro	MT	3420	4145	3565	3710	3855	4000	4145
Pemagatshel	MT	589	630	597	606	614	622	630
Punakha	MT	474	581	496	517	538	560	581
SamdrupJongkhar	MT	1817	2004	1855	1892	1929	1967	2004
Samtse	MT	4180	5092	4363	4545	4727	4910	5092
Sarpang	MT	4947	6516	5261	5574	5888	6202	6516
Thimphu	MT	2825	2882	2837	2848	2859	2871	2882
Trashigang	MT	655	1169	757	860	963	1066	1169
Trashiyangtse	MT	260	324	272	285	298	311	324
Trongsa	MT	235	250	238	241	244	247	250
Tsirang	MT	1143	1200	1154	1166	1177	1189	1200
Wangdue	MT	231	300	245	259	273	286	300
Zhemgang	MT	224	250	230	235	240	245	250
Total	MT	25063	30114	26073	27083	28094	29104	30114

3.9: Potato Production

Dzongkhag	Unit	Baseline (2015-17)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Bumthang	MT	5492	6390	5672	5851	6031	6210	6390
Chukha	MT	6223	8614	6701	7179	7657	8136	8614
Dagana	MT	226	366	215	241	281	317	366
Gasa	MT	417	420	418	418	419	419	420
Haa	MT	1883	2613	2029	2175	2321	2467	2613
Lhuentse	MT	1292	1569	1347	1403	1458	1514	1569
Mongar	MT	5336	6974	5664	5991	6319	6646	6974
Paro	MT	4276	4500	4321	4366	4411	4455	4500
Pemagatshel	MT	1591	2043	1681	1772	1862	1953	2043
Punakha	MT	130	200	144	158	172	186	200
Samdrupjongkhar	MT	1550	1899	1620	1690	1760	1829	1899
Samtse	MT	268	373	289	310	331	352	373
Sarpang	MT	140	215	155	170	185	200	215
Thimphu	MT	2167	2210	2176	2184	2193	2201	2210
Trashigang	MT	6039	7365	6304	6570	6835	7100	7365
Trashiyangtse	MT	2719	2906	2756	2794	2831	2869	2906
Trongsa	MT	724	777	735	745	756	766	777
Tsirang	MT	354	500	383	412	442	471	500
Wangdue	MT	14163	15967	14524	14885	15245	15606	15967
Zhemgang	MT	142	310	176	209	243	276	310
Bhutan	MT	55134	66211	57311	59524	61751	63975	66211

3.10: Citrus production

Dzongkhag	Unit	Baseline (2015-17)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Chukha	MT	1192	2623	1478	1764	2050	2336	2623
Dagana	MT	5002	6584	5318	5635	5951	6267	6584
Haa	MT	12	5	10	9	8	6	5
Lhuntse	MT	242	470	287	333	378	424	470
Monggar	MT	2003	3000	2203	2402	2601	2801	3000
Pemagatshel	MT	3247	5303	3658	4070	4481	4892	5303
Punakha	MT	172	336	205	237	270	303	336
Samdrupjongkhar	MT	3683	6293	4205	4727	5249	5771	6293
Samtse	MT	1360	1978	1483	1607	1730	1854	1978
Sarpang	MT	4231	7363	4857	5483	6110	6736	7363
Trashigang	MT	827	1372	936	1045	1154	1263	1372
Trashiyangtse	MT	224	345	248	272	297	321	345
Trongsa	MT	578	600	582	587	591	596	600
Tsirang	MT	4037	5992	4428	4819	5210	5601	5992
Wangdue	MT	191	219	197	202	208	213	219
Zhemgang	MT	1898	3260	2170	2443	2715	2988	3260
Total	MT	28898	45741	32267	35635	39004	42372	45741

3.11: MAPS Production

Dzongkhag	Unit	Baseline	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Chhukha	MT	1494	1908	1653	1717	1780	1844	1908
Dagana	MT	364	367	318	330	342	355	367
Haa	MT	172	227	197	204	212	220	227
Monggar	MT	49	59	51	53	55	57	59
Pemagatshel	MT	418	460	370	393	415	438	460
Punakha	MT	5	5	4	4	4	5	5
SamdrupJongkhar	MT	2270	2276	1973	2049	2125	2201	2276
Samtse	MT	3414	3621	3138	3259	3380	3500	3621
Sarpang	MT	1690	1951	1691	1756	1821	1886	1951
Trashigang	MT	42	45	43	43	44	44	45
Trashiyangtse	MT	28	28	20	22	24	26	28
Trongsa	MT	74	74	64	67	69	72	74
Tsirang	MT	600	833	722	750	777	805	833
Wangdue	MT	39	39	34	35	37	38	39
Zhemgang	MT	146	150	110	120	130	140	150
Total	MT	10804	12044	10389	10802	11216	11630	12044

3.12: Mushroom Production

Dzongkhag	Unit	Baseline (2017)	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Paro	MT	27	28	27	27	28	28	28
Thimphu	MT	6	15	8	9	11	13	15
Chukha	MT	4	30	9	14	20	25	30
Punakha	MT	1	10	3	5	6	8	10
Wangdue	MT	2	10	4	5	7	8	10
Gasa	MT	3	4	3	3	4	4	4
Dagana	MT	6	9	7	7	8	9	9
Tsirang	MT	3	6	4	4	5	5	6
Trongsa	MT	3	5	3	4	4	5	5
Zhemgang	MT	8	10	8	9	9	10	10
Mongar	MT	6	8	6	7	7	8	8
Lhuentse	MT	2	5	3	3	4	4	5
Tashigang	MT	19	19	19	19	19	19	19
Yangtse	MT	1	5	2	2	3	4	5
Pemagatshel	MT	3	5	3	4	4	5	5
SamdrupJonkhar	MT	13	7	12	11	9	8	7
Sarbang	MT	3	10	4	6	7	9	10
Samtse	MT	2	15	5	7	10	12	15
Haa	MT	0.12	2	0	1	1	2	2
Total	MT	112.12	201	130	148	166	183	201

3.13: Agency's Infrastructure development plan

Agency	Activity	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	Plan Outlay (Nu. in Millions)		Priority
							Priority 1	Priority2	
NSSC	Construct Soil Microbiology Laboratory and Bio-fertilizer store						30.00		High
	Equipment for soil, plant, compost, FYM & water analysis							20.00	Medium
	Construction of display hall, preparation room and toilet at NSSC						1.34		High
NPPC	Construction and up gradation of laboratory in the centre							25.00	Medium
	Establish pesticide analytical laboratory						10.00		High
	Strengthening regional pesticide stores with state-of-the-art facilities						20.00		High
	Drinking Water supply in the centre						0.10		High
NMC	Construction of laboratory						19.00		High
	Water supply, chain linked fencing and approach road						2.35		High
	Installation of new transformer						1.00		High
	Strengthening of laboratory facilities for mother spawn production						5.00		High
NSC	Construction of seeds and seedlings stores at Jephu farm						6.00		High
	Establishment of citrus repository in Jachedphu						10.00		High
	Construction of irrigation facilities at Pobjikha						0.50		High
	Installation of misting irrigation in glasshouse at Chunidingkha farm						1.00		High
	Construction of office and meeting hall at Jachedphu farm							2.30	Medium

	Construction of water reservoir and water pump installation at Bondey farm				■		1.25		High
	Construction of drinking water supply at Samtenling farm					■		3.00	Medium
	Installation of drip irrigation system at Samtenling farm			■			0.30		High
	Construction of compost collection shed at Samtenling farm			■			2.00		High
	Expansion of tissue culture laboratory				■		10.00		High
	Construction of irrigation facilities at Bajo farm				■		1.00	0.00	High
	Major renovation of structures (office, staff quarter, glasshouses)			■			13.00		High
ARDC-Bajo	Construction of irrigation pump house and renovation of internal irrigation facilities in Bajo			■			2.00		High
	Up-gradation and Maintenance of citrus repository in Tsirang			■			10.00		High
	Construction of Farm house in Bajo				■		1.50		High
ARDC Samtenling	Renovation of late Dasho Nishoka's office at ARDSC Panbang		■				8.00		High
	Construction of office and meeting hall (packaged with office furnitures)	■					13.00		High
	Construction of staff and ESP quarter in Panbang			■			4.50		High
	Construction of cold storage at ARDC Samtenling					■		10.00	Medium
	Construction of mushroom cropping house at ARDC Samtenling			■			1.00		High
	Construction of seedling hardening shed					■		1.00	Medium
	Procurement of machineries			■			20.00		High
	Procurement of diesel cum motor self-starter generator					■		3.50	Medium
	Major renovation of monsoon affected irrigation channel of ARDC Samtenling		■				2.00		High
	Maintenance of water supply at ARDSC Tingtibi			■			0.75		High

ARDC Yusipang	Major renovation of road						1.72		High
ARDC Wengkhar	Strengthening of National Referee Seed Testing laboratory						14.24		High
NPHC	Major renovation of existing building						5.00		High
CMU	Construction of new bridge and road widening at Nasephel						16.45		High
	Construction of scrap house at regional offices Samtenling & Khangma						1.00		High
	Maintenance of machines for land development						20.00		High
							255.00	64.80	

ANNEXURE 4: VALUE CHAIN DEVELOPMENT PLAN

Output	KPI	Baseline	Target	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	Responsible agency
Output 1.1. Commodity value chain for agriculture produce established	Value chain for agriculture produce developed	n/a	3	0	1	1	1	0	
	Quinoa				1				APD
	Mushroom					1			APD
	Maize						1		APD
Output 1.2. Agriculture based enterprises established	Agriculture Enterprises established	n/a	8	0	1	3	2	2	
	1. Protected cultivation				1				APD
	2. Organic-fertilizer production						1		NSSC
	4. Vermi-compost					1			NSSC
	5. Bio-pesticide production						1		NPPC
	6. Mushroom production					1			NMC
	7. Mushroom spawn production					1			NMC
	8. Cereal processing and value addition							1	NPHC
	9. Floriculture							1	APD

ANNEXURE 5: AGENCY'S RESEARCH AND EXTENSION PROGRAMS PLAN

Output	Agency	Baseline	Target	FY 2018-19	FY 2019-20	YFY 2020-21	FY 2021-22	FY 2022-23
KPI: Number of Agriculture Research conducted		307	427	331	355	379	403	427
Output 1.1: Agriculture research conducted	NSSC	1	10	1	1	1	1	1
	NPPC	6	20	6	6	6	6	6
	NPHC	3	29	3	3	3	3	3
	AMC	6	12	6	6	6	6	6
	NMC	5	16	5	5	5	5	5
	NSC	0	16	0	0	0	0	0
	ARDC Bajo	48	165	48	48	48	48	48
	ARDC Samtenling	3	13	3	3	3	3	3
	ARDC Yusipang	90	259	90	90	90	90	90
	ARDC Wengkhar	376	531	376	376	376	376	376
	Consolidated	538	1071	538	538	538	538	538
KPI: Number of agriculture technologies generated		255	325	255	255	255	255	255
Output 1.2: Agriculture technologies generated	NSSC	0	2	0	0	0	1	1
	NPPC	0	3	0	1	1	1	0
	NPHC	107	130	107	107	107	107	107
	AMC	6	10	6	6	6	6	6
	NMC	2	5	2	2	2	2	2
	NSC	0	10	0	2	3	3	2
	ARDC Bajo	29	35	29	29	29	29	29
	ARDC Samtenling	6	18	6	6	6	6	6
	ARDC Yusipang	55	95	55	55	55	55	55
	ARDC Wengkhar	63	107	63	63	63	63	63
	Consolidated	268	415	268	271	272	273	271

KPI: Number of agriculture technologies adopted		117	162	117	117	117	117	117
Output 1.3: Agriculture Technologies adopted	NSSC	0	0	0	0	0	0	0
	NPPC	4	8	4	4	4	4	4
	NPHC	17	40	17	17	17	17	17
	AMC	0	6	0	0	0	0	0
	NMC	2	10	2	2	2	2	2
	NSC	0	0	0	0	0	0	0
	ARDC Bajo	8	70	8	8	8	8	8
	ARDC Samtenling	0	2	0	0	0	0	0
	ARDC Yusipang	16	114	16	16	16	16	16
	ARDC Wengkhar	2	19	2	2	2	2	2
	Consolidated	49	269	49	49	49	49	49
KPI: Number of demonstration sites and outreach programs established		154	1061	154	154	154	154	154
Output 1.4: Awareness on improved agricultural technologies enhanced	NSSC	10	10	10	10	10	10	10
	NPPC	6	12	6	6	6	6	6
	NPHC	11	45	11	11	11	11	11
	AMC	0	0	0	0	0	0	0
	NMC	5	7	5	5	5	5	5
	NSC	0	0	0	0	0	0	0
	ARDC Bajo	6	132	6	6	6	6	6
	ARDC Samtenling	53	227	53	53	53	53	53
	ARDC Yusipang	111	232	111	111	111	111	111
	ARDC Wengkhar	305	527	305	305	305	305	305
	Consolidated	507	1192	507	507	507	507	507
Number of reports, articles, leaflets and journals on agriculture published/produced		59	114	70	81	92	103	114
Output 1.5: Agricultural knowledge	NSSC	37	45	37	37	37	37	37
	NPPC	3	13	3	3	3	3	3

and information management improved	NPHC	8	10	8	8	8	8	8
	AMC	3	12	3	3	3	3	3
	NMC	2	13	2	2	2	2	2
	NSC	5	21	5	5	5	5	5
	ARDC Bajo	111	46	111	111	111	111	111
	ARDC Samtenling	8	18	8	8	8	8	8
	ARDC Yusipang	7	26	7	7	7	7	7
	ARDC Wengkhar	32	74	32	32	32	32	32
	Consolidated	216	278	216	216	216	216	216

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