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For the distribution of the technologies, each Dzongkhag has extension officer for disseminating seeds varieties. At district level, District Agriculture Officer supported by the Regional RDC coordinates the dissemination. Knowledge of the technology is already raised at the ground level even before the release of the variety. While the country does have an institutional structure in place for development and diffusion of new technologies, but still the diffusion of new varieties remains weak. Therefore, building the dissemination capacity has been the focus of the Ministry of Agriculture and Forests specifically since the past 2-3 years.

Despite being largely an agrarian economy and also having a relatively robust policy and institutional structure governing the sector, there are still barriers dampening the agricultural growth in the country and addressing impacts of climate change on the sector. The institutional capacities of the RDCs are very limited. The research laboratories are outdated with a need for upgrading the equipments and devices. There also exist large financial gaps, with a need for funds to undertake some vital activities. For instance, the financial capacity of the current institutions is very limited and needs to be increased. There is a need for funding to set up research laboratories, and testing institutions, install latest equipment, enhance the human resource capacity and also build collaborations with international research institutions, if needed. There are also limited storage facilities for food, in the country. Food grain losses are observed to be very high in the old storage facilities built many years ago and there is also high management cost associated with these facilities. Storage facilities for horticulture crops like potatoes and fruits across the country are non-existent, this has an impact on the level of food security in the country.

The small land holdings of farmers often act as a barrier for implementation of certain cropping techniques and patterns. Also the subsistence nature of the farming hinders large scale adoption of new technologies in Bhutan. In addition, with the growing consensus on impacts of climate change, the specific research agenda to address effects of climate change on food security has not yet been included in the main policy domain.

1.1.2 Selected Technology

With the above background, together with extensive stakeholder discussions, in the Part I of the TNA report, 10 technologies for climate change adaptation in Bhutan were shortlisted for the agriculture sector. Out of these, 3 technologies were selected through an extensive multi-criteria decision analysis (MCDA), that was used to prioritize technologies through a process that was country-driven, participatory and involved a number of stakeholders. A three day workshop for criteria weighting and technology prioritization was held at Paro, Bhutan.

Agro-forestry, Development of drought resistant and pest resistant varieties of crops and Sloping Agriculture Land Technology (SALT) were the prioritized technologies for the sector. Further information on these technologies is contained in the TNA report.

Out of these three technologies, development of drought and pest resistant varieties of crops was the technology finalized by the TNA Taskforce for preparation of barrier analysis, enabling framework and technology action plan.

According to NAPA, increased occurrence of pests and diseases in various parts of the country have been observed and climate change is suspected to be a major factor in this regard. Further, studies have shown that majority of the total rice growing areas and 51% of the maize growing areas in the country is still planted with traditional varieties of crops and that there are low adoption rates of improved varieties. In this regard, it becomes important that Bhutan moves towards development of drought and pest resistant varieties of important cereals and horticulture crops to ensure food security at the face of changing climate in the nation.

1.2 Action Plan for Drought and Pest Resistant Varieties of Crops

1.2.1 About Drought and Pest Resistant Varieties of Crops

Breeding new and improved crop varieties enhances the resistance of plants to a variety of stresses that could result from climate change such as water and heat stresses and the emergence of new pests. Varieties that are developed to resist these conditions will help to ensure that agricultural production can continue and even

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improve despite uncertainties about future impacts of climate change. Breeding for improved performance under environmental stresses involves activities which accumulate favorable alleles (different forms of a gene) contributing to stress tolerance (Clements et al., 2011). In addition to developing new and improved varieties, the management of crops is equally important to prolong resistance. With good biotic stress management plans – resistance can be prolonged otherwise it has been observed that they do not last long.

Development of new crop varieties requires both traditional knowledge in gene-pool as well as utilization of modern biotechnological processes like transgenic crops and molecular breeding. Conventional breeding requires the identification of genetic variability to drought among crop varieties and introducing this tolerance into lines with suitable agronomic characteristics. Although conventional breeding for drought tolerance has and continues to have some success, it is a slow process that is limited by the availability of suitable genes for breeding and largely limited to exploiting the existing genetic variation in crop plants and their very close relatives.

The development of tolerant crops by genetic engineering, on the other hand, requires the identification of key genetic determinants underlying stress tolerance in plants, and introducing these genes into crops. The physiological response of plants to water stress is accompanied by the activation of genes involved in the perception of drought stress and in the transmission of the stress signal. These set of genes are targeted for replication and amplification of their expression in the new breeds. A major reason for the relatively slow progress in conventional breeding responses to the stresses related to climate change arises from the fact that plant adaptations are not likely to be single gene changes and whole metabolic pathways are likely to be involved¹.

1.2.2 Target for technology transfer and diffusion

The target for diffusion of this technology in Bhutan has been primarily based on the national strategy developed by the MOAF. A country road map paper, '*Impact of Climate Change on Food Security*', prepared for the *Bhutan Climate Summit 2011* identifies climate change as one of the major threats of food security in the country and thereby includes a National Food Security Program.

This program has an overall goal of:

- Ensuring availability of safe and quality food at affordable prices through increased production and diversification of food items by instituting efficient distribution net works and regulation of local supply and imports

Under this program, a Food Availability Program has been prepared with the goal of increasing crop production through development of improved varieties, breeds, and management technologies. One of the key strategies to achieve this goal is through evaluation and adoption of genetic resources resistant to biotic and a-biotic stresses including drought, pests and diseases. The country paper also includes a 10 year roadmap for the same. The roadmap includes specific targets for development of drought and pest resistant varieties.

Based on National strategy of MOAF and in line with plans of the ministry under the 11th Five Year Plan, the TNA consultations agreed on following targets for the diffusion of the technology:

- Develop and promote drought resistant rice varieties for low or wet subtropical zones during the period 2013-2018
- Develop and promote drought resistant varieties of spices (cardamom and ginger) for low or wet-subtropical zones during the period 2013-2018
- Develop disease resistant varieties of rice, maize, potatoes, spices and chilies and fodder for high and mid-altitude zones during the period 2013-2018

Work on the main staples of the country (rice and maize) has already been initiated. However, the country aims to also target other important food crops such as wheat, barley, millets, buckwheat etc. as mentioned above. Table 2 shows the details of geographies and traits of selected crops targeted under the TNA. .

¹ For further details on the technology please refer to the technology factsheet of the, 'Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation', National Environment Commission, Royal Government of Bhutan, 2012

Table 2: Crops and geographical area to be targeted for diffusion and transfer of drought and pest resistant varieties

Crops	Districts	Traits	Status
Rice	Thimphu, Paro	Cold tolerance, Blast resistance	Development in process
	Wangdue, Punakha, Tsirang, Dagana, Chukha,	Blast resistance, Sheath Blight resistance	
	Samtse, Sarpang, Samdrupjongkhar	Drought tolerance, Blast resistance	
Maize	Trashigang, Monger, Lhuntse, Yangtse, Samtse, Tsirang, Dagana, Pemagatshel	Disease (GLS, TLB) tolerance, high protein content	Development in process
Wheat	Haa, Paro, Thimphu	Winter hardiness	To be developed
	Punakha, Wangdue, Tsirang, Dagana	Rust resistance	
Barley, buckwheat	Bumthang, Haa	Disease resistance	To be developed
Millets	S/jongkhar, Sarpang, Samtse, Tsirang, Dagana	Rust resistance, High Yield	To be developed

1.2.3 Barriers to the technology's diffusion

Given the current situation in Bhutan with regard to development and diffusion of drought and pest resistant varieties of crops, in the course of TNA process several barriers have been identified. These barriers are either economic barriers or non financial barriers. The non financial barriers are mostly those associated with the limitations of the current institutional structure, the current policy and regulatory framework or those associated with information and awareness with regard to drought and pest resistant varieties of crops. Based on these identified barriers, suitable enabling measures which will assist the country in overcoming these barriers have also been identified. A brief summary of these barriers and enabling measures is presented here below. These enabling measures have further been defined and elaborated on with concrete action for each in the next section of this report.

1.2.1.1 Economic and financial barriers

The key barrier for research and development on drought and pest resistant varieties of crops in Bhutan is the huge investment costs required for setting of research laboratories, development of human resources and for knowledge transfer in the form of exchange programmes, collaboration with international laboratories and universities. The financial capacity of current institutions such as the RNR RDCs is very limited to carry out the needed activities. Also, many new varieties of seeds need to be transferred from elsewhere into the country. These would then have to be tested on fields before they are distributed to farmers. All this involves enormous cost which has been identified as a significant barrier, hindering the introduction of this technology in the country. It was emphasized that there are large financial gaps and with needs for funds to undertake some vital activities.

1.2.1.2 Non financial barriers

- a) **Institutional barrier:** Among the existing institutions, RNR Research and Development Centres (RDCs) are the oldest dealing with crop improvement research. The National Biodiversity Center (NBC), created in

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1998, serves as the focal centre for Plant Genetic Resources (PGR) and conservation of biological resources. RNR RDCs under the Department of Agriculture are actively involved in development and utilization of crop genetic resources in field crops and horticulture. RDCs are assigned specific commodities such as rice, maize, fruits and vegetables to lead research and development of those commodities. RDCs also maintain small germplasm collections and tree mother blocks for their use. The National Seed Center (NSC) also handles large amount of crop germplasm including that of potato.

Although the country has a relatively well-defined institutional structure in place looking at its seeds sector, amongst the existing institutions there is limited human resource capacity to carry out adequate research and development and more importantly extension activities. In addition, synergy amongst institutions is much desired.

- b) **Policy, legal and regulatory barrier:** Bhutan's overall legal and regulatory framework is quite favorable towards research and development in crops specifically for developing new biotic and abiotic stress tolerant seed varieties. For instance, the Seeds Act has a clear objective to regulate import and export of agriculture seeds, prevent introduction of plants and diseases and to promote seed industry in the country aimed at enhancing rural income and livelihoods. Similarly, standards and guidelines have already been developed for seed production for implementation by the National Seed Centre. To ensure enforcement of the standards, the Bhutan Agriculture and Food Regulatory Authority (BAFRA) has been made the nodal agency. The IPR related issues are addressed by the Biodiversity Act of Bhutan. Thus there is no direct legal and regulatory barrier hindering the development, production and dissemination of new varieties.

However, the task force members and sectoral experts pointed out that there is a need for a comprehensive agriculture sector policy to be developed to act as an overall guidance document for the sector.

- c) **Market barrier:** Access to new seeds of improved strains, especially for the farmers in the remote villages is one of the key barriers in diffusion. Access is an issue largely due to tough topography of the country and is coupled with the limited capacity of the existing institutions to carry out effective dissemination. The Government appointed sales representatives for Geogs(blocks of villages) show less interest in promoting new varieties of cereals particularly rice due to their inexpensive nature, thereby lower incentives for them.
- d) **Technical barrier:** Methodologies used for developing new varieties are old and there is heavy reliance on institutes outside the country for germplasm. The research laboratories are outdated and there is a need for upgrading the equipment there. Inadequate manpower and technical skills in crop breeding and germplasm utilization remain a serious impediment. There is also a need to build institutional capacity within the country in the long run to be able to breed new varieties of seeds independently and domestically.

There is also lack of awareness among stakeholders engaged in germplasm development and utilization on recent technology trends and also international treaties and agreements such as Standard Material Transfer Agreements, Cartagena Protocol, and International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Information dissemination and sensitization of the technical staff to these, could further R&D in the sector and development of more new varieties.

Also, the subsistence nature of farming along with small land holdings hinders large scale adoption of new technologies.

- e) **Social, cultural and behavioral barrier:** In Bhutan, farmers have been developing crop breeds traditionally for generations and hence they may be reluctant to adopt new varieties especially if they require different farming practices and additional investments.
- f) **Information and awareness:** There is in general a lack of awareness, education and information disseminated on new available technologies and their benefits to the farmers, which hinders its uptake. Also farmers often are not acquainted with the methods of multiplying new varieties of crops and have to buy new varieties from the market again and again. The recurring cost of purchase of new varieties of

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these seeds dissuades farmers from adopting the new varieties, thereby preventing its widespread diffusion.

1.2.4 Enabling measures

Based on intensive discussions with experts, extensive secondary research as well as international experience, measures for building an enabling environment for development and diffusion of the technology in a way to overcome the above barriers have been identified. These measures include:

Economic and financial measures

The new technology development would require huge capital costs to enhance the domestic research and development capacity. The domestic financial resources need to be supplemented by international sources to meet the targets. Financial support needs to be sought for:

- Strengthening of research laboratories, universities and other institutions for R&D.
- Development of human resources and technical knowledge
- Knowledge transfer and exchange programmes

Non financial measures

- **Institutional strengthening:** Strengthening the current institutions (such as NSC, RDCs etc) with human resources and required facilities for accelerating research and development for developing new varieties and preserving traditional varieties. This will help build human and technical capacity of institutes at the central and regional level. Built domestic capacity and ability to develop and produce new varieties domestically, without external dependence. Currently, there is too much of reliance on international germplasm and on conventional methods of crossing are practices domestically to produce new seeds. Capacity building of RDCs to undertake extension services for diffusion of seeds. Currently, the existing institutional capacities are limited to undertake large scale production and dissemination for these varieties to farmers.
- **Building Market support:** Reinforcing the current community based model and up scaling new models for production of seeds. The seed production part has been a major challenge in Bhutan. A well defined community based model will ensure large scale production of improved seeds and also build confidence of farmers in these varieties based due to farmer's direct involvement. This could be ensured by formation and strengthening of community groups by RDCs with support from their outreach centres in different geographical regions for specific crops. It is also important to undertake pilot projects and field testing of new varieties. It is important to test the technologies before a large scale roll out to farmers. This will help make modifications, if required, based on learning of the pilot before a large scale roll out.
- **Policy, legal and regulatory measures:** Modifying the current Seeds Rules and Regulation of Bhutan to also focus on other crops in addition to rice and maize. It is also important to bring to focus through policies and regulation on research and development. Strengthening of these policies would go a long way in creating an enabling environment in development and dissemination of such varieties of crops. The policy structure is in place, but it needs to be strengthened to assist focus on development and dissemination of these varieties. There is also a need to develop a comprehensive agriculture development policy. An overall policy for the agriculture sector, would ensure a combined vision for the sector and avoid overlap of responsibilities between different departments and agencies.
- **Information and awareness creation:** Designing and conducting awareness campaigns to spread information about challenges with existing crops and the need to develop and disseminate new varieties of crops that are pest and drought resistant.

1.2.5 Proposed Action Plan for Drought and Pest Resistant Varieties of Crops

In order to develop action plan for development and diffusion of drought and pest resistant varieties of crops, focused sector specific roundtable discussions were held in Thimphu, Bhutan at NEC office. The

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roundtable participants consisted of sectoral experts and representatives from Department of Agriculture under MOAF, Royal Government of Bhutan. Through a technology specific presentation, the roundtable had intensive discussions, which focused on following aspects:

- *Overview of agriculture sector*- discussions were held on relevant institutions, stakeholder networks, policies, acts and regulations governing the sector and likely to facilitate development and diffusions of drought and pest resistant varieties of crops
- *General sector barriers and measures*-this brought forward discussions on general profile of barriers faced in the agriculture sector and the kind of measures that are needed to overcome them.
- *Defining the technology domain*: special focus was given to discussion in terms of defining the technology in a most relevant way given the national circumstances of Bhutan
- *Targets for technology transfer and diffusion*- specific targets were identified for drought and pest resistant varieties of crops. These were based government plans and documents, particularly the 11th FYP and any ongoing or planned government programme for diffusion of these varieties.
- *Barriers to diffusion of drought and pest resistant varieties of crops*- barriers as identified in Part II of the TNA report, were again revisited along with specific enabling measures to overcome them.
- *Proposed Action Plan Framework for Technology development and diffusion*- a draft action plan framework was presented and discussed in detail to aggregate and rationalize themeasures identified to develop national capacities foracceleration of technology development and transfer. The discussion also prioritized and characterized measures for technology acceleration for a national action plan along with estimates of possible technology investment costs.

Based on discussions held at the roundtable, a revised national strategy/action plan was prepared and sent to roundtable participants, especially to the Ministry, for review and comments. Based on which a final prioritized action plan along with national strategy was prepared.

The section brings together the Action Plan which is reflective of the national priorities as those highlighted in the Government of Bhutan Plans, such as the 11th FYP as well as those felt most urgent by TNA Taskforce members and Bhutanese experts.

The Action Plan and thereby the national strategy formulation for the development and diffusion of drought and pest resistant varieties of crops is reflective of national priorities. The budgets of each of these action points are those provided by the Department of Agriculture, Bhutan.

a) Aggregation and rationalization of measures identified for technology acceleration

The list of measures identified for formulation of a national strategy to accelerate the development and transfer of technologies can be seen in Table 3 below.

Table 3: Measures for strategy formulation

Strategic measure	Accelerating innovation RD&D	Accelerating deployment	Accelerating diffusion
Economic and Financial Measure			
Financial support for: •Strengthening R&D •Development of human resources and technical knowledge • Knowledge transfer and exchange programmes	X	X	X
Non Financial Measures			
Institutional			
Strengthening the current institutions for R&D	XX		
Capacity building of RDCs for extension services		X	
Policy, Legal and regulatory			
Strengthen the current Seeds Rules and Regulation of Bhutan and Develop a comprehensive agriculture development policy	X	X	X
Market			
Strengthening of the current community based model and up scaling new models for production of seeds		XX	XX
Pilot projects and field testing of new varieties		X	X
Social, cultural and behavioral			
Awareness campaigns for new varieties		X	X

* Note: This table illustrates for a strategy of acceleration measures according to letters of each square, using the timescale for completion of an action, where:

- Letter "X" refers to measures which need to be started in the short term and carried out within the next five years;

- Letter "XX" refers to measures which can be completed in up to 10 years;

- Letter "XXX" refers to measures longer-term measures which can be planned for completion within 15 years from the current date and also will be used for other technologies below.

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b) Prioritization and characterization of technology acceleration measures for a national plan

Based on the barriers and the enabling measures required for deployment and diffusion of drought and pest resistant varieties of crops in Bhutan, the key action points that are essential and immediate are described in Table 4. These action points are organized in priority, in order to convey the importance of action required.

The proposed measures are aligned with the 11th Five Year Plan of Royal Government of Bhutan to ensure that these measures receive required policy and funding support of the Government.

An immediate step for which is strengthening of the current institutions with human resources and required facilities for accelerating research and development for developing new varieties and preserving traditional varieties of seeds. This has been thought to be extremely crucial to solve the larger food security issues as well as combating climate change. Though this process will be a long drawn one, it is important to start moving in the direction by initiating the planning required for this.

Almost in parallel to this step, there is a need to build capacity of RDCs to undertake extension services for diffusion of seeds in order to ensure large scale production and dissemination for these varieties to farmers. As a next step it has been proposed to strengthen the current community based model and upscale new models for production of seeds. It is expected that a well defined community based model will ensure large scale production of improved seeds and also build confidence of farmers in these varieties, due to farmer's direct involvement.

Following this, and in order to provide the financial strength to undertake the identified activities under the current action plan, it has been proposed to establish a seed development fund using both domestic and international funds. The fund can be provided in form of grant and debt for identified activities and could potentially be created under the existing and proposed policies and programs. The fund could be used to finance activities such as strengthening of research laboratories, universities and other institutions for R&D, development of human resources and technical knowledge as well as needed knowledge transfer and exchange.

In line with this, it is also important to strengthen the needed policy and regulatory support. In this context, the current Seeds Rules and Regulation of Bhutan needs to be modified and a comprehensive agriculture development policy to be prepared for Bhutan. In order to build the confidence in new varieties of seeds it is also proposed to undertake pilot projects and field tests of new varieties. While focussing on establishing a strong policy framework, arranging the necessary finance and creating a community based model, it is extremely crucial to conduct awareness campaigns to spread information about challenges with existing crops and the need to develop and disseminate new varieties of crops that are pest and drought resistant.

The importance of each action point along with the timelines and activities, agencies responsible, potential costs along with indicators of success are defined in the Table 4 below.

Table 4: Technology Action Plan based on measures identified for technology acceleration (in priority)

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S. No	Measure	Why is it important?	Who should do it?	How should they do it?	Time-scale	Monitoring, reporting and verification for measure	Indicators of Success	Estimated costs (*000 USD)	Potential sources of funding/donors
	Strengthening the current institutions with human resources and required facilities for accelerating research and development for developing new varieties and preserving traditional varieties	Help built human and technical capacity of institutes at the central and regional level. Built domestic capacity and ability to develop and produce new varieties domestically, without external dependence. Currently, there is too much of reliance on international germplasm and on conventional methods of crossing are practiced domestically to produce new seeds.	Department of Agriculture (DoA) under the Ministry of Agriculture and Forests (MoAF)	<ul style="list-style-type: none"> - Hiring the relevant technical experts in key institutes including BAFRA, National Seed Centre, Technology Release Committee and RDCs - Identifying equipments/lab requirements, of the institutions for development of technology - Establishing required facilities either through tie-ups with domestic suppliers or international technology suppliers - Acquisition of latest required lab equipments to further research in related areas - Training and other skill development measures for staff in 	2013-2018- the 11th Five Year Plan period	DoA, MoAF	<ul style="list-style-type: none"> - Number of technical experts appointed by 2018 - Number of training programmes and workshops conducted during the period 2013-2018 - Acquisitions of Lab equipments by 2018 - Number of tie-ups established over the period 2013- 2018 	1000	<p>Existing funding programs in Bhutan:</p> <p>Bhutan Trust Fund for Environmental Conservation and UN Capital Development Fund global LoCALprogramme (MoU between UNCDF and GNHC signed);</p> <p>International Adaptation Funding windows:</p> <p>UNFCCC Adaptation Fund; Green Climate Fund; International Climate Fund (UK); International Climate Initiative (Germany); Pilot</p>

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			institutes mentioned above					Program for Climate Resilience under the Strategic Climate Fund within the Climate Investment Funds Framework; Least Developed Countries Fund.
			Collaboration with regional and international research institutes with the RDCs under DoA by - Establishing tie-ups - Defining scope of tie-ups - Promoting exchange of experts on exchange programmes					Government budget appropriated for agriculture sector under the 12 th Five Year Plan.
Capacity building of RDCs to undertake extension services for diffusion of seeds	The existing institutions capacities are limited to undertake large scale production and dissemination for these varieties to farmers.	DoA/RDC	- Design and conduct training and capacity building programmes for RDCs and outreach centres focusing on sales representatives and extension officers - Develop extension and communication materials for the training programmes by Hiring consultants or using in-house	2013-2018	DoA/RDC	- Number of training programmes and exposure visits conducted by 2018	500	

			resources - Undertake exposure visits for extension officers sensitizing the existing and new officers to benefits of new technology				
Strengthening of the current community based model and scaling up new models for production of seeds	The seed production part has been a major challenge in Bhutan. A well defined community based model will ensure large scale production of improved seeds and also build confidence of farmers in these varieties based due to farmer's direct involvement.	RDCs/National Seeds Centre	Formation and strengthening of community groups by RDCs with support from their outreach centres in different geographical regions for specific crops.	2013-2018	RDCs	Number of community groups formed in different regions	50
Financial support for: • Strengthening of research laboratories, universities and other	The new technology development would require huge capital costs to enhance the domestic research and development	DoA, MoAF	Establish a seed development fund using both domestic and international funds. The fund can be provided in form of grant and debt for identified	2013-2018	DoA, MoAF	- Creation of a Fund by 2018	100

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<p>institutions for R&D. • development of human resources and technical knowledge • knowledge transfer and exchange programmes</p>	<p>capacity. The domestic financial resources need to supplement by international sources to meet the targets.</p>		<p>activities. The fund could be created under the Comprehensive Agriculture Development Policy.</p> <p>Estimate the fund corpus based on targets set</p> <ul style="list-style-type: none"> - Identifying potential international agencies/funds to be approached - Developing tie-ups with selected agencies - Formalizing the scope of financing and particular financing mechanism to be introduced through such tie-ups 				
<p>Policy and regulation development - Strengthen the current Seeds Rules and Regulation of Bhutan. - Develop a comprehensive</p>	<p>Strengthen of these policies would go a long way in creating an enabling environment in development and dissemination of such varieties of crops. The policy</p>	<p>DoA lead agency</p>	<p>Identifying specific areas of regulations to be strengthened and development of the comprehensive policy - Consulting relevant experts for amending policies and developing the</p>	<p>2013-18</p>	<p>DoA</p>	<p>- Policy amendments made by 2015 - Comprehensive Agriculture Development Policy developed by</p>	<p>100</p>

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agriculture development policy	structure is in place, but it needs to be strengthened to assist focus on development and dissemination of these varieties. An overall policy for the agriculture sector would ensure a combined vision for the sector and avoid overlap of responsibilities between different departments and agencies.	new policy - Actual amendments of policies in a way to strengthen them	2018				
Pilot projects and field testing of new varieties	Important to test the technologies before a large scale roll out to farmers. Will help make modifications, if required, based on learning of the pilot before a large scale roll out.	RDCs and Dzongkhag	Identifying sites for pilots and field testing - Identifying institutions for conducting the pilots - Seeking source of funding these pilots - Implementing pilots - Monitoring the pilots - Drawing lessons from pilot applications of the	2013-2015	RDCs	Number of pilots implemented by 2015	1000

drought and pest
resistant varieties

<p>Awareness campaigns to spread information about challenges with existing crops and the need to develop and disseminate new varieties of crops that are pest and drought resistant</p>	<p>It is needed to help farmers and technology providers to overcome traditional practices and habits and thus develop faith in new technologies.</p>	<p>RDCs/Dzongkhag</p>	<p>Design awareness campaign for farmers - Clearly identify elements of such campaign - Develop content of relevance to farmers for such campaigns - Collaborate with village level bodies for proper dissemination of information and conducting such a campaign - Broadcast media - Include successful case studies to sensitize farmers</p>	<p>2013-2018</p>	<p>RDCs/Dzongkhag</p>	<p>- Number of awareness campaigns conducted by 2018</p>	<p>200</p>
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c) Finalizing national strategy

Based on priority technology action plans in the sub-sectors, a national strategy and action plan for the drought and pest resistant varieties of crop targets are presented in Table 5.

Table 5: National Strategy (technology transfer and development for adaptation)

Timescale	0-5 years	5-10 years	10-15 years
Large-scale, medium and short-term technology			
<i>Drought and Pest Resistant Varieties of Crops</i>			
Strengthening the current institutions for R&D	X		
Capacity building of RDCs for extension services	X		
Strengthening of the current community based model and up scaling new models for production of seeds	X		
Financial support for:		X	
•strengthening R&D			
•development of human resources and technical knowledge			
• knowledge transfer and exchange programmes			
Strengthen the current Seeds Rules and Regulation of Bhutan and Develop a comprehensive agriculture development policy		X	
Pilot projects and field testing of new varieties		X	
Awareness campaigns for new varieties	X	X	X