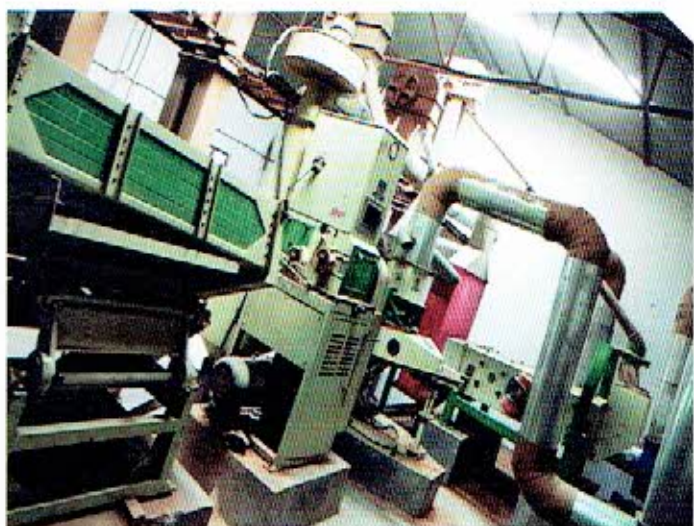


# SEED INDUSTRY DEVELOPMENT IN NEPAL



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# Research and Support Services in Seed Production and Supply in Nepal

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## Abstract

Seed system is one of the most vital components of agricultural system that serves as an important element in strategies for agricultural development, biodiversity conservation and poverty reduction. A strong and effective research and support system is essential to develop and rapidly deploy quality seeds of a wide range of competent choice varieties to farmers. Recently production and supply of seeds is increasing in formal sector in Nepal with a surge of community based and contract seed production led by community groups and private seed companies respectively. The role of private sector is evolving and emerging rapidly with its higher share in the production of commercial seeds and making availability of hybrid varieties in rice, maize and vegetables. The public sector is dominating in supply of varieties and seeds of OPVs including source seed production and supply of major food crops (rice, wheat, maize). Public sector is still a major player for agricultural research and provision of source seeds and support services (subsidies, extension services etc.) including quality assurance services in the country. Despite these positive outlook and initiatives, presently the available options for quality seeds of new competent farmer preferred varieties are limited at the farm level. Available seed varieties supplied in the market, adopted and used by farmers in major food crops are very old that were mostly released during 1990s. Furthermore, the source seeds produced by public research stations and farms are not adequately linked to seed multiplication and marketing chains of the private sectors to multiply and market subsequent cycle of certified and improved seeds. The current research and extension services and public support measures are also inadequate, poorly targeted and ineffective in meeting the quality seed needs of choice varieties to the farmers. Private sector participation and investment in varietal research and development is also limited to meet the diverse seed needs of farmers and stakeholders.

Decentralized production of source seeds and maintenance of varieties in different domains and locations by strengthening private sector's capacity in source seed production and marketing can reduce mis-match in demand and supply and enhance efficiency in production and supply of quality seeds of improved varieties. Similarly, increase availability of competitive varieties and breeding materials through fast track development of crop varieties, development of incentives and legal mechanism for variety development and devolution of source seed production may help improve private sector investment in R&D. In this context strategic efforts and action plans are needed to promote investment in R&D for development and delivery of competent farmer preferred varieties and hybrids. Promoting the development of a strong, dynamic and sustainable seed sector in Nepal will require adoption of public-private partnership in R&D with a coordinated effort between the public and private sectors, where the roles of public and private sector may differ across crops, value chains, production systems and stage of seed industry development. The partnership modality needs to consider the current context and future development that requires use of integrated seed system linking both formal and informal system and use of market and non-market channels. The public sector needs to invest more in plant breeding, varietal maintenance and production of early generation seeds (breeder seed), particularly for open-pollinated varieties of self-pollinated food crops, while private sector research and investment are to focus on hybrids and high value crops that are more efficiently carried out by private sectors.



## 1. Introduction

Seed is the very basis of food security, conservation of biodiversity and vital input for agriculture. It is also a means for the delivery of new technologies and support services to rural areas. Use of quality seeds of improved varieties is necessary to increase crop productivity and income of small farmers. Use of quality seeds also enhances efficiency and productivity of other key inputs such as fertilizers, irrigation and human labour. It is estimated that about 50% of the global increase in yields over the past 50 years has been derived from improved variety (genetic progress) and seed quality, in addition to agronomic improvement and phytosanitary product uses (FAO, 2011). Therefore, an effective and sustainable seed systems can help improve the livelihoods of small farmers and benefit consumers as well, serving as an important element in strategies for agricultural development and poverty reduction (Minot, 2006).

The history of agricultural research and institutional seed system development in Nepal dates back to the late fifties and early sixties when exotic rice, maize and wheat varieties were introduced. Lerma-52, an improved wheat variety was the first officially released and promoted variety in 1960 with formal R&D in Nepal. Since then, several food crop varieties are introduced, introgressed with local landraces and promoted at the farm level. Systematic agricultural research directed for developing and delivering seeds of modern crop varieties in Nepal was initiated in 1972 with the establishment of national commodity research programs for rice, maize and wheat in Parwanipur, Rampur and Bhairahawa respectively. Agriculture Input Corporation (AIC), a parastatal organization was the first formal sector institution to start seed business in Nepal by establishing seed processing plant and seed testing laboratory in 1972 (MoAD, 2013). Nepal Agricultural Research Council (NARC) with its autonomous status since 1992 has been the main public organization in Nepal that conducts agricultural research, develop new varieties and supplies source seeds of improved varieties in the country through its national commodity research programmes, regional agricultural research stations (RA/RS) and central Disciplinary Divisions. Participation of private sectors and non-governmental organizations (NGOs) in seed research and promotion started only after 1990s with the start of liberal economic policy of the Government of Nepal. LI-BIRD, FORWARD and CEAPRED<sup>1</sup> are the three key NGOs engaged in agricultural R&D and seed sector development in Nepal through the resources they obtain mainly from bilateral donors and international development agencies. Since the middle of 1990s, Community Based Seed Production (CBSP) programmes were initiated with the support of I/NGOs particularly through donor funded projects to meet the local seed needs. The major shift in seed business started during the period of Ninth Development Plan (1997-2002) with the initiation of public sector led District Seed Self- Sufficiency Programme (DISSPRO) in 1998 by the Department of Agriculture (DoA), establishment of Seed Quality Control Centre (SQCC) in 2001 and development of a separate public seed company namely, National Seed Company (NSC) as the outshoot of AIC in 2002 (MoAD, 2013). Similarly, private sector participation in food crop seed business with formal registration of seed companies started after the year 2000. Recently, more than a dozen of private seed companies and a large number of seed traders have emerged to undertake seed business (Joshi et al, 2012; Sah and Gill, 2014).

Presently low productivity in agriculture is one of the major problems that the country needs to address to ensuring food security and income needs of ever growing population (ADS, 2014). Low productivity in agriculture is the result of low use of quality seeds of high yielding varieties (HYVs) including other inputs (e.g. fertilizer, irrigation, farm machinery) and production technologies. Considering the importance of quality seeds of improved varieties for increased crop productivity and ensuring national food security, recently Government of Nepal has formulated National Seed Vision (2013-2025)-a seed sector strategy that aims to increase productivity and income of farmers through seed self-sufficiency, import substitution and export promotion (MoAD, 2013). The Vision has ambitious plan of achieving seed replacement rate of 25% in rice, wheat and other self-pollinated crops, 33% in maize and

<sup>1</sup> CEAPRED= Center for Environmental and Agricultural Policy Research, Extension and Development; LI-BIRD= Local Initiative for Biodiversity Research and Development; FORWARD= Forum for Rural Welfare and Agrarian Reform for Development; MoAD = Ministry of Agricultural Development



90% in vegetables through threefold increase in improved seed production by 2025. The Vision has strong emphasis on strengthening domestic capacity of national research, extension and service delivery system to develop, release and make availability of competent varieties and hybrids jointly by public and private sectors. This will require a strong and vibrant national research and support systems that will be able to deliver needed varieties, technologies and technical support service by involving wide range of stakeholders from both public and private sectors.

In this context, this paper aims to make review and analysis of current seed system structure, explore state of provisioning of seed and support service in seed production and supply and identify ways to make it more effective to sustainably increase the scale of production and expand seed business.

The **key questions** to be addressed in this paper are:

1. What is the current status of provision of new seed varieties, other physical inputs and support services for seed production and supply?
2. What are the problems and issues associated with the supply of breeder, source /foundation and improved seeds, and how are they affecting production and productivity?
3. What and how effective are the current support measures to ensure high rates of retention and recycle of source/foundation/improved seeds?
4. What and how efficient are the seed marketing networks and channels?
5. What is the potential for enhancing the role of private sector and other non-state actors (e.g. NGOs and cooperatives) in seed production and supply?
6. What are the key constraints to increased seed production and productivity?

This paper first aims to present current seed system structure and actors and their role in seed value chains involving activities associated with research in varietal development, release, registration, farm level adoption, production and supply of source and commercial (certified / improved) seeds. The second section highlights briefly about status of farm level use of physical inputs and makes analysis of current provision of seeds and support measures. The third section briefly outlines seed marketing systems and channels followed by potential role of private sector and other non-state actors in seed production and supply. The key constraints and issues in effective functioning of seed system as well as constraints to private sector investment in R&D are outlined in fourth section. The final section provides recommendations and action plans for future for sustainable development of seed sector in Nepal.

## **2. Seed System Structure and Organizations**

### **2.1 Seed system structure and role of actors**

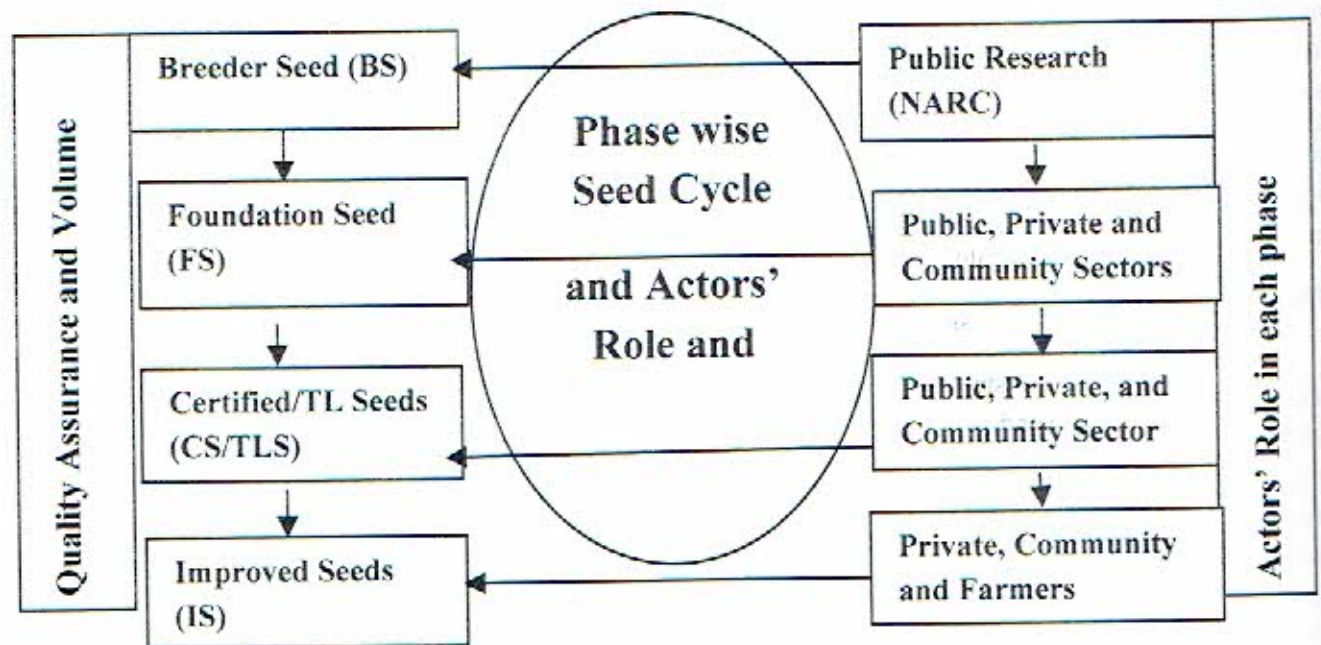
Understanding of seed system structure and actors is essential to provide information about complexity of current seed system structure and role of different actors and sectors in delivering different class of seeds in seed value chains. Presently seed system in Nepal is dominated by production of open pollinated /inbred varieties requiring different stages of seed production and supply. Hence, the seed system structure is complex with rigid phase wise/ cyclic seed production and supply (BS-FS-CS/TL-IS)<sup>2</sup> to meet the needs of required quantity and quality of seeds by involving different sectors and actors in each prescribed seed cycle (Fig 1).

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2 Current Nepalese seed policy has envisaged seed generation model of four years (BS-FS-CS/TL-IS) for the released crop varieties in which either certification or truthful labeling can be opted. However, at present a large share of cereal seed is multiplied and used in three generation (BS-FS-CS/TL) models.



Figure 1: Phase wise seed cycle, seed system structure and role of actors



Source: Author

The dominant key actors in seed value chains involved in the production and delivery of seeds of new varieties are public Rand D agencies (NARC, DoA, NSC), community sectors (CBSP groups, CSB, Cooperatives)<sup>3</sup>, NGOs and private agencies represented by private seed companies, seed dealers and retailers. Variety development, maintenance and breeder seed production and supply are mainly carried out by public research institutions (e.g. NARC). Foundation seed is produced and multiplied by both public (NARC, DoA, NSC) and private sector including the cooperatives/CBSP groups in close supervision of NARC research centers and some NGOs (CEAPRED, LI-BIRD, FORWARD). The commercial seeds (certified, truthful labeled and improved) are mainly multiplied and marketed by private seed companies, cooperatives and community based seed producers groups. The marketing functions are the main domains of private seed dealers, retailers (Agrovets) and seed traders. Therefore, at present no single actor and sector can meet the needs of quality seeds and choice varieties by adopting these phase wise seed cycle to different group of farmers in diversified ecology (hills, mountains, Terai), ecosystems (rainfed, irrigated) and production systems (subsistence, semi-commercial and commercial).

Participation and dominance of specific type of actors in seed value chains depends upon the production system and market accessibility of locations. In commercial market accessible favourable production regions of Terai (Chitwan, Bhairahawa) private sectors are active participants in seed business due to their reliable profit margins from economic volume of seed business. A relatively more number of functioning seed companies and seed dealers are concentrated in these commercial production locations. In semi-commercial production systems of majority part of Terai and market accessible Hills, a small number of private seed actors (e.g. dealers), cooperatives and CBSP groups are participating in seed business. Private sectors are mainly involved in marketing of seeds through contract seed production with farmers and purchase of community produced or publicly produced seeds. Public agencies such as District Agriculture Development office (DADO) through DISSPRO<sup>4</sup> and INGOs through CBSP provide seed money and technical support in seed production, while local private seed companies support community / cooperatives by marketing community produced seeds. In subsistence, risk prone and market inaccessible regions such as remote hills and mountains presence of both public and private sector is very much limited in formal sector seed production due to uneconomic size of seed demand and remoteness to provide technology (high yielding

<sup>3</sup> CBSP=Community based Seed Producer Groups; CSB= Community Seed Bank.

<sup>4</sup> DISSPRO= District Self-Sufficiency Program; SQCC=Seed Quality Control Centre



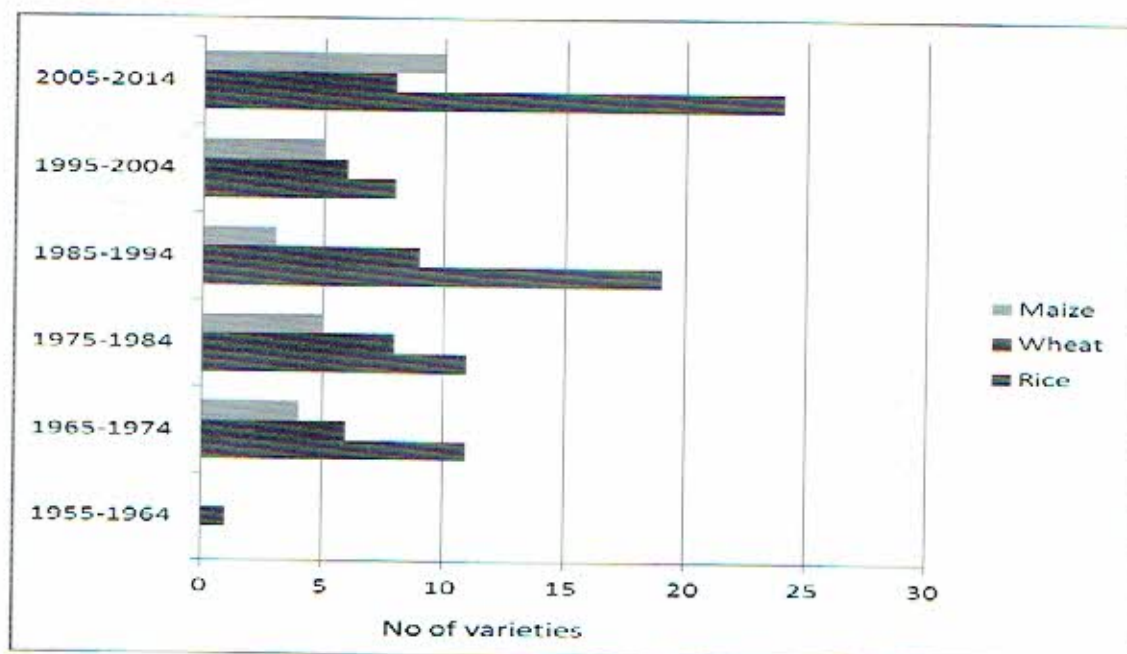
variety seeds) and technical support services. Hence, informal farmer based seed system is dominant in these remote and subsistence production systems.

## 2.2 Varietal development and release pattern

Status of varietal development and release by the research system is an indicator of available varietal options for seed producers, suppliers and farmers in the country. Improved varieties are released rapidly by national research system as a measure of their success of the program (Evenson and Gollin, 2003). Until 2014 the R&D agency in Nepal has developed, tested and officially released and registered a total of 609 crop varieties with release of 257 and registration of 352 varieties (SQCC, 2014). Out of the release list, 35 crop varieties are denotified resulting in a total of 574 crop varieties (222 release and 352 registered) presently in use. Figure 2 presents the list of only released crop varieties per decade over the last 60 years since the beginning of agricultural research in Nepal. The analysis indicated that, the highest numbers of crop varieties were released during the recent decade (2005-2014) with the release of 24 varieties in rice, 10 in maize and 8 in wheat. A fairly good number of rice varieties were also released during 1985-1994. Average number of varieties released per year was 1.5 for rice, 0.6 for wheat and 0.5 for maize. This indicates that presently, farmers' choice of new improved varieties from official released sources is limited to farmers due to slow release and ineffective deployment of the new variety seeds at the farm level.

Similarly, when we use the number of varieties released by the public sector for the given cultivated area of the major food grain crops as indicators of varietal choices to farmers, it comes that there is about 1 variety in each 20,000 ha for rice and wheat crop, and it is one variety per 32,000 ha for maize. The figures are low to provide adequate choices to farmers considering the prevailing huge diversity of agroecological conditions, production systems and socioeconomic circumstances of the farmers in Nepal.

Figure 2: Pattern of release of major crop varieties in Nepal (1955-2014)



Source: Compiled from various MoAD and NARC sources

## 2.3 Hybrid and OPV registration

Recently with the liberal economic policy and country's increased focus on seed sector development, there is a surge of registration of hybrids in vegetables, rice and maize including open pollinated varieties (OPV) in some



crops from private sectors to provide options to farmers particularly in market accessible locations and production domains. Registration of hybrids and OPV are mainly initiated since 2010 from the private sectors. Until the end of 2014, there are about 352 varieties (hybrids and OPVs /inbreds) registered in crops comprising of 292 in vegetables, 37 in maize and 18 in rice, two each in potato and rapeseed and one in cowpea for cultivation in different domains and conditions. Even though there has been a surge in registration of exotic hybrids recently after favourable policy shift, the registration of local farmer varieties (landraces) is very much limited from both public and private sectors. Table 1 presents release and registration of crop varieties and annual rate of variety notification for the last 55 years (1960-2014) including for a recent 10 years (2005-2014). When both public and private sector released and registered varieties are aggregated for the last 55 years, the annual rate of variety released /registered is about 2 for rice, 1 for maize, less than 1 for wheat but about 6 for vegetable. The pace of notification of crop varieties has surged in the recent decade (2005-2014), with annual rate of release and registration of 4 varieties for rice and maize and 29 varieties for vegetables. This indicates that varietal options mainly hybrids is quite high for vegetables, a fairly good number for rice and maize with the increasing participation of private sectors in hybrid variety registration. The details of varieties released and registered by crops as well as sectors (public or private) is given in Annex 1 and 2.

**Table 1:** Release and registration of crop varieties (1960-2014)

Crops	Total varieties	Inbred / OPV	Hybrids	Annual average rate of release and registration (1960=2014)	Annual average rate of release and registration (2005-2014)
Rice	91	74	17	1.65	4.1
Public sector	70	70	0		2.4
Private sector	21	4	17		1.7
Wheat	35	35	0	0.64	0.8
Public sector	35	35	0		0.8
Private sector	0	0	0		0
Maize	63	29	34	1.15	4.4
Public sector	25	22	3		1.2
Private sector	38	6	32		3.2
Vegetables	328	36	251	5.96	29.1
Public sector	37	36	1		0
Private sector	291	41	250		29.1

Source: Compiled and estimated from SQCC (2014)

## 2.4 Pattern of farm level diffusion and adoption of crop varieties

Information on actual farm level adoption and diffusion of type and age of varieties is essential to understand the type of varieties that are available to farmers. The adoption study of crop varieties recently for major crops in Nepal revealed that older varieties released before 1990s dominate the farmer fields. The varietal age of most of these commercially produced, marketed and distributed varieties are above 15 years, as they were released before the year 2000. A recent IRRI-NARC led household survey findings of rice crop under STRASA and TRIVSA projects<sup>5</sup> in Nepal revealed a prevalence of older varieties with 12 years of adoption lags and 18 years of weighted varietal age in farmers' fields were released in a recent decade (2000-2009) indicating only about 1% annual replacement of new varieties (Gauchan et al., 2012, Gautam et al., 2013, Velasco et al., 2013). Only 10% of the rice varieties adopted in farmers' fields were released in a recent decade (2000-2009) indicating only about 1% annual replacement of new varieties (Gauchan et al., 2012) The dominant rice varieties in farmers' fields during 2011-12 survey were Radha-4 (released in 1994), Sabitri (released in 1979), Sona Masuli (released in India in 1982), Mashuli (released in 1973)

5 STRASA=Stress-tolerant rice for Africa and South Asia; TRIVSA= Tracking rice variety for south Asia; CIMMYT= International Maize and Wheat Improvement Centre; IRRI= International Rice Research Institute



and Khumai-4 (released in 1989). The seed sales data based on nationwide dealers survey (Gauchan et al, 2014) and source seed demanded in national balance sheet for the last three years (2012, 2013, 2014) also indicate similar pattern (SQCC, 2014). The average share of seed sale by seed dealers across the country (N=240 sample survey of seed dealers) for newly released varieties in rice in 2013 was about only 10% of the total sale indicating over 90% of the seed sold were of older generation released before 2000. This happens since seed companies and most of the community sectors are producing and multiplying seeds of dominant old varieties because of their high market demand, high profit margin, and low risk of marketing and poor access of new competent varieties in seed chain. A recent Expert Elicitation adoption study of maize and wheat in Nepal coordinated by Michigan State University and CIMMYT with NARC in Nepal also showed that older varieties released early 1980s and 1990s are dominant in Nepal (Gauchan et al forthcoming). Rampur Composite (released in 1975), Arun-2 (released in 1982) are still two dominant old varieties in maize. Similarly older wheat variety NL-297 (released in 1985) is dominant variety with nearly half of the wheat seed sales come from this single variety from National Seed Company in 2013-14 (N. Jha personal communication) in the country. Old varieties released 20-30 years ago are still predominant in the country indicating inefficiency of research and extension system in developing and delivering new choice varieties to farmers. Slow replacement of older varieties with newer ones in farmers' fields delays the transfer of benefits of varietal development research to farmers and heightens the risk of disease epidemics, especially with limited diversification of varieties (Brennan and Byerlee, 1991).

## 2.5 Status of seed production, supply and seed replacement rate

The status of seed production, supply and actual seed replacement rate (SRR) for major crops is presented in Table 2. The data show that the current SRR in major food staple is low (11-13 %) indicating low use of quality seeds of improved varieties. In vegetables, however, seed replacement rate is quite high because of the use of hybrids in commercial production pockets. In the last one decade the trend of SRR in major cereal (rice, maize, and wheat) has increased from less than 3% in the year 2000 to about 12% in 2013, indicating a gradual rise of formal supply of quality seeds in the country. If this trend continues to grow, there is a scope to meet the projected target of National Seed Vision-2025 which aims to achieve 25 % SRR for self-pollinated crops (rice, wheat); 33% for cross pollinated food crop (maize) and 90% for vegetables.

**Table 2:** Seed production and seed replacement rate in major crops 2013-14

Crops	Production (MT)			Seed Replacement Rate (SRR)	
	Private	Public	Total	Current SRR (%)	Projected Optimum SRR* (%)
Paddy	8676	862	9537	13	25
Wheat	6687	3529	10216	11	25
Maize	2328	2	2330	11	33
Vegetables+	1100	500	1600	73	90

Source: SQCC (2014) and SPAN+ (2014); \*National Seed Vision 2013-2025 projection

The demand for seed exhibits strong inter-annual fluctuations due to seasonality of production and rainfed uncertain production system prevailing in Nepal. As a result there is lack of sustained market demand and use of improved seeds. Due to lack of market intelligence and effective market monitoring mechanisms, DADOs, seed companies, and other seed producers are not able to accurately assess and determine variety and seed demands. The farmers and seed actors also make seasonal changes in demand in terms of varieties and quantity due to the introduction of new varieties and hybrids, uncertain weather conditions, and/or other factors. Estimates show that current production of seed is not adequate to meet the increasing demand of high yield varieties and hybrids in major food crops and vegetables. As a result farmers resort to imported seeds of hybrids and OPVs in rice, maize and vegetables. A recent study showed that a large proportion of rice area (25%) mainly in Terai in 2010 (Gautam et al, 2013) and 21 %



of rice seed sold by seed dealers in 2013 was informally supplied varieties and hybrids (Gauchan et al, 2014). As Nepal's present domestic capacity of hybrid seed production is limited to few crops, mainly tomato, the import of hybrid seeds constitutes a substantial part of total imports. Estimates show that hybrid seeds in vegetable occupy about half of the total import by volume and two-third of the import by value (SEAN, 2013). The imported hybrids in rice constituted about one tenth of the total formally supplied seeds in rice in 2013 (SQCC, 2014; Gauchan et al, 2014).

## 2.6 Pattern of source seed demand and supply

The analysis of status of supply of breeder, foundation and improved seeds and status of current SRR is needed to understand specific problems and gaps in fulfilling required demand. The demand for source seeds (breeder and foundation) in Nepal for various actors from public, private and community sectors are generally made in national Seed Balance Sheet. Private seed companies are major actors demanding source seeds for Terai and market accessible and favourable production regions of Hills. Cooperatives and CBSP groups make demand for source seeds for some parts of Terai and Hills. Presently NARC is the sole supplier and source of breeder seeds to private seed companies and community organizations (CBSP groups, Cooperatives) for the domestically developed varieties in food crops (rice, maize, wheat, lentil, oilseeds). For vegetables, NARC share of source seed is small and limited to few vegetable varieties and hybrid. The share of source seeds from DoA farms is relatively high, even though private and NGO sector particularly CEAPRED also contributes 10% of the total share in source seeds of vegetable (CEAPRED, 2014).

The data in Table 3 show actual quantity of source seed demand from various stakeholders and actual production and supply in NARC stations and DoA farms. NARC is a sole public sector research organization producing breeder and foundation seeds for food crops and some vegetables in Nepal. Foundation seed is also produced and supplied mainly by DoA, particularly in vegetables. A small portion of foundation seed is also produced by private companies and community sectors in collaboration and technical support of NARC. The data reveal that the production and supply of source seed is far higher than actual demand made for the year 2012/13. The production and supply of breeder seeds is nearly two to three times or even higher than actual demand while the supply of foundation seeds (except for wheat) is nearly double to that of current demand in 2012/13 for rice and maize. Moreover, the demand for breeder and foundation seed are inconsistent over the years with varying demand by specific regions and ecologies due to variability in production of specific varieties as a result of drought, scarcity of fertilizer and farmers own saving and exchanges of previous years' seeds.

**Table 3:** Status of demand and supply of breeder and foundation seeds in Nepal (2013)

Crop	Demand		Production/Supply		Difference (+ over supply; - under supply)	
	Breeder seed	Foundation seed	Breeder seed	Foundation seed	Breeder seed	Foundation seed
Rice	7.4	231.5	22.63	419	15.23 (206)	187.5 (81)
Maize	0.73	41.21	7.84	78.95	7.15 (967)	37.74 (91.6)
Wheat	22.72	427.7	29.30	403.69	6.58 (28.9)	-24 (-6.0)
Vegetables	0.054	NA	NA	10.0	-	-

*The figures in parentheses indicate percent of the total*

*Source: Compiled from NARC (2014), SQCC (2014), VDD (2013)*

Since, public sector mainly NARC is the major supplier of source seeds in major food crops, the role of public sector is critical in sustaining and facilitating seed business of private seed companies, cooperatives and CBSP groups by supplying source seeds of publicly bred varieties. Estimates show that if this current production and



availability of source seeds are used in proper seed chains, the quantity available is adequate to meet projected seed replacement rate of 25% for rice and wheat and 33% for maize. However, the current oversupply of breeder and foundation seed has been misused without using them in subsequent prescribed seed multiplication chains to multiply and market for the production of commercial (certified and improved) seeds. They are either directly used in food grain production or for the production of improved seeds without using them in foundation or certified seeds. This occurs because of inadequate planning, lack of effective demand collection, and poor incentives for source seed production and marketing, including lack of adequate varietal options for different ecosystems, regions and socioeconomic circumstances of farmers.

Furthermore, the source seeds produced are not adequately linked to seed multiplication and marketing chains to multiply and market for the production of subsequent cycle of certified and improved seeds. There is no policy for advance payment for breeder seeds and official enforcement of timely collection and lifting out the breeder seeds. There are also no legal sanctions or penalties for breaking demand or purchase agreements. As a result, there is a high mismatch of the demand, production and timely marketing of source and improved seed.

## **2.7 Source seeds demand and popularity of major crop varieties**

Despite public sector release of fairly good number of varieties in major cereals (e.g. rice =73; wheat=36 and maize=27) and significant number of registration of hybrids in rice, maize and vegetables, about half of them are only demanded in the market. A recent (2013/14) national Seed Balance Sheet record of National Seed Board (NSB) indicates that only half of the officially released varieties of major cereals seeds are in demand for source seeds in the country (SQCC 2013). This indicates that, a large number of varieties are either not popular in farmers' fields or locally produced to meet local needs. This suggests a mismatch between farmers' requirements and the varieties on offer (Joshi et al., 2012).

The analysis of varieties produced and marketed by different seed enterprises in different regions also indicated that a handful of varieties (not more than one dozen) dominate seed industry. For instance, about 85% of the foundation seed demand indicated in national seed balance for rice in 2013 (SQCC 2013) is for 10 varieties namely Radha-4, Sabitri, Hardinath-1, Makawanpur-1, Radha-12, Khumal-4, Ram Dhan, Masuli, Shamba Sub-1, and Swarna-Sub-1. Similarly in wheat, Gatuum, NL 297, Bhirkuti, WK 12 and Vijaya are major demanded popular varieties, while in maize, Rampur composite, Manakamana-3, Deuti, Aurn-2, are popular among farmers. In vegetables, Shrijana hybrid tomato is popular in Hills of Nepal. A recent expert elicitation study led by IRRI-NARC for rice and CIMMYT-MSU-NARC for maize and wheat study in Nepal also indicated that there are few varieties being popular in Nepal with their regional adaptation and demand (Gauchan et al, forthcoming). This indicates that there are limited choices of demanded varieties for subsequent seed multiplication to provide diverse options to farmers.

## **3. Status of Provision of Inputs and Support Measures**

### **3.1 Status of provision of key physical inputs**

Easy access, availability and increased use of the improved seeds and other physical inputs (fertilizers, pesticides, agricultural machinery etc.) are important to promote sustained use of new improved quality seeds and technologies for increased productivity and profitability. The major physical inputs used for crop production are; seeds, fertilizers (chemicals and organics), pesticides, irrigations, agricultural equipment and machineries. Table 4 presents percent households using major physical inputs mainly seeds, fertilizers and pesticides in crop production in Nepal as estimated from recent national sample census of agriculture (CBS, 2013).



**Table 4:** Household percentage with the type of physical inputs used in agriculture production (2011/12)

SN	Physical inputs	Rice	Maize	Wheat	Potato	Sugarcane	Vegetables	Other crops
1	Use of local seed	68.16	81.93	68.77	71.76	66.28	75.43	93.60
2	Use of improved seed	26.43	12.89	31.23	25.97	33.72	19.89	5.95
3	Hybrids	5.41	5.19		2.27	0.00	4.68	0.46
4	Pesticides	29.04	8.68	16.39	27.84	36.02	15.87	7.41
5	Use of chemical fertilizers (irrigated)	21.46	3.00	22.44	8.77	23.48	3.57	4.09
6	Use of chemical fertilizers (unirrigated)	5.95	2.62	4.51	2.75	9.15	1.41	1.32

*Source: CBS (2013)*

The data show that only one fourth to one-third of the households use improved seeds, fertilizers and pesticides in rice, wheat and sugarcane, while it is very low for maize. The use of fertilizer is low in rainfed conditions in all the crops. About 5% of the sample farm households use hybrids in rice, maize and vegetables. In addition, the same sample survey of agriculture also showed that proportion of sample farm household using farm machineries mainly tractors and power tillers, thresher, pumping sets, and shallow tube wells constituted about 24%, 21%, 14% and 9% respectively. Even though, the use of farm machinery has increased recently as compared to last sample survey in 2001, the proportion of farm households using these machinery is confined to Terai and market accessible regions of hills (Gauchan and Shrestha, 2014).

The key actors in delivering physical inputs vary by the type of institutions/organizations. For seeds, National Seed Company (NSC) and Salt Trading Company (STC) are the main public agencies supplying certifying and improved seeds in the country, while NARC research centers and DOA farms are supplying source seeds. NSC is implementing seed subsidy schemes in partnership with various seed actors including participation of private seed companies. Presently NSC is a major supplier of wheat seeds in the country. Rice seed is supplied by NSC, private seed companies and community sectors (cooperatives, CBSP groups.). For maize seeds, OPVs are mainly supplied by domestic seed companies, cooperatives and CBSP groups supported by HMRP and DADO, while hybrids are supplied by dealers, importers and Agrovets. Vegetable seeds are presently mainly supplied by private sector agencies (SEAN, Agrovets) and NGO (mainly CEAPRED through Vegetable Seed Production Project (VSP)).

Agricultural Inputs Company Limited (AICL) is the sole public sector agency importing and delivering chemical fertilizers in the country. However, for the supply of organic fertilizers, there are some new actors /entrepreneurs emerging in the country. Agrovets are the main private sector dealers and retailers dealing with seeds, pesticides, fertilizers, veterinary medicines (including some agricultural machinery) and provisioning of technical services and information in the use of these physical inputs and technologies. Some of the public agencies are also involved in supply of selected physical inputs such as farm machinery, micro-irrigation through different national directorate and offices. Department of Agriculture (DoA) through Directorate of Agricultural Extension is providing micro-irrigation support, Directorate of Agricultural Engineering is supporting for agricultural machineries, and Crop Development Directorate (CDD) is facilitating and supporting field implementation of seed related programs and agricultural machineries. Seed Quality Control Centre (SQCC) and Regional Seed Testing Laboratory (RSTL) of the MoAD are providing quality assurance services (seed testing, field inspection and information support) and monitoring services to ensure production and supply of quality seeds. Information related to varietal characteristics, seed quality attributes and related information are also provided by research centres and Disciplinary Divisions (Seed science, Biotechnology, Gene Bank etc.) of NARC. Some private sector and NGO laboratories such as SEAN and CEAPRED respectively also provide seed testing laboratory and quality assurance services to seed producers and suppliers.



### 3.2 Current support measures for physical inputs and seed provisioning

Public support in terms of incentives, information and infrastructure is essential for the growth of seed sector. Presently, the public sector is supporting seed systems notably by conducting research in breeding, by carrying out varietal development, by organizing (and subsidizing) seed quality control, or by promoting quality seed and improved varieties. Policy and legal frameworks are also supporting and facilitating investment in breeding and seed production, providing access to plant genetic resources, protecting breeders' rights, and ensuring seed quality control (Louwaars and De Boef, 2012).

Government of Nepal (GoN) is providing subsidies and support measures on physical inputs and seed production. The objective of support measure is to promote use of quality seeds of improved varieties and other physical inputs (e.g. fertilizers, pesticides, farm machinery) in affordable price to farmers for increasing productivity and ensuring food security. It also aimed to stimulate input market development for commercialization of agriculture by offsetting high initial distribution costs until the market expands, economies of scale are realized, and prices decline (World Bank, 2008). In the fiscal year (2013/2014) the Government of Nepal allocated NRs. 6.07 billion as subsidies for key physical inputs (i) chemical and organic fertilizer, (ii) improved seed and (iii) mechanization of agriculture. The subsidies are on price and transportation of inputs mainly fertilizers and seeds. GoN provides subsidy on fertilizer and seed transportation from road head to district headquarter for the remote Mountain and mid hill districts, which has been in operation since 1972 (FIDA, 2012). Government has also introduced incentive schemes and programs to promote investment in the agriculture which include price and transport subsidy on fertilizers, subsidy on premium (75% subsidy on premium) for agricultural insurance, subsidy on use of organic fertilizers, bio-pesticides and farm machinery, incentives for mechanization of agriculture (relaxation on import duty for agricultural machinery such as tractors), incentives for opening up agro-enterprises especially targeted to young people, land ceiling waiver for agro-enterprises and provision of special soft loans for agriculture through Nepal Rastra Bank (NRB) directives (GoN, 2014).

### 3.3 Support measures and services targeted for seed production and supply

The major support services currently used in seed production include research and extension promotional activities (e.g. demonstration, Minikits, seed kits), price and transport subsidy on seeds, quality assurance services, regulation on import and export, training and networking, infrastructural support (storage, equipment etc.) and information support services on quality seeds, new varieties and their availability. The major support measures and services targeted to seeds are briefly outlined below.

#### 3.3.1 Seed promotional packages and demonstration

Seed promotion packages and demonstration programs for new seed varieties are the means for delivery of new agricultural technologies and the measure of support for agricultural development. At present public sector institutions (NARC, DoA), I/NGOs and private seed entrepreneurs provide new seed packages of improved varieties and hybrids for testing, demonstration and adaptation to specific environments. NARC research organizations including some NGOs (LI-BIRD, FORWARD, CEAPRED etc.) provide seeds of popular pre-release and newly released varieties in the form of seed kits (PVS, FATs, IRD)<sup>6</sup>, while DOA and many local NGOs and rural developmental organizations provide seed Minikits (seed kits) and saplings for popularization, acceptance and support measures. Many of the seed support schemes are provided as an incentive for adoption and adaptation of new crop varieties. Support of seeds and saplings are also provided as a relief measures for the loss of crops in the previous seasons due to drought, flooding and other reasons. Special support of seeds, saplings and technical support are made to farmers in production pockets and Mission programs.

6 PVS= Participatory Variety Selection; IRD= Informal Research and Development; FAT= Farmers' Acceptance Test;



### 3.3.2 Price and transport subsidies on seeds and saplings

Government of Nepal (GoN) has recently (since last 3 years) initiated price subsidy on seeds for major food staples (rice, wheat and maize) and being implemented through state owned National Seed Company (NSC). About 120 million rupees were allocated for seed subsidy in 2013/14 (GoN, 2014). Seed subsidies are provided mainly for major crops (rice, wheat, maize) through NSC by purchasing improved seeds from private seed companies and cooperatives. The actual price subsidy on seeds was about 20-35% depending upon crop variety types. The estimates showed that about one third (33%) of total marketed rice seed, two third of wheat seed (67%) and 43% of maize seeds by volume were sold on subsidy programs through NSC in 2013/14 (SPAN, 2014). Subsidy on source seeds and provision of revolving fund (seed money) to community based organizations (DISSPRO/CBSP groups, Cooperatives) for seed production has been in place for the last more than one decade. The extent of subsidy is 50% for the price of source seeds and 100 % for transportation of seeds to remote areas (Bhattarai and Bista, 2013).

There is a provision of transportation subsidy of seeds and saplings of fruit trees and cash crops in priority production pockets and mission programs. Presently the program is being implemented in 26 remote districts as per the *Chemical Fertilizer and Seed Transportation Subsidy Directive, 2003 (2059)* for Nepal (FIDA, 2012). The subsidy schemes for seed and saplings is administered through District Agriculture Development Office (DADO).

### 3.3.3 Infrastructure support (storage, processing, tillage / transport equipment)

Recently Government of Nepal and various donor funded projects are providing seed infrastructure support to Cooperatives, Community based Seed Producer (CBSP) groups, Community Seed Banks (CSB) and private entrepreneurs in seed production and marketing on competitive performance basis. The community organizations and seed entrepreneurs who have shown promises in enhancing their seed enterprises are receiving grant support on competitive basis mainly on establishing seed storage, seed processing structure and equipment, threshing floor, tillage and transport equipment (e.g. tractor). Agriculture Engineering Directorate of DoA, donor funded projects (PACT, HVAP, HIMALI)<sup>7</sup> and some I/NGOs through donor funded projects (VSP, HMRP, RIU etc.) have provided these seed infrastructural support to selected seed actors. DoA and some I/NGOs also provide seed money or revolving fund (matching fund) for starting seed business to selected potential groups and cooperatives.

### 3.3.4 Support on training, networking, information and capacity building

Public and private sector organizations have recently putting their increasing focus on training, networking and capacity building support to farmers, farmers' organizations (CBSP groups, Cooperatives) and seed entrepreneurs in seed enterprise development in Nepal. DOA through DADO offices provide technical support in formation and mobilization of DISSPRO groups and provide orientation /training for seed production and marketing. I/NGOs provide support in establishment and strengthening of CBSP groups. NARC and DoA provide technical support through various donor funded projects (HMRP, IWRMP, Safety Net, KISSAN, CSISA, STRASA, *Kissanka Lagi Unnat Biu Bijan Karyakaram*, AFSP, GEF Local Crop, and VSP) in source seed production and supply. International Agricultural Research Centres of CGIAR such as CIMMYT, IRRI, IFPRI and Bioversity International have also been providing technical support and services through public R&D organization (NARC, DOA, and MoAD), NGOs (LI-BIRD, CEAPRED, FORWARD) and community based organizations. SQCC/ NSB also provides information support for balance sheet preparation on source seeds, seed planning meeting for source seed production to different seed stakeholders and entrepreneurs. MoAD, NARC and DoA provide technical and marketing information through radio, weekly agricultural

<sup>7</sup> PACT= Project for Agriculture Commercialization and Trade; HMRP= Hill Maize Research Project; HVA= High Value Agriculture; HIMALI= High Mountain Agribusiness and Livelihood Improvement; GEF=Global Environment Facility; VSP= Vegetable Seed Project; AFSP= Agriculture Food Security Project; KISSAN=Knowledge-based Integrated Sustainable Agriculture and Nutrition; CSISA=Cereal System Initiative for South Asia; IWRMP= Irrigation Water Resource Management Project; RIU= Research in Use



technologies) in provisioning of seed technical information has not yet been widely adopted. Private seed companies and seed dealers are also providing training, networking and information support to promote their new seed varieties and hybrids.

### 3.3.5 Seed research, quality assurance and regulatory support services

Public R and D agencies, National Seed Board (NSB) and regulatory bodies (e.g. SQCC) provide varietal research, characterization and performance evaluation services for registration and release of new seed varieties. Seed quality assurance is done through two mechanisms: internal and external quality control that are guided by the enforcement of legal provisions, field standard, seed standard, market monitoring and sample tests, and other practices adopted internationally (Khanal, 2015). Public and private seed testing laboratory facilities provide quality assurance (seed testing for genetic and physical purity). Regional Seed Testing Laboratory (RSTL) of DoA, SQCC and DADOs provide field monitoring, inspection and seed certification/quality assurance services to farmers and entrepreneurs. Similarly some private seed entrepreneurs (e.g. SEAN) and national NGOs (CEAPRED) provide laboratory and field inspection services for assuring of quality seeds in its project districts. NARC research organs (e.g. Gene bank, Seed Science and Technology Division, Biotech Division, etc.) provide seed and varietal characterization services while national commodity research programs (e.g. NRRP, NMRP) and R/ARS provide varietal testing, and evaluation support and services to private sectors particularly for registering their imported hybrid varieties.

### 3.4 Effectiveness of current support measures

It clearly demonstrates the public sector is still a major player for agricultural research (new seed of inbred / OPVs and source seeds) and provision of support services (subsidies, extension services etc.) both in accessible areas and remote regions, while private sectors are emerging in the provision of input supply and agro advisory services associated to their agricultural inputs particularly in commercial production systems and market accessible areas. Agrovets are the major sources of information for hybrids cultivation, pesticides and micronutrients. The effectiveness of various support measures are briefly outlined below.

1. The support measures for seed promotion and information dissemination is very much limited as a result of limited focus on extension demonstration and awareness campaigns on new seed varieties and poor research-extension and education linkages. Extension demonstration and technical seed promotional services are limited to few locations particularly in specific project areas, pocket programs and Government Mission programs. The coverage of agricultural extension services is very much limited covering only 12 % of the farm households (ADS, 2014). The extension services and agricultural educations are also not well targeted for seed extension and seed educational campaigns. Outreach research services of NARC are also very much limited to few OR sites of R/ARS with specific focus on crop variety testing but not directed for service provisioning on new seed varieties.
2. Price and transport subsidy support on seeds and other inputs are not available on time and in-adequately targeted to small farmers', new high yielding varieties and resource poor farmers in target production domains (rainfed stress prone areas). The lengthy procurement process of government and several other procedural formalities including frequent public strikes are the major reasons for delaying seed supply process in remote hills and mountains (FIDA, 2012). Furthermore, the marketing of subsidized seeds through single outlet of NSC has disrupted private sector dealer's network and growth of private seed entrepreneurs.
3. Current support measures on seed research, testing and quality assurance services are also inadequate and ineffective. The seed variety characterization, evaluation and laboratory and quality assurance services are not available in many remote Hills, Mountains and interior Terai regions since, most of



these support services are located in accessible and regional urban centres of Terai and Katumandu valley. Furthermore, the institutions providing variety characterization, evaluation, testing services in NARC and quality assurance services such as RSTL, private laboratories and DADOs lack adequate trained human resources and technical competency in seed quality assessment and provision of quality assurance services (Bhandari, 2012, Thapa, 2013).

4. The resource poor small farmers in many parts of Nepal lack adequate training, networking and capacity building services in quality seed production and market. The available training and capacity building services are mainly available for limited number of elite farmers, farmers groups, cooperatives and their representatives mainly from accessible locations.
5. The seed infrastructural support (e.g. research facilities, storage, processing facilities and equipment) and technical seed production and marketing information and support are available to only few farmers' cooperatives or outstanding groups as the resources are limited and competitive. Seed subsidy and support are not normally available for seed certification, packaging, branding and strategic marketing of newly released high yielding variety seeds and technologies.
6. There are no incentives for investing in high tech seed research, strategic marketing, R&D and modern storage technology and processing machinery, such as tax breaks and subsidies which are available in the neighbouring countries like India, Pakistan and Bangladesh (Sah and Gill, 2014). Public sector breeders and researchers lack adequate incentives and orientation to collaborate with private sector agencies.

#### **4. Seed Marketing Systems and Channels**

Seed marketing is one of the most vital components of seed system that involves activities associated with seed production, distribution, and market intermediaries to ultimate seed user farmers. There are both market and non-market channels through which new seed varieties can be disseminated and deployed at the farm level according to the prevailing seed system and needs of a seed enterprise. Market channels help to market, disseminate and deploy seeds produced by mainly formal organized seed systems. However, seeds produced and used by informal seed systems require non-market channels for reaching large number of subsistence farmers in marginal regions. Present non-market channels that are dominant in rural and remote hills, mountains and some interior parts of Terai involve seed distribution and deployment through extension programs, NGOs, CBOs, farmers' networks, small rural traders and research agencies (NARC) in the form of minikits, IRD, PVS, FATs, seed kits etc. Seeds are deployed and disseminated by these non-market channels mainly through farmers' own local social networks and community exchanges reaching resource poor farmers, women and disadvantage groups in marginal areas. Seed companies adopt market channels to sell their seeds while most of the CBSP groups follow non-market channels to sell their seeds through informal loose network of local traders, farmers and NGOs and through the help of public R&D organizations (NSC, DADO, NARC), who have provided technical and institutional support in seed production.

There are two major seed market channels currently prevalent in Nepal. These include (i) Sales of seeds by seed enterprises through seed dealers and retailers often referred to as Agrovets (Agriculture and veterinary shops). These Agrovets are the major channels through which bulk of the improved seed varieties and hybrids are marketed in major market centres in Terai and some market accessible regions of Hills. (ii) Direct marketing (sale) by seed enterprises to seed users from their own seed stores /sales points, which involves no intermediaries in the marketing. A case study of rice marketing indicated that most of the seed companies market their major bulk of their seeds (90%) through first channel or private dealers (Agrovets), while some cooperatives and many of the CBSP groups market their seeds directly through their own stores / outlets (Gauchan et al, 2014). The seeds that are marketed through market and non-market channels are either produced with contract growers or it may



be purchased from farmers groups (e.g. CBSP) and cooperatives. Seed dealers prefer to market hybrid seeds as compared to OPV and inbreds as there is a high price margins and benefits in selling hybrids. The seed marketing of crops is more efficient if producers of seeds directly market their seeds to producers and other users of seeds. Direct marketing not only benefits to producers receiving higher prices but also making timely availability of quality seeds to farmers' in affordable price. Longer seed marketing channels is not desirable since seed quality gets deteriorated during handling, storage and transportation. However, presently there are limited scientific information and research analysis about impact of direct marketing systems and channels in improving marketing efficiency of seed for rapid flow and deployment of quality seeds at the farm level.

## 5. Potential Role of Private and Other Non-state Actors

### 5.1 Potential role of private sector in variety development and seed production

In recent years with liberal economic policy, the role of private sectors and other non-state actors (Cooperatives, CBSP groups, CBOs, and NGOs) are increasingly emerging as key providers of inputs, seeds, exotic varieties and the technical services. With the development of liberal policy in seed sector (Seed Policy 1999; DISSPRO 1998, Seed Regulation 1997) and emergence of public seed company (e.g. NSC in 2002) and private seed companies (e.g. SEANSC, Lumbini) during the beginning of 2000s, the growth of seed production and supply increased. Favourable seed policy development in seed sector since the beginning 2000s also resulted in increased participation and contribution of private sectors' to introduce, register and release diverse set of varieties particularly hybrids in vegetables, maize and rice (Table 5). Recently, the share of private sector in making availability of registered hybrids has been quite high in vegetables, maize and rice. About 90% and 60% of available notified varieties in vegetables and maize respectively is supplied by private sector. Similarly, the share of private sector (combining private seed companies, cooperatives, CSB and CBSP groups) is quite high with above two-third of total seed production in major crops and vegetables.

**Table 5:** Share of private sector in notified varieties and seed production in 2013

Crops	Share (%) of variety release / registration			Share in seed production (%)	
	Public	Private	Private hybrid	Public	Private
Paddy	77	23	19	13	87
Wheat	100	0	0	33	67
Maize	40	60	51	14	86
Vegetables	11	89	76	31	69

*Source: Compiled and adapted from SQCC (2014)*

The current share of private sector in seed production actually ranges from 67% in wheat, 85% in maize and 87% in rice. Hence, presently private sector has dominance in making availability of varieties and quantity of formally produced seed for cross pollinated crops (vegetables, maize) and public sector is dominating in supply of varieties and seeds of OPVs and self-pollinated crop such as wheat. From the above analysis, it is clear that the role of private sector is evolving and increasing in both making availability of varieties and seed production and supply in the formal sector. However, as elsewhere, private sector in Nepal persistently have overlooked those crops, traits, and technologies that are vital to livelihoods of the poor (Nascem et al, 2006) particularly in remote hills and mountain regions such as neglected and underutilized crop seeds (e.g. millets, buckwheat, barley etc.). Presently, farmers in Nepal buy almost none of the improved seeds from formal sector for underutilized mountain crops (barley, buckwheat) that are planted each year, preferring to save their own seed or exchange seed with neighbours.

Recently the participation of private and non-state seed actors are increasing rapidly, where there are around 20 registered seed companies, over 100 seed cooperatives (half of these cooperatives are in vegetable sectors promoted

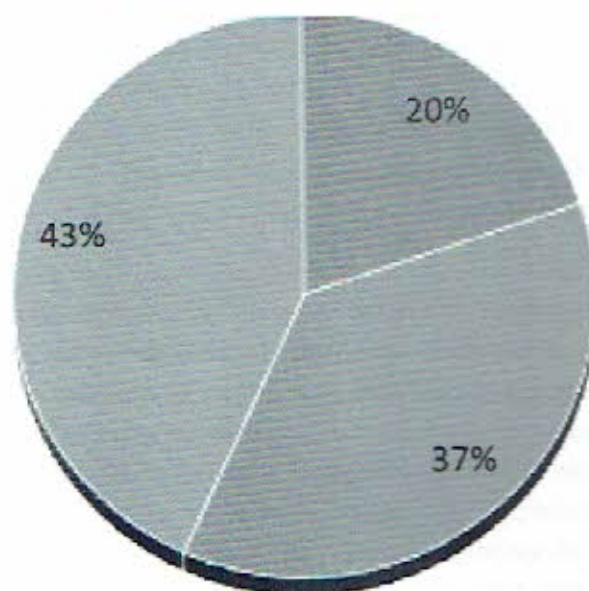


by VSP/CEAPRED), around 1,000 CBSP/DISSPRO seed groups. Similarly, SEAN estimates about 2,600 Agrovets in Nepal that are engaged in supply of seeds and agricultural inputs (SEAN, 2013). Agrovets are the main actors in major market centres and commercial production pockets in providing seeds and other inputs (e.g. fertilizers, pesticides, micronutrients) and associated technical information and advisory support services to farmers. Private seed companies also are increasingly participating in seed production and marketing in market accessible regions of Terai and Kathmandu valley. Cooperatives, CSBs, CBSP groups, NGOs and CBOs are emerging in many accessible hills and Terai regions in seed production and supply. However, sustainability of these community based enterprises is concern due to lack of appropriate mechanisms to access business skills, financial services, quality control, and source seed from service providers, and benefit sharing process among the members/shareholders (Khanal and Maharjan, 2010).

## 5.2 Share of public, private and community sectors in seed production

The share of public, private and community sector actors that are involved in seed production and supply depend on crops. Figure 3 indicates the share of seed production in aggregate for three major cereals (rice, maize and wheat) by specific actor types based on the recent official data available in the country (SQCC, 2014). The share of actual private entrepreneurs (seed companies and seed dealers) in production and supply of commercial seeds (certified, truthfully labeled and improved) is higher 43% as compared to the share of community sector<sup>8</sup> (37%) and public sector (20%). This figure indicates that the share of seed production in private and community sectors is increasing while the share of public sector is declining. The share of NGOs is accounted in community sector through which they facilitate and play important role in seed production and supply. For instance, CEAPRED has a dominant role in vegetable seed production and supply through its involvement in vegetable seeds implemented by VSP (SDC funded) which accounts for 14% of the total requirement and 27% of the total domestic production and supply of the vegetable seed in the country (CEAPRED, 2014). Recently, there is an increasing growth of community sector in seed production as a result of facilitation of community seed production by both public agencies and I/NGOs in the country. Many of these community level seed production programs are gradually transferring into by private seed companies as they graduate and grow into specialized enterprises.

**Figure 3:** Share of seed production by public, private and community sectors



<sup>8</sup> Community sector includes seed production and supply by DISSPRO, CBSP groups, CSB and Cooperatives. The public sector includes certified, truthful labeled and improved seed production by NSC and Salt trading limited.



### **5.3 Opportunities for private sector participation and investment in R and D**

There is a substantial opportunity for private sector investment in seed sector R&D in Nepal as indicated from the evidence presented above that the role of private sector is growing with the stages of seed industry development in the country. Private-sector investment and participation is high for high value crops, hybrids and seeds of those crops that have high seed multiplication ratio (SMR). It is estimated that the role of private sector will grow up further rapidly in the future, when large number of cooperatives and CBSP groups finally graduate into specialized seed companies, provided that they are supported through public sector programs and policies.

The country has several underutilized comparative advantages in terms of diverse altitude, ecology and natural isolation barriers appropriate to quality seed production of diverse crops and varieties. Nepal has also availability of larger number of seed producer farmers in different ecology who are willing to participate in contract seed production in lower cost with private seed companies. Contract seed production helps small private seed companies to reduce investment cost in production of seeds without having own investment in land and labor. The country's proximity to a large seed market in India, Bangladesh and China provides opportunity to develop seed industry with comparative advantage for export of quality seeds. Moreover, the country can take advantage of R&D spill-ins from India and other neighbouring countries on seed research. A great potential exists to increase productivity and income of resource poor farmers by strengthening existing seed business models led by private and other non-state actors such as cooperatives and farmers' organizations.

There is potential for private sector investment targeting domestic market focusing on hybrids, horticultural crops and those with high seed multiplication ratio (SMR). The demand for hybrid seeds is rapidly growing and is being met by increased level of imports, suggesting the possibility to increase hybrid seed production for import substitution with increased involvement of private sectors. A good scope exist involvement of domestic private sectors in hybrid seeds of rice, maize, vegetables and those of the source seed of inbred and OPVs that are not currently undertaken by public sectors (newer varieties of cash crops, vegetables etc.).

Present policy of Government of Nepal is also liberal focusing on private sector participation in seed sector development. The national Seed Vision of the Government of Nepal envisages increased emphasis on private sector led seed sector growth for self-sufficiency, import substitution and export promotion (MoAD, 2013). It emphasizes private sector participation in seed business with special focus on public-private partnership (PPP) in seed multiplication and marketing (including hybrids). The national agricultural development policy (ADS, 2014) and economic policies have also put increased emphasis on the promotion of private sector.

## **6. Constraints and Issues in Effective Functioning of Seed System**

### **6.1 Constraints in research support system for effective functioning of seed system**

Presently there are two major constraints for seed system development in Nepal. These include (i) limited choices of wider range of preferred varieties available to farmers and (ii) easy access and availability of research developed varieties to farmers at right time and right place in affordable prices. However, research and support systems at present are weak to address the constraints in seed value chains. Moreover, seed enterprise development requires availability of advanced technologies, skills, and knowledge and research support services from public sector which is currently not adequately available in Nepal. The major constraints and issues in research support services for effective functioning of current seed systems are outlined below.

### **6.2 Constraints and issues for private sector investment in R and D**

Presently, private sectors face several constrains in participation and investment in R&D. The specific constrains and issues for private sector participation and investment in variety development, seed multiplication and marketing



and efficient farm level deployment of new improved seed varieties is presented below.

- The major constraints and issues for private sector investment in seed sector R&D include high investment cost, small and uncertain market, limited access to public germplasm, and insufficient capacity and knowledge of the technical aspects of seed production, financing constraints, and lack of local suppliers of related goods and services (Naseem et al, 2006; Langyintuo. et al, 2010). Private seed companies and other seed actors also face problems of accurately estimating demand for seeds due to poor research capacity, low awareness, and poor information about performance of quality seeds of new improved varieties.

**Box 1: Constraints in research and support systems in effective functioning of seed system**

- Limited choice of competent farmer preferred varieties as a result of slow process of variety development, release and registration
  - High adoption lags of varieties in farmers' fields due to inefficiency in seed systems to supply seeds rapidly at the farm level
  - Mis-match in demand and supply of source seeds as a result of ineffective planning, monitoring and lack of correct demand assessment. In addition, new varieties developed and their source seed produced are not adequately linked with subsequent multiplication and marketing.
  - Slow dissemination and uptake of choice varieties as a result of poor popularization of newly developed varieties and poor linkage of research with extension, education and private agencies
  - Inadequate research and laboratory support for varietal identification, characterization, evaluation and assessment of potential risk of new seeds and varieties in the market and farmers' fields.
  - Limited supply and targeting of research and support services (e.g. seed subsidy, seed quality assurance, technological packages) to poor in remote areas particularly in remote hills and mountains as there are poor presence of both public and private seed actors and agencies (e.g. NSC, AIC, private seed companies and dealers etc.).
- Private sector participation and investment in own R&D is weak due to weak enforcement of existing seed policy and regulations, lack of incentives for private seed companies to invest in long term R&D and absence of plant variety protection law in place coupled with poor performance of hybrids to date. Supply of large share of seeds through informal channels from India has hindered not only the development of local seed industry in Nepal but also difficult to assure quality seeds supplied to farmers (EAT, 2014). The country also lacks adequate legal framework (e.g. Biosafety laws) for introduction and commercialization of biotechnological products with adequate infrastructure for risk and safety assessment.
  - Seed industry is not a special priority sector investment in country, hence private sector in Nepal also do not receive special tax breaks, infrastructural support, research grant and credit subsidies from the government for seed industry development that are presently available in neighbouring countries in South Asia (Sah and Pal, 2014). Nepal's variety registration system is also more stringent than in some other Asian countries (e.g. Bangladesh, India, Thailand) making difficult to promote private sector participation and investment in the growth of seed sector (EAT, 2014).
  - Furthermore current practice of doing research and business culture is not supporting for appropriate collaboration between public and private sector in seed R&D. Currently, there is a mis-trust between public and private sectors researchers and development professionals in variety development, seed production



and supply. Public sector researchers and breeders also lack adequate incentives and professional support to collaborate openly with private sectors.

- Distribution of subsidized seeds and inputs through state owned companies (e.g. National Seed Company and Agricultural Input Corporation) are hindering the growth of network of private seed dealers and seed enterprises. Seed relief, donors and I/NGO support to farmers and communities through free or subsidized seeds during non-emergency situations also have distorted private sector investment and growth in seed sector development.

## 7. Conclusion

The current seed system is based on slow and rigid phase-wise seed production and supply, where both the early (breeder and foundation) and later generation (certified and improved) seeds are multiplied and marketed with the prescribed seed cycle following seed multiplication, conditioning, storage and use systems. In each of these phases different actors, sectors and institutions from public and private organizations are involved. NARC is the main public sector research providers involved in variety development, maintenance and suppliers of early generation source (breeder and foundation) seed, the community sector (CBSP, Cooperatives) is mainly involved in production and supply of commercial seed (improved and certified), while private sector is engaged in seed multiplication and marketing. The role of private sector is evolving and emerging rapidly with its higher share in the production of commercial seeds and making availability of hybrid varieties in rice, maize and vegetables. The public sector is dominating in supply of varieties and seeds of OPVs including source seed production and supply of major food crops (rice, wheat, maize).

The current production of breeder and foundation seed in major food crop is more than sufficient to meet the projected seed replacement rate of 25%, if seeds are produced as per the recommended seed multiplication steps (BS-FS-CS-IS) using standard seed multiplication ratio (SMR). However, farmers' often complain lack of quality seeds of choice varieties in time due to mis-match of the demand, production and timely marketing of source and improved seeds. Old varieties released 20-30 years ago are still predominant in the country indicating inefficiency of research and extension system in developing and delivering new choice varieties to farmers. Furthermore, the source seeds produced by research stations and farms are not adequately linked to seed multiplication and marketing chains of the private sectors to multiply and market for the production of subsequent cycle of certified and improved seeds. This occurs because of inadequate planning and monitoring, lack of effective demand collection, and poor incentives for source seed production and marketing.

Presently, research in seed production and marketing system is not a prioritized activity in overall seed system in Nepal. The current research and extension services and public support measures are inadequate, poorly targeted and ineffective in meeting the quality seed needs of choice varieties of the farmers. Private sector participation and investment in varietal research and development is also limited to meet the diverse seed needs of farmers and stakeholders. Seed subsidy is mainly directed to major cereals and is not well targeted and effective for new high yielding varieties and resource poor farmers in remote regions. Variety testing, characterization, evaluation and quality assurances services are also focused in market accessible urban centres of Terai and Kathmandu valley. Marketing of good quality seeds are constrained in the absence of research and analysis and information flow. A great potential exists to increase productivity and income of resource poor farmers by strengthening seed R&D and business of private sectors and facilitating graduation of community groups in seed business. The role of public sector is also critical in sustaining and facilitating seed business of seed companies, cooperatives and CBSP groups by supplying quality source seeds of publicly bred new varieties, and required quality assurance and monitoring services. Public sector is still a major player for agricultural research and provision of support services (subsidies, extension services etc.) both in accessible areas and remote regions. Private-sector actors are slowly becoming important players in accessible areas for most agricultural services, except research and extension.



## **8. Suggested Actions**

The focus of the seed system in Nepal should be on the development of self-sustaining enterprises and farmer centric seed system that function well without external support. Special emphasis should be given to invest on research and support services for improving access of quality seeds of choice varieties in adequate quantity at affordable price to small farmers through improved distribution system, efficient marketing and effective quality assurance services. The following actions are recommended for improving seed production and supply.

### **8.1. Suggested actions for R&D in seed sector development**

#### **8.1.1 Strengthen fast track variety development, release and registration**

Public sector research agencies in Nepal need to develop strategies and action plans to facilitate and promote fast track development, release and make availability of wider range of new competent choice varieties by shortening breeding cycle (e.g. through marker assisted breeding, shuttle breeding etc.), pre-release seed multiplication with pre-notification and early generation testing of varieties in multiple domains and seasons. Increase public and private investment is needed in advanced plant breeding (e.g. biotechnology, marker assisted breeding), hybrid research and value added technologies that lower the costs of research and promote spillovers from public research into the private sector. Focus is also needed for decentralized and participatory plant breeding to provide diverse options and choices to farmers.

#### **8.1.2 Decentralized and demand based source seed production and supply**

Focus should be on demand based decentralized source seed production and supply of choice varieties with greater involvement of private sector's capacity in to reduce mis-match in demand and supply and enhance efficiency in production and supply of quality seeds of improved choice varieties. This will require revision, approval and implementation of proposed "private sector decentralized source seed production directive" (draft). Support is needed for the devolution of source seed production of specific varieties in private sectors with regular and effective assessment of demand, variety planning, monitoring and maintenance by production zones. Special focus need to be given for adoption of "Seed Zoning Concepts" for specific varieties. There is also need of increase, networking and regular field survey of seed actors to get reliable demand data of the source seeds.

#### **8.1.3 Incentives for private sector participation and investment in variety development, release and source seed production**

Incentive systems need to be developed and adopted to attract and incentivize plant breeders and private entrepreneurs in developing competent varieties and hybrids. Incentives should be created based on assessment of potential options and practices globally available (e.g. IPR, rewards, royalties from seed sales, research grants, tax breaks, etc.). These may include recognition and reward, royalties from revenue of seed sales, soft loans and subsidies for private sector, research block grant for breeding and breeders' seed production, formulation and implementation of plant variety protection laws. Private sectors also need increase access to diverse germplasm, advance breeding lines to invest and promote their own R andD. There is also need for protecting plant varieties such as finalization, approval and implementation of draft Plant Variety Protection and Farmers Rights Bill (2005) that will encourage investment and participation of private sector in plant breeding as well as creating ownership rights for farmers. Enforcement of contractual agreement for production and marketing is also essential to incentivize private sector participation by reducing risk and assuring production and marketing of quality seeds. Efforts are therefore needed to finalize, approve and implement proposed Agri-Business Promotion Bills (2014) / Contract Farming Act to strengthen seed business for ensuring compliance measures and make full implementation of pre-contract agreement practiced in market by some agencies (e.g. HMRP, VSP etc.).



#### **8.1.4 Establishment of source /breeder seed network**

A more efficient national seed system would have to ensure timely adequate supply of quality source seeds of choice modern variety to farmers at affordable price for the subsequent multiplication and marketing. In this context, establishment of Breeder Seed-Net-work is essential for each crop and commodity to promote sustained production and supply of sufficient quantity of quality breeder seeds of choice varieties and reduce mis-match in demand and supply. The network should be of crop-specific and decentralized covering all actors and sectors through a public-private collaboration. Policy reform is, therefore, needed to optimize breeder seed production, monitor quality and provide incentives to breeders to maintain and produce quality seeds of choice varieties and strengthen performance of the seed network.

#### **8.1.5 Targeted subsidies for new climate resilient HY varieties and vulnerable farmers**

Subsidies on newly developed and officially released and registered high yielding climatic resilient varieties targeted for remote and resource poor farmers in rainfed regions is must for few years to promote and deploy them rapidly at the farm level in order to ensure food security and enhance income of small holders. This targeted subsidy for new varieties, regions and target groups also helps create demand, reduce adoption lags and promote for their commercialization. Support and subsidies are also desirable to farmers and seed entrepreneurs in seed quality assurance services (e.g. certification, truthful labelling), packaging and branding in order to reach and meet needs of quality seeds of diverse target group of farmers.

#### **8.1.6 Popularization of new varieties through extension and awareness campaigns**

Popularization of new seed varieties is essential in multiple domains and location through multiple sources of information channels and promotional campaigns for rapid dissemination and uptake of new variety seeds. The popularization schemes will involve publicity measures, awareness creation and demonstration activities employing diverse seed promotional packages (e.g. PVS/FATs, FFT, and IRD). Mobilization of both public and private outreach, extension and educational programs and marketing activities are essential for creating farm level awareness for the use of quality seeds and reduce adoption lags. Agricultural education and extension programs need to be targeted in the dissemination of good quality attributes of the new varieties by strengthening research-extension-education linkages and enhancing capacity of extension services. Seed users should be made aware of the benefits of the improved quality seeds of improved varieties with appropriate labelling, branding and awareness campaigns in specific recommendation domains and production seasons.

### **8.2 Suggested actions for R&D partnership modality based on comparative advantage**

Promoting the development of a strong, dynamic and sustainable seed sector in Nepal will require adoption of specific R&D partnership modality with a coordinated effort between the public, private and or community sectors, where the roles of each of the sector may differ across crops, value chains, production systems and stage of seed industry development. The R&D partnership modality needs to consider the current context and future development that requires use of integrated seed system linking both formal and informal system and use of market and non-market channels.

For subsistence marginal farming system, where there is dominance of informal system, public sector has a critical role to supply quality seeds of choice varieties by mobilizing and empowering local communities since private sector has presently no incentives to participate in this system. In semi-commercial system, role of community sector presently has greater in seed production and supply due to growth of DISSPRO, CBSP groups and Cooperatives. In such system, private sectors still have inadequate incentives to engage in seed R&D due to their lower economic scale of seed business and poor quality assurance services available in the country. In more favourable production regions and commercial production systems, private sectors have dominant role in seed R&D because of their



better incentives of participating in seed production and supply. However, the role of public sector is critical in all three types of systems through its greater role in variety development, quality assurance and creating favourable environment for the participation of private and community sectors.

Public sector research (NARC) is encouraged to develop R&D policy and programs to facilitate sharing and enhanced access of germplasm (e.g. advanced breeding materials, parental lines) to private sectors by linking with national commodity programs and national gene banks. Participatory plant breeding, PVS and grass root breeding are specific focus of community based system in subsistence and semi-commercial system, while advanced plant breeding (e.g. market assisted breeding (MAB) and biotechnology) focusing on high yielding varieties and hybrids will be directed for commercial system. The specific modality of R&D partnerships in two major scenarios of formal seed production system is outlined below.

### **8.3 Modality of partnership: 1: Public-Private-Community Partnership in R and D**

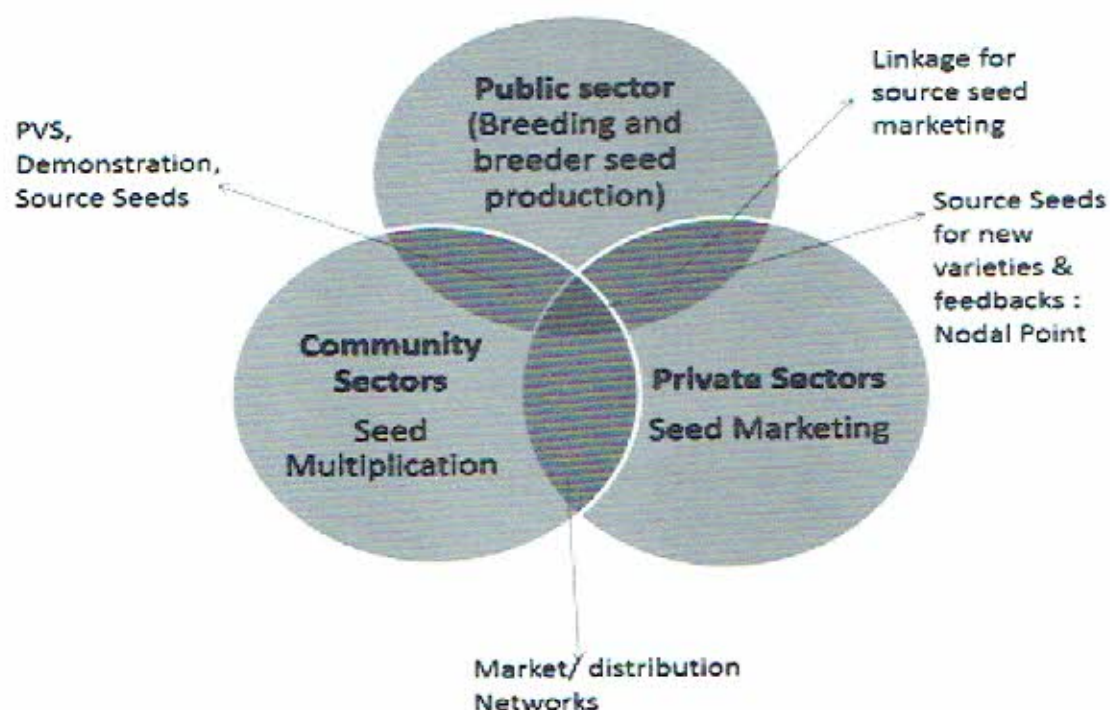
In semi-commercial system of major parts of Terai and some accessible hills, public-private-community partnership is essential to capture synergy and utilize comparative advantage of each of the actors. In the context of current dominance of OPVs /inbred varieties in Nepal, presently public sector has comparative advantage in variety development and maintenance, community sectors in seed production and multiplication, and private sector in strategic marketing (Fig 4). The policy and program should strengthen and utilize these comparative advantages of each of the sector. Therefore, there is a need to strengthen public-sector breeding, supporting community sector seed multiplication and promoting private-sector marketing for rapid dissemination and deployment of new high yielding varieties in farmers' fields. Seed research and development strategies need to consider this multiple partnership that requires use of integrated seed system linking both formal and informal system (Louwaars and De Boef, 2012).

### **8.4 Partnership modality in future: 2: Public-Private Partnership in R and D**

In more favourable production regions and commercial systems, private sectors have dominant role in investment in seed R&D because of their better incentives of participating in seed production and supply. Recently with increase market demand and growth of commercial production system, there is an increasing trend of graduation of community based seed production into specialized seed companies. Private sectors' participation and role is also increasing in hybrid seed business because of increase demand of hybrids in market accessible favourable production system. In the future, this trend will continue to grow as economy develops with increased commercialization of agriculture. Hence, in such context, state needs to facilitate creation of enabling environment for private sector participation and long-term investment in hybrid research through public-private partnership based on their comparative advantages. Development of strategies and action plan for hybrid R&D including implementation of modality of public-private partnership is immediately needed to meet the growing needs of hybrid varieties in market accessible regions of Terai and river basins. One of partnership modality in hybrids would include hand over of public bred inbred



**Figure 4:** Suggested role of public-private and community partnership in R&D



lines/parental lines and advance breeding materials by public research (e.g. NARC) to private seed companies to multiply and market them. However, the research programs undertaken by private sector should avoid duplication and complement with public sector efforts (Pal et al, 2008).

There is also a need of state support in establishment of larger seed companies for hybrid R&D through appropriate support (research support, germplasm access, grants, subsidies, tax relief etc.) and by availing required land on lease for development and commercializing new varieties and hybrids. Seed Vision -2025 also envisages development of four regional mega seed companies with its own R&D to cater the local needs as well as promote export of quality seeds.

## 9 Plan of Action for Seed Sector Development

Based on the assessment of status and key constraints in research support and services for improving seed sector development, the following action plan is purposed with specific recommendations to address the current issues. The suggested plan of action and expected outputs for short, medium term and longer term with responsible agencies and tentative resources is given below in Table 6.



**Table 6: Suggested plan of actions in research and support services**

Current issues	Suggested Actions			Responsible Agency	Resource (NRs Million)
	Immediate (0-3 years)	Medium term (3-5 years)	Long term (>5 years)		
1. Strengthen fast track variety /hybrid development, release and registration	<ul style="list-style-type: none"> <li>-Shorten breeding cycle through shuttle breeding, multi-season and early generation testing</li> <li>-Shorten variety registration period ( 2 to 1 year) for non-food security crops (e.g. vegetables, cash crops)</li> <li>-Promote pre-release seed multiplication of promising varieties</li> </ul>	<ul style="list-style-type: none"> <li>-Promote fast-track breeding using MABB linking with IARCs</li> <li>-Promote PPB with early generation testing with farmers and private sectors employing public-private partnership.</li> <li>Develop incentives to breeders in terms of royalties on seed sales, award research grants and licensing mechanisms for new varieties and technologies</li> </ul>	<ul style="list-style-type: none"> <li>Strengthen human resource capacity and infrastructure in modern MAS breeding, biotechnology and hybrid R andD</li> <li>Increase investment in domain-specific breeding by establishing new research stations</li> </ul>	N A R C , N G O s , Private R&D agencies	70
2. Creating incentives for private sector investment in R and D	<ul style="list-style-type: none"> <li>- Enhance easy access of breeding lines and quality breeder seeds of choice varieties for private sector</li> <li>- Provide support, (subsidies, soft loans, tax relief, research grant etc.) for private sector investment in R andD</li> </ul>	<ul style="list-style-type: none"> <li>-Develop, approve and enforce PVP (breeders' rights) law as an incentive to private sector investment for variety development-</li> <li>-Formulate, approve contract farming Act / Agribusiness Bills for encouraging private sector participation and investment in R&amp;D</li> </ul>	<ul style="list-style-type: none"> <li>Facilitate establishment of larger seed companies for hybrid and OPVs R&amp;D and commercialization of seed varieties</li> </ul>	MoAD, DoA, NARC	45
3. Reform in seed regulations/ directives and blanket seed subsidy for crop varieties	<ul style="list-style-type: none"> <li>-Revise seed subsidy to only new HY climate resilient varieties targeted for small and vulnerable farm groups and remote regions</li> <li>-Strengthen joint planning, monitoring and procedures (rules) for development and maintenance of effective Seed Balance Sheet</li> </ul>	<ul style="list-style-type: none"> <li>- Develop guidelines /procedures for Seed Zoning Concept and <i>domain-specific source seed and custom seed production</i></li> <li>-Develop/revise and implement rules, regulations/ directives for <i>devolution/ decentralized source seed production in private sector</i></li> </ul>	<ul style="list-style-type: none"> <li>Facilitate graduation of CBSP groups by strengthening their capacity for self-sustaining specialized seed companies/ enterprises</li> </ul>	NSB/SQCC, NARC, DoA	25



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**Annex 1: Number of released and registered OP and Hybrid crop varieties (1960-2014)**

SN	Crop group	Total number of varieties	Number Released varieties	Number of Registered varieties	Hybrid Registered	OP/Inbred registered	Annual rate of released varieties only	Annual rate of total released and registered varieties
1	Rice	91	73	18	17	1	1.33	1.65
2	Maize	63	26	37	32	5	0.47	1.15
3	Wheat	35	35	0	0	0	0.64	0.64
4	Barley	6	6	0	0	0	0.11	0.11
5	Finger millet	3	3	0	0	0	0.05	0.05
6	Potato	12	10	2	0	2	0.18	0.22
7	Vegetables	328	36	292	251	41	0.65	5.96
8	Grain legumes	37	36	1	0	1	0.65	0.67
9	Oilseed crops	19	17	2	1	1	0.31	0.35
10	Commercial crops	10	10	0	0	0	0.18	0.18
11	Pasture and Fodder crops	5	5	0	0	0	0.09	0.09
	<b>Grand Total</b>	<b>609</b>	<b>257</b>	<b>352</b>	<b>301</b>	<b>51</b>	<b>4.75</b>	<b>11.07</b>

*Note: Total includes denotified varieties (n=35) as well. Compiled from SQCC (2014)*

**Annex 2: Varieties released and registered and their share in Public and Private sector**

Crop	Total varieties	Public	Private	% Share of private
Rice	91	70	21	23
Maize	63	25	38	60
Wheat	35	35	0	0
Barley	6	6	0	0
Finger millet	3	3	0	0
Potato	12	10	2	17
Vegetables	328	36	292	89
Grain legumes	37	34	3	8
Oilseed crops	19	17	2	11
Commercial crops	10	10	0	0
Pasture and Fodder	5	5	0	0
<b>Grand Total</b>	<b>609</b>	<b>251</b>	<b>358</b>	<b>59</b>

*Compiled from SQCC (2014)*



