

Chapter 11

Integrated Approach of National Seed Systems for Assuring Improved Seeds to the Smallholder Farmers in Nepal

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Abstract

An efficient seed system is necessary to make agribusiness profitable and to improve food and nutrition security. Existing seed systems have been analyzed and possible strategies are suggested in this paper. There are three types of seed systems (informal, non-formal and formal) based on breeding and legal status, and five types based on key players in Nepal. Informal seed system covers from 82 to 100%, whereas formal seed systems deals only 77 species among 484 domesticated crop and forage species. Informal seed system gives more assurance for smallholder farmers with regards to right time, right quantity and right affordability. The non-formal seed system is the production and marketing of improved varieties, which are not neither released nor registered by government. It also includes some features of formal and some features of informal seed system (therefore, it is also termed as semi-formal). Right quality is the major feature of formal seed system. Involvement of over 2,500 seed dealers including farming communities and 25 different tools and R&D organizations have made seed systems effective for smallholders. After few years of the variety's release or registration, seed of such varieties (which is under the formal seed system for few years) are integrated under informal seed system. The Informal seed system needs to strengthen and it should be included in education and research systems. Farmers prefer to save their own seeds from their farm, therefore, breeding varieties with such potentiality through CBSS may be good strategy for increased and assured quality seeds to smallholders.

Keywords: Smallholder, formal seed system, integrated approach, informal seed system

1. Background

An effective and sustainable seed system ensures the availability and timeliness of high-quality seeds of a wide range of varieties to farmers and other stakeholders. However, in Nepal, farmers have not yet been able to fully benefit from the advantages of using quality seeds due to a number of factors, including limited access to information, inefficiency in seed production, proper distribution and quality assurance, as well as bottlenecks caused by a lack of good seed policy on key issues such as access to credit for inputs. Agriculture Development Strategy (ADS) has visualized the improved and decentralized seed system providing timely access to quality seeds at affordable price (MoAD, 2014). Roka (2017) and has analyzed the possible impact of ADS on smallholder.

ADS focuses on commercialization and competitiveness of agriculture, however it does not clearly point out what form this commercialization will take and who will get benefited (Roka, 2017). A small group of people owns large chunks of land in the country and so controls the irrigation facilities. All kinds of facilities including bank credit at low interest rates are given only to commercially viable rich landlords. The ADS classifies rural population in three different groups: i) Small commercial farmers (1 to 5 ha), comprising 25% of rural families (selling more than 30% of their output); ii) Subsistence farmers (0.5 to 1 ha), comprising 27% of rural families; and iii) Landless and near landless (nearly half of the population), comprising 1.6 million families in number but which owned only 15% of the land. The ADS has given due recognition to small commercial farmers landholding between 1 and 5 ha and has in its plans the collaboration with farmers holding above 5 ha.

The ADS has envisioned engaging different farmers' categories with different tools for their development. Commercial banking has been stated as more appropriate for commercial farmers and microfinance for subsistence farmers. The ADS argues that performance of subsistence agriculture is unsatisfactory and that agro-chemical and transgenic intensification of production is essential for the transition from subsistence to commercial production. Traditional crop and animal combination along with diversity rich solution can be improved to increase productivity and such practices suite small farmers and it promotes healthy crop growth, reduce pests and encourages beneficial organisms.

Food and nutrition security is possible through a sustainable and competitive seed system. Formal seed production and distribution in Nepal began after

releasing the introduced rice variety CH-45 in 1959 (Joshi, 2017; SQCC, 2013; Joshi et al., 2017b). Seed testing system was started from 1961 (Thapa, 1997) and Central Seed Testing Laboratory (CSTL) was established under Agronomy Division of Department of Agriculture in 1962. Then, Agriculture Input Corporation (AIC) started seed business from 1974 by establishing a seed processing plant and a seed testing laboratory. Public sector had dominated formal seed system before 1990 and seed entrepreneurs were established only after 1991 (SQCC, 2013).

The national seed system is complex and is composed of different mechanisms, which involves a wide range of stakeholders i.e. governments, agricultural research institutes, gene banks, private-sectors, seed companies, input dealers and agro-industries, farmers and farmer organizations (SQCC, 2013). The major seed stakeholders are: Nepal Agricultural Research Council (NARC), Department of Agriculture (DoA), Agriculture Input Cooperation Ltd (AICL), NGOs (CEAPRED, LIBIRD, FORWARD), Community Based Seed Production Group (CBSPG) and Community Seed Bank (CSB) (SQCC, 2013). This paper has analyzed the existing seed system in Nepal and possible strategies are discussed for smallholder with regards to 4Rs (right time, right quality, right quantity and right affordability).

2. National Seed System

Due to varied land structure, climate, crop species, food habit and markets, different seed practices exist in the country. About 65% of total population are involved on agriculture, where local seed system is predominant in Nepal. Functional and effective seed system should have smallholder access to seeds on right time, with right quality, right quantity, and right affordability. Seed systems can be of 5 types based on key players. They are farmer led, community led, private sector led, public sector led and non-governmental organization led (Figure 1). Within each system, there are many players for making seed system more functional. Over 2,500 seed entrepreneurs are engaged in production, processing and marketing of seeds and all of them rely on public research centers to get source seeds (SQCC, 2013).

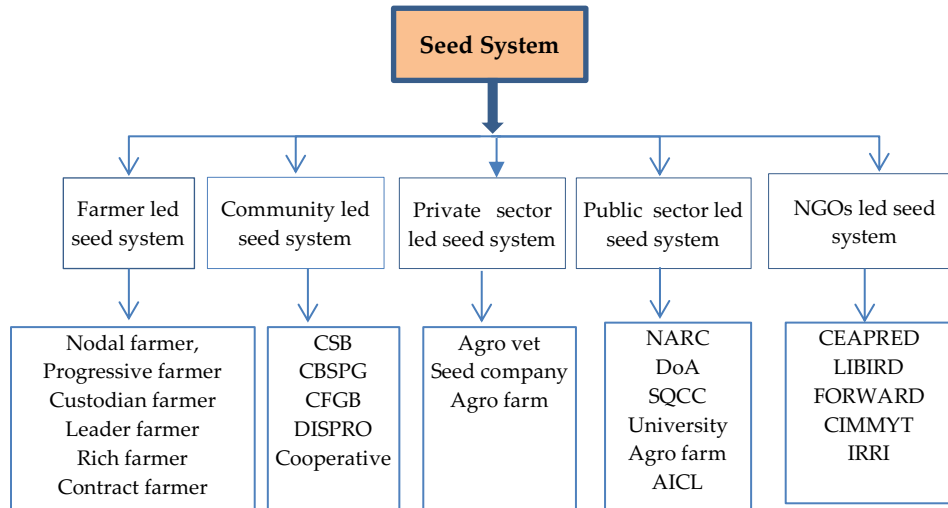


Figure 1. Types of seed system based on the key players

Note: CSB, community seed bank; CBSPG, community based seed production group; CFGB, Community Field Gene Bank; DISPRO, District Seed Self-sufficiency Program; AICL, Agriculture Input Cooperation Ltd.

Seed systems can be further broadly divided into three types based on breeding and legal status (Figure 2). They are formal seed system (FSS), non-formal seed system (NFSS) and informal seed system (ISS), however in general two seed systems have been broadly classified by Gauchan et al. (2014) and SQCC (2013). FSS is a vertically organized production and distribution of tested, released and registered varieties of seeds by public and private organizations using agreed quality control mechanism. It is guided by government act and policy, and main principles are to maintain varietal identity and purity, and to produce seed of optimal physical, physiological and genetic quality. Certified seeds marketing and distribution take place through a limited number of officially recognized seed outlets and there is a clear distinction between seed and grain.

In ISS, farmers themselves produce, disseminate, and access seed directly from their own harvest; through exchange and barter among friends, neighbors, and relatives; and through local grain markets. ISS was even successful to restore lost diversity, revive and strengthen the local crop diversity (Gauchan et al., 2018; 2016). The steps do not flow in a linear sequence and they are not monitored or controlled by government policies and regulations. ISS is not legally guided and mostly involve local landraces as well as old improved varieties.

The NFSS is the production and marketing of improved varieties through such varieties which are neither released nor registered by government. Majority of such non formal seeds are mostly imported for cereals, ornamental, vegetables and fruit species. NFSS is not officially guided and monitored. Based on the farmers' preferences, many improved but not legally notified varieties are being widely grown. NFSS can easily be converted to FSS. Additionally, based on the area coverage, seed system may be extended from family farm to community to ward to municipality to district to province to region to nation (Figure 2).

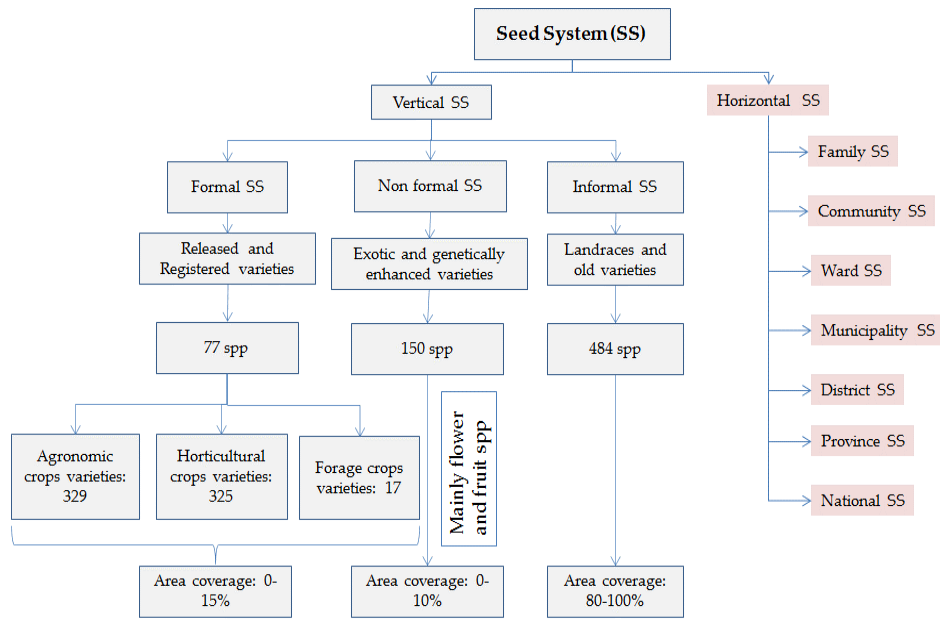


Figure 2. Types of seed system based on breeding, legal status and areas coverage

Note: SS, seed system; spp, species

These three types of seed systems are adopted considering the similar system in education. The principle and practical applicability are more or less similar to these three education systems (Dib, 1988). Formal education is defined as a systematic, organized education model, structured and administered according to a given set of laws and norms. Formal education has a well-defined set of features and non-formal is with one or more of these features of formal system is absent. Informal education is diverse from formal and non-formal education, although in certain cases it is capable of maintaining a close relationship with both. It does not correspond to an organized and systematic view of education; informal education does not necessarily include the objectives and subjects usually encompassed by the traditional

curricula. In some cases, non-formal seed system is defined as semi-formal (Francis & Waithaka, 2015).

Formal seed system is guided by *Seed Act 1988*, *Seed Production Guidelines 1998* and *National Seed Policy 1999*. Under the FSS, total seeds of 28,110 tonnes (11,706 tonnes rice; 12,550 tonnes wheat; 2,887 tonnes maize, 306 tonnes vegetables and 661 tonnes others) have been produced within a country and total of 3,198 tonnes seeds (1,859 tonnes rice; 1,178 tonnes maize and 161 tonnes vegetables) were imported in 2018. The origins of 95% varieties under FSS are foreign sources. But seed quality of vegetables sold in Nepal has been deteriorating each year (Thapa, 2011). Seed Replacement Rate (SRR) is just 0-18% depending on the varieties (SQCC, 2019) (Table 1).

There is a big gap between total seed required and quality seed distributed or produced in the country. Seeds that are produced and distributed through formal seed system are considered quality seeds. Majority of the farmers save seeds of most of the crops they grow from their own farms for next season planting. Therefore, major sources of seeds are from their own farm, neighbors and relatives.

Table 1. Seed replacement rate along with demand and supply of major crops

Crop	2016			2017			2018		
	TSR (Tonnes)	QSD (Tonnes)	SRR (%)	TSR (Tonnes)	QSD (Tonnes)	SRR (%)	TSR (Tonnes)	QSD (Tonnes)	SRR (%)
Rice	71,237	9,621	13.5	68,145	9,472	13.9	73,477	13,533	18.4
Maize	17,648	2,294	13	17,832	2,407	13.5	23,853	3,682	15.2
Wheat	91,485	12,259	13.4	89,498	12,529	14	84,821	12,910	15.4
Lentil	8,179	352	4.3	8,179	368	4.5	8,226	397	4.8
Mustard	2,162	166	7.7	2,162	173	8.9	2,133	183	8.6
Vegetables	NA	NA	NA	NA	NA	NA	2,868	306	75

Source: SQCC (2019)

Note: TSR, Total seed required; QSD, Quality seed distributed; NA, Not available

Smallholders have low capacity to purchase seeds each season, even they maintain seeds over the seasons after buying at certain time. Smallholder farmers just need one seed to a maximum 200 kg depending on types of crops (e.g. one seed of sponge gourd, 200 kg seeds of rice) and 85% of Nepali farmers are unable to access improved seeds. Existing inclusion of crop species, varieties and area coverage of each seed system are presented in Figure 2 (Joshi et al., 2017a).

3. Smallholder Farmers

Smallholder has been used interchangeably with small-scale agriculture, family farm, subsistence farm, resource-poor farm, low-income farm, low-input farm or low-technology farm (Heidhues & Brüntrup, 2003). Murphy (2010) has defined smallholder farmers are those who are marginalized in accessing resources, information, technologies, capitals and assets. Smallholder is a farmer having operating land of less than 2 ha (World Bank, 2003). The average size of holding in Asia is only about 1 hectare (FAO, 2010). Over 85% holdings were below 2 ha and accounted for nearly 31% agricultural land in Asia. Smallholder farmers provides 80% of the food supply in Asian and sub-Saharan Africa, where 80 to 90% of planting materials are ISS (GRAIN, 2007).

Agricultural holdings under 2 ha are 91.7% in terms of number of smallholder and 68.7% in term of operated areas in the country (FAO, 2010). The agricultural holdings below 1 ha operate about 40% of cultivated land. Required farming areas for a six- member family household are 0.64, 0.52 and 0.42 ha in mountain, hills and Tarai, respectively to produce enough food (NPC, WFP & NDRI, 2010). Smallholders without land is 3% and 10% of the land-owning households have less than 0.1 ha and 53% of the land-owning households have less than 0.5 ha (CBS, 2013). In Nepal, 2.7 million smallholder farms make up for 70% of the food produced and only about one fifth of the 2.7 million smallholder farms use improved seed varieties (Rapsomanikis, 2015). Majority of their crops are neglected and underutilized, and grow mostly in sloppy marginalized upland areas.

4. Integrated Approaches for 4Rs

Integrated seed systems imply coordinated actions among the formal, non-formal and informal seed sectors. It also conveys the interdependence of such systems, with multiple links among them, with each reacting to the other and changing over time. Collaborative actions among family, community, ward (the smallest political unit), municipality, district, province and national seed system greatly support smallholders with regards to 4Rs (right time, right quantity, right quality and right affordability). Integrated seed sector development has become a very effective strategy for delivering seeds with faster and sustainable impact of seed system to a larger number of smallholders. Private and public, informal, non-formal and formal seed systems have been working coherently that helped newly developed seeds

to reach out to thousands of small scale farmers even in remote areas of the country. A conducive seed policy environment has also facilitated the development of complementary seed channels making seed industry inclusive (Pokhrel, 2012). It is also common that the seeds from the formal seed system enters into the non-formal seed systems. Among the many seed supported programs, DISSPRO¹ is the most popular, widely adopted and cheapest seed producing program with annual production of 40.4% followed by CBSPG² 3.83% of the total certified/ improved seeds (Pokhrel, 2012).

Generalized steps in FSS, NFSS and ISS are given in Figure 3. Relatively higher numbers of stakeholders are involved in FSS, however ISS dominates the seed systems mainly because of secured, easy access and confidence on the availability of the seeds during planting time. Integrated approaches have been imposed as much as possible in each step to effectively scale up the seeds. In developing the FSS is costly for any variety in comparison to other two systems. Landrace enhancement is also commonly implemented in many areas to improve the ISS and it is successful because of site specific variety development programs with the participation of farmers.

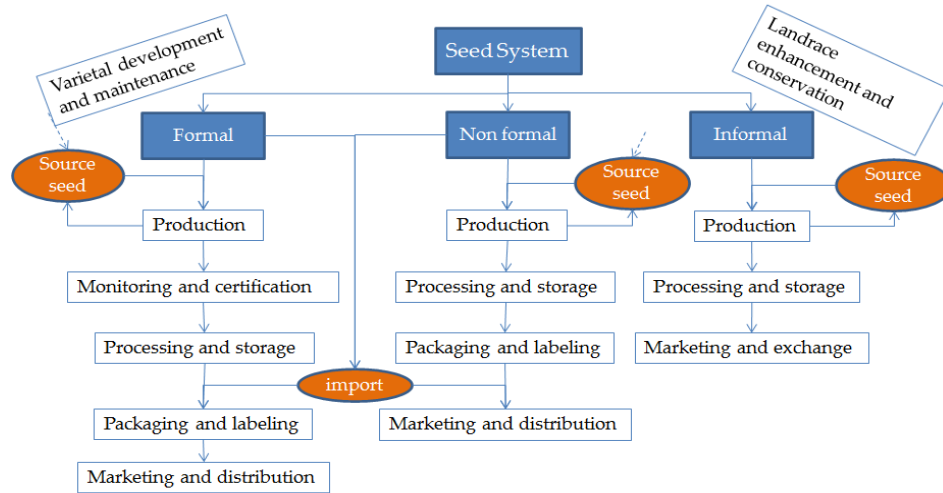


Figure 3. Steps in three types of seed systems in Nepal

¹ DISSPRO (district seed self-sufficiency program) is semi-formal seed system where seed production and marketing are through public sector, government owned national seed company and private sector as formal system.

² CBSPG (community based seed production group) is farmer's seed system and have good linkages with government offices and this linkage is very important for accessing source seeds, for seed certification as well as market linkages and networking. These initiatives have greatly increased access of farmers to new seed varieties.

To accelerate the availability and accessibility of seeds to the farmers, about 25 different tools, methods and distributors are in operation in Nepal (Figure 4). Integration of such different tools in both FSS and ISS have played greater role for assuring quality seeds in time of desired varieties. Both accessibility and availability are greatly enhanced through different approaches that integrate multi stakeholders, multi events, and participatory. Diversifying the sourcing and deploying diverse sets of methods for seeds testing and distribution have increased rapidly the adoption of seeds making seed system more affordable and effective.

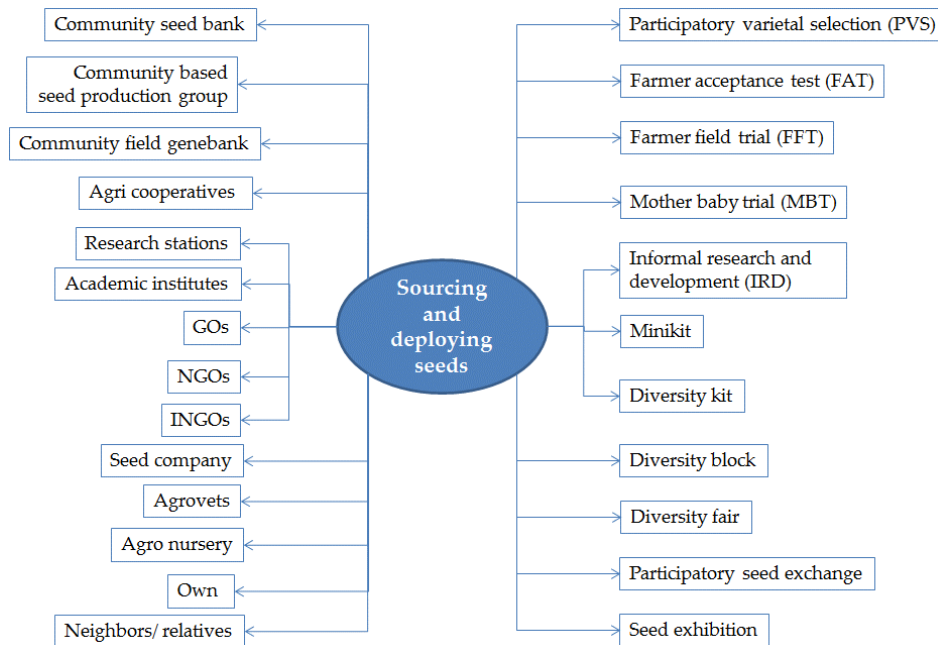


Figure 4. Sourcing and deploying methods and tools of seeds

Source: Sthapit et al. (2019); Joshi (2017); Joshi et al. (2019); Pokharel (2012); SQCC (2013)

5. Factors Affecting Seed Systems

The FSS is centralized around city areas and along the road sides. But larger number of smallholders are located remotely. Involvement of farmers in at least some steps of FSS can accelerate seeds to adopt quickly and widely. Farmers do not prefer or not able to buy seeds each season mainly because of time management, availability of seeds and budget constraints. Seeds with the potential of maintaining its quality by farmer themselves greatly affect the seed system. Modern varieties generally come up with other standard practices and management but smallholder generally uses only modern

seeds with their usual traditions of agronomical practices. Other issues affecting the seed systems are: the need for just a small amount of seeds but for diverse crops and varieties; easy and affordable access to seeds, technology and information; right information with farmer language, among others. Education and research are only on formal seed system and this is replacing the traditional seed system. Involvement of multiple seed producers may be impacted when producing quality seed because the quality of maintaining and multiplying the seeds in small areas may be difficult to assure.

Seeds are generally made available that are produced from other than cultivation sites to the growers. Single variety is generally recommended to large areas but due to larger variation in socio-economic setting and agro-ecology, this strategy is not effective. A large number of site-specific varietal options can greatly improve the seed systems. Assurance of quality seeds from reputed suppliers is the major factor to increase the seed replacement rate. However, Post-harvest technologies and facilities are poorly structured in the country and this has led the difficulty to maintain the standard of seed quality. Also, there are limited resources, unstable markets and poor planning. Due to limited funding, manpower, advanced technologies (for example, heterosis breeding, molecular breeding) have not been practiced. Researchers and growers always expect the contribution of such advanced technologies. Environment is the major factor for flourishing the seed systems and policy environment should be in favor of advancing local based diverse technologies and marketing to regional, national and global levels.

6. Recommendations to Improve the Seed Systems

- i) Improvement is necessary in all types of seed systems (formal, non-formal, informal, family, community, municipality, district, province and national).
- ii) In Nepal, 82-100% is informal seed system depending on the crops. For example, 82% informal seed system is on major cereals crops (rice, wheat, maize) and major vegetables, and 100% for neglected and underutilized crop species (e.g. proso millet, amaranth, foxtail millet, horse gram, rice bean, etc.). ISS is thus needed to strengthen for getting large scale impacts from functional improved seed system.
- iii) All smallholders should be capacitated on quality seed systems so that ISS can work equally as FSS. ISS is effective in terms of right time, right quantity and right affordability but there are always issues of right

quality. Modern seeds if it gets integrated to ISS, farmers can get seeds at right time with right quantity and right affordability.

- iv) Transforming farmers' groups into village seed enterprises could be of effective strategy as community-based seed organizations spread seed impact fast.
- v) Focus should be equally given to heterogeneity, mixture, broad genetic base and diverse population of crop varieties to get space in FSS and NFS.
- vi) Farmers are well familiar on diverse agricultural systems and have generated diverse traditional knowledge. This knowledge should be strengthened rather than replacing them and ignoring them completely by research and development workers and organizations.
- vii) Access to information and access to seeds are the major constraints in FSS and NFSS in Nepal. Digital, farmer-friendly online information system including mobile apps may contribute significantly to facilitate access to information (for example, online information in local/ Nepali language).
- viii) There are many cases of misusing the term hybrid and name of other popular variety in national seed system, therefore monitoring and evaluation mechanism should be strengthened.
- ix) Varieties with the characteristics of maintaining quality seeds by farmer themselves over the years could be more effective for long term functional seed system with regards to 4Rs.
- x) Farmers generally do not consider different classes of seeds and therefore, there might be good strategy to have different seed categories on different seed systems (FSS, NFS and ISS) and on different crop species (sexually propagated, vegetatively propagated, hybrids and inbreeds, etc.). Truthful labeling seeds are more appropriate in Nepal and therefore it is necessary to prescribe the minimum seed quality standards for this type of seeds.
- xi) Seed testing labs including molecular are needed to be established across the country so that farmers, seed entrepreneurs, seed inspectors and researchers can have access to the lab for quality works and testing works.
- xii) Registration and release process of seed varieties should be simplified and accelerated. Comprehensive guidelines for all types of crops and seeds, and three seed systems are needed to be developed.

- xiii) Farmers' systems and technologies should be recognized legally including provision of farmers' rights to save, use, re-use, exchange, and sell seeds.
- xiv) There are needs of technical and physical support to the seed producing farmers, extension workers and the seed entrepreneurs. The involvement of private sector should be enhanced with increased investment in seed sector.

7. Conclusions

Smallholders have integrated agriculture system, which is necessary in heterogeneous types of farming and which provides for the nutritional needs of households with small areas of land. Integration of vertical (formal, non-formal and informal seed systems) and horizontal seed systems therefore are only the option to have a seed system at the right time, with the right quantity, right quality and right affordability. Farmers generally prefer to maintain seeds themselves for next planting season. This demands the development of such varieties so that farmers can maintain seeds themselves at least for few years. Multi-stakeholders and multidisciplinary teams should involve and integrate compatible modern varieties in informal seed system for an effective national seed system.

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Strengthening Seed Systems

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