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Policy Gaps and Practices on Genetic Diversity, The Heterogenous and Localized Evolutionary Population as well as Native Landraces in Agriculture of Nepal

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Abstract

Formal breeding strategies and processes focus on developing uniform and non-evolutionary populations. However, many farmers continue to cultivate heterogenous cultivars and populations. To understand the recognition of genetic diversity (heterogenous cultivars and populations) in policies and the fields, a literature survey along with field survey, interaction and field action research were carried out in 15 districts of Nepal. Existing policies demand varieties to go through DUS (distinctness, uniformity, stability) testing and be registered in National Seed Board (NSB) for commercial production and sale. This means all native landraces and other broad genetic-based genotypes cannot be marketed without registration. A formal agriculture system accelerates the cultivation of a single genotype in a large area, leading to a lack of pollinators and the loss of many genetic diversities.

Legal agricultural systems have focused mainly on modernizing agriculture through exotic resources, giving less priority to making native landraces and technologies globally competitive. In contrast, the informal seed system deals with polymorphic and evolutionary populations. Therefore, policies should consider the strategies that favor and increase genetic diversity, evolutionary population, site-specific genotypes and staple food, self-seed production system, ecological services, insects/birds/ microorganism-friendly systems, etc. Native agricultural genetic resources (AGRs) with broad genetic bases are essential for food, nutrition, health, environment, and business security. Therefore, native landraces of all six components of agrobiodiversity (namely crops, forages, livestock, aquatic genetic resources, insects, and microorganisms) should receive priority in research, development, extension, and education. Additionally, a favorable policy for the commercialization of such native landraces and/ or their products without registration should be established. Alternatively, a registration system should be developed for broad genetic base genotypes and heterogenous and evolutionary populations.

Keywords: Commercialization, Genetic Diversity, Monogenotype, Registration, Site-Specific Variety, Uniform

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1. Introduction

The agricultural industry has long been focused on yield increment through controlled practices, such as the use of chemical fertilizers, pesticides, plastic tunnels and the promotion of monogenotype cultivation., etc. (MoAD, 2014). These practices have been necessary to feed growing human and livestock populations. Chemical and uniform genotype-based agriculture (also called modern agriculture) had proved to increase the yield significantly in major crops and livestock. Therefore, all policies developed so far in many countries have provisions for accelerating modern agriculture (MoAD, 2013, 2014; SQCC, 2013). Under modern agriculture, a few technologies and genotypes have been disseminated around the world. In Nepal, few uniform genotypes have been given due attention to increasing their areas of farming, resulting in the loss of localized and high genetic diversity from the fields (Chaudhary et al., 2006). The values of genetic diversity and heterogenous evolutionary populations are ignored by policy, agriculturists, researchers and consumers (Gauchan et al., 2004). The risk-bearing and buffering capacity of native landraces to the natural and farmers' practices are being replaced by modern varieties which in some cases, completely failed to produce (Gauchan, Joshi, Ghimire, et al., 2018; Thapa Magar et al., 2020)

In the past, circular agriculture (Figure 1) had been practised by farmers and was self-dependent and sustainable. In circular agriculture, genetic diversities at all five hierarchical levels (Figure 2) are valued and utilized. Later linear agriculture was given due focus targeting to increase very few traits e.g., grain in cereals through developing uniform and homogenotypic varieties. Farmers started using almost all inputs brought from outside the system and dependency on other agents therefore farming keeps going increasing. In Nepal, all released and registered varieties are uniform, monogenotype and non-evolutionary (Joshi et al., 2020). The policy has established a formal seed system where farmers are not eligible to produce seeds of different classes. Native and genetically diverse landraces could not be marketed, and incentives are not applicable to traditional practices and landraces, and so on (MoAD, 2013; Gauchan, Joshi, & Bhandari, 2018). In the contexts of climate change, unstable production practices and degradation of environmental and human health, many farmers, consumers, researchers and policymakers are seeking and practising alternatives such as natural farming, evolutionary population (EP) farming, organic agriculture, permaculture, ecological agriculture, integrating farming, cultivar mixture, sustainable agriculture, circular agriculture, etc. These practices consider genetic diversity at species, varietal and genotype levels for expecting sustainable and healthy production systems. EPs are successful in maize, barley, bread, durum wheat, common bean, tomato and summer squash in Jordan, Ethiopia, Iran, and Italy (Ceccarelli, 2017). European Union's organic Guidelines, (EU, 2018) have also recognized the importance of evolutionary plant breeding. EP is being registered in Italy, the UK, Canada and Spain.

Policy provisions and field practices might differ on using and maintaining the genetic diversity of agrobiodiversity which includes six components (crops, forages, livestock, insects, microorganisms, and aquatic genetic resources) and four subcomponents (domesticated, semi-domesticated, wild relatives and wild edibles) of agrobiodiversity (MoAD, 2016). This paper, therefore, highlights the provisions and gaps in sectoral policies and field practices along with policy options in line with genetic diversity, heterogenous and localized evolutionary populations and native landraces.

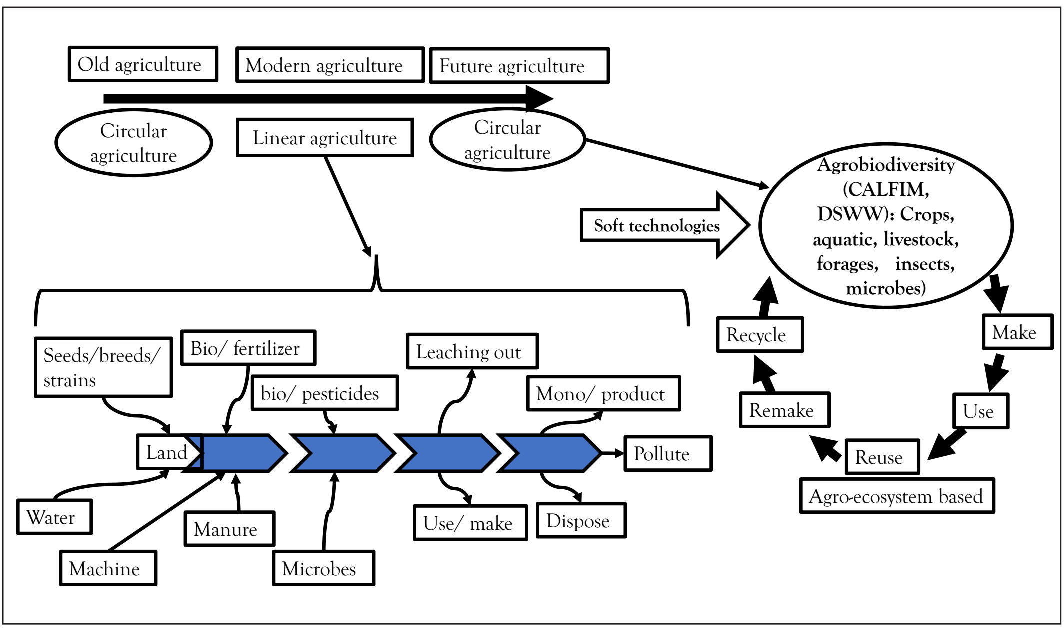

Figure 1. Scope and utilization of agrobiodiversity in linear and circular agriculture

DSWW, domesticated, semi-domesticated, wild relative, wild edible

2. Methodologies

National Genebank has been carrying out on-farm research on native AGRs for the last two decades in Nepal. Publications of six projects namely 1. Evolutionary plant breeding project (Use of Genetic Diversity and Evolutionary Plant Breeding for Enhanced Farmer Resilience to Climate Change, Sustainable Crop Productivity and Nutrition under Rainfed Conditions), 2. In-situ global project (Strengthening the scientific basis of *in situ* conservation of agrobiodiversity on the farm in Nepal), 3. CUAPGR project (conservation and utilization of agricultural plant genetic resources), 4. Rebuilding local seed system project (Rebuilding local seed system: Collection, conservation and repatriation of native crop seeds in earthquake affected areas in Nepal), 5. Local crop project (Integrating traditional crop genetic diversity into technology: Using a biodiversity portfolio approach to buffer against unpredictable environmental change in the Nepal Himalayas), 6. IMPGR project (Morphological and Molecular Characterization of Selected Rice and Buckwheat Collections to Promote Use), which were implemented by the National Genebank, were reviewed along with other relevant literature. Twelve policy documents (Table 1) related to agriculture, nutrition, environment and climate change were analyzed. Focus group discussions and key informant surveys were carried out in more than 15 districts and 50 key persons respectively to document the localized important cultivars and products (Table 2) and field practices (Table 3). Issues and concerns along with practices in the fields were collected from workshops, travelling seminars, and field visits. Interactions with farmers, policymakers and breeders were the additional approaches to collecting the information along with the authors' field works and experiences.

3. Finindings and Discussion

3.1 Genetic diversity and heterogenous agricultural genetic resources

Genetic diversity refers to different inherited traits within a species, cultivar and individual. Landraces and populations having different types, colors, sizes, shapes, heights, structures, textures, scents and forms are called heterogenous. Such populations have different traits over generations and possess the potential to adjust the changes in climatic and growing conditions. Genetic diversity is crucial for genetic improvement, adapting to changing environments, giving birth to new genotypes, etc. The importance of agrobiodiversity in ecologically resilient agriculture is understood by the relationship, "*Genetic diversity at inter/intra population (varieties, breeds, genotypes)* $\propto$ *Resilient (climate changes, stresses) population (adaptability)*".

In modern agriculture, genetic diversity is mostly talked about and utilized in breeding stations. Such diversity is very crucial in the field as there is huge diversity in different aspects e.g., soil type, climate, biotic and abiotic stresses, etc. (Mcguire & Sperling, 2016; Sthapit et al., 2019; Thapa Magar et al., 2020). Diversity at all five hierarchical levels and types (Figure 2) should be increased as much as possible to make the agricultural business profitable, sustainable and self-dependent.

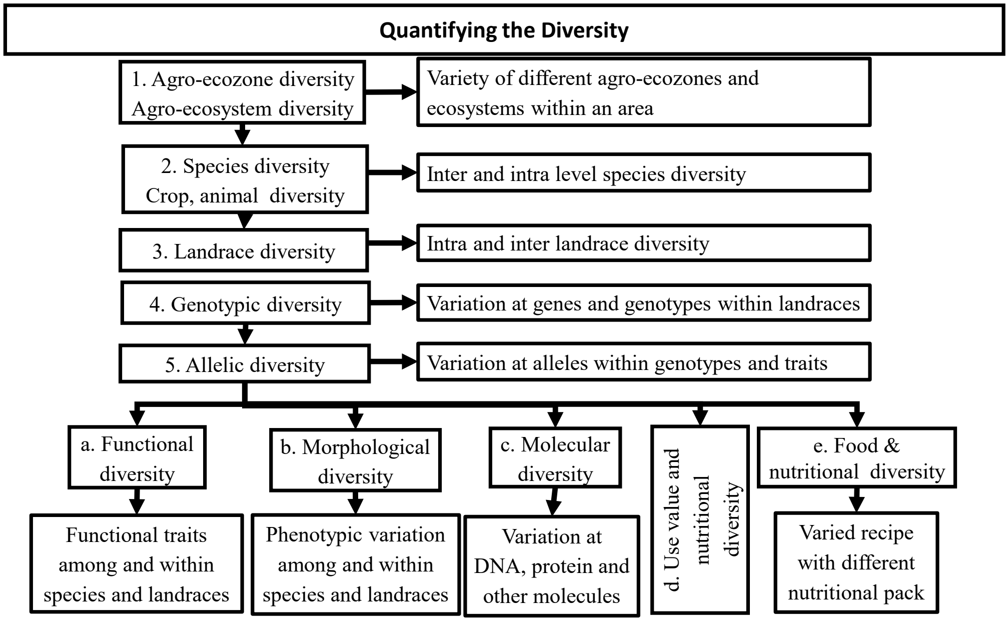

Figure 2. Hierarchical levels (number levels) and types (horizontal box levelled by letters) of agrobiodiversity

3.2 Policy provisions and gaps

Provisions and gaps in policies related to agriculture, agrobiodiversity, environment, nutrition and climate changes are given in Table 1. The majority of the policies have considered the importance of native agricultural genetic resources, but they are poorly implemented. Informal seed systems, informal agricultural practices and neglected and underutilized AGRs have been poorly recognized in these policies. Due to the favourable policies for exotic and uniform mono genotypes (of crops, forages, livestock, fish, bees, mushroom, etc.), more than 90% of total germplasm in the formal system are exotic. Major gaps in these policies are restrictions on formally handling and promoting genetic diversity, cultivar mixture, heterogenous and localized evolutionary populations, native landraces and wild relatives and edible species (MoAD, 2013). The guiding philosophy in the policy formulation was that economic benefits can only be derived from the promotion of modern uniform varieties (Gauchan et al., 2004). Moreover, despite some positive policy provisions vis-à-vis interlinkages among agrobiodiversity, nutrition and climate change, many provisions have hardly been translated into action. The majority of the farmers are unaware of policy provisions (Khanal et al., 2022). Lacking a policy framework on farmers' rights also limits the promotion of conservation and use of heterogenous landraces (Gauchan, Joshi, Ghimire, et al., 2018).

Table 1. Provisions and gaps in selected policies related to agriculture, agrobiodiversity, nutrition and climate changes

SN	Policy	Provisions	Gaps
1	Agriculture Development Strategy 2015	• Promote and use local genetic resources • Developing regulation for genetically modified organisms (GMOs) • Promoting community-based seed production • Research on climate-resilient varieties • Reorientation of investment in public research towards biosafety, mitigating effect of climate change, environment and biodiversity conservation	• Complementary interlinkages among native agrobiodiversity, agriculture, nutrition, health and climate change • Promotion of localized genetic diversity for food, nutrition, health, business and environment
2	Agrobiodiversity Policy 2007 (Amendment 2014)	• Manage, conserve and sustainable use of agrobiodiversity and traditional knowledge • Protection of farmers and traditional knowledge • Arrangements for equitable sharing of benefits • Incentives for the conservation of native AGRs • Ex-situ, on-farm and in-situ conservation strategies	• Conservation and marketing of native AGRs through uses • Evolutionary system of agrobiodiversity conservation • Role of agrobiodiversity for nutrition and health security, and climate changes
3	Environment Protection Act 2019	• Periodic study on adverse impacts of climate change on eco-system and biodiversity • Implementation of adaptation	• Agrobiodiversity for balanced agro-ecosystems and enhancing ecological services
4	ITPGRFA-MLS Implementation Strategy and Action Plan	• Documentation system of agricultural plant genetic resources (APGRs) at local, regional and national levels	• Utilizing the native agrobiodiversity for nutrition and climate change mitigation and

SN	Policy	Provisions	Gaps
	(IMISAP) 2017	• All relevant national policies act, and regulations are to be integrated to implement the IMISAP. • One-window system for export of PGR and multiple-window system for import	adaptation • Focus only on crop sectors not integrated farming
5	National Agriculture Policy 2004	• Provision of genebank and biodiversity park • Promotion of in-situ conservation	• Roles of native AGRs on climate change and nutrition and health improvement • Agro-park, agro-garden, agro gene sanctuary for the conservation • Marketing and promotion of native AGRs
6	National Climate Change Policy 2019	• Agriculture and food security-related issues • Crop diversification, protection of agricultural biodiversity and organic farming	• Linkage with nutrition, resilient system using niche-specific agrobiodiversity
7	National Environment Policy 2019	• Mainstreaming environment issues in development plans and policies • Pollution control, waste management, nature/ environment-friendly sustainable development	• Good practices of agrobiodiversity conservation and utilization, circular agriculture • The role of agrobiodiversity in carbon sequestration, climate change mitigation, and developing an evolutionary production system

SN	Policy	Provisions	Gaps
8	National Seed Policy 1999	• Conservation of local crop varieties and agrobiodiversity • Protecting the rights of the local community • Regulation of GMOs	• Good practices for dynamic conservation of native AGRs • IPR mechanisms for AGRs and associated knowledge
9	National Seed Vision 2013-2025	• Use of local landraces and their wild relatives for developing climate-resilient and nutrient-rich varieties • Local seed security and promote community-level conservation works • Promote the exchange of germplasm among national, international genebanks and community seed banks	• A specific mechanism for the use of native agrobiodiversity for food, nutrition, health, business and environment • Informal and non-formal seed system • Seed production by farmers
10	Seed Act 1988 (Amendment 2008)	• Promotion and regulation of quality seeds and exotic seeds • Ownership rights to local varieties	• Values of agrobiodiversity, in the context of climate change and nutrition • Marketing of seeds not linked with ownership rights • Informal seed system • Native crop landraces in the formal seed business • Genetic variation within cultivars
11	Zero Hunger Challenge National Action Plan 2016-25	• Five pillars-based actions for creating hunger and malnutrition free society • Actions for promotion of climate-smart crops	• Complementary interlinkage among agrobiodiversity, nutrition and climate change • Site-specific stable food items and genetic resources

Although modern varieties produce relatively high yields, the risk of harvest loss is comparatively more than the landraces. Landraces are polymorphic and keep evolving as directed by nature, therefore, they are resilient to climate change and other factors. Even with minimum care and inputs, landraces produce a good amount of grains and biomass. This is mainly because of a higher degree of genetic diversity in landraces as compared to modern varieties (Joshi et al., 2018). Because of these merits, registration of landraces is now started in some countries e.g. Bolivia, Laos, Nepal, Zimbabwe, India, Mexico, China, Peru, Ethiopia, Turkey, and Spain (De Jonge et al., 2021). The impact due to gaps in policies along with mitigation is given in Figure 3. The major impact is the loss of genetic diversity and an unstable production system mainly due to the wide expansion of monoculture. Such monoculture also contributes to creating an unhealthy environment, unhealthy people and an imbalanced agroecosystem. Site-specific genetic diversity of all six components of agrobiodiversity should be maximally utilized for food, health, nutrition and environment security and to cope with climate changes.

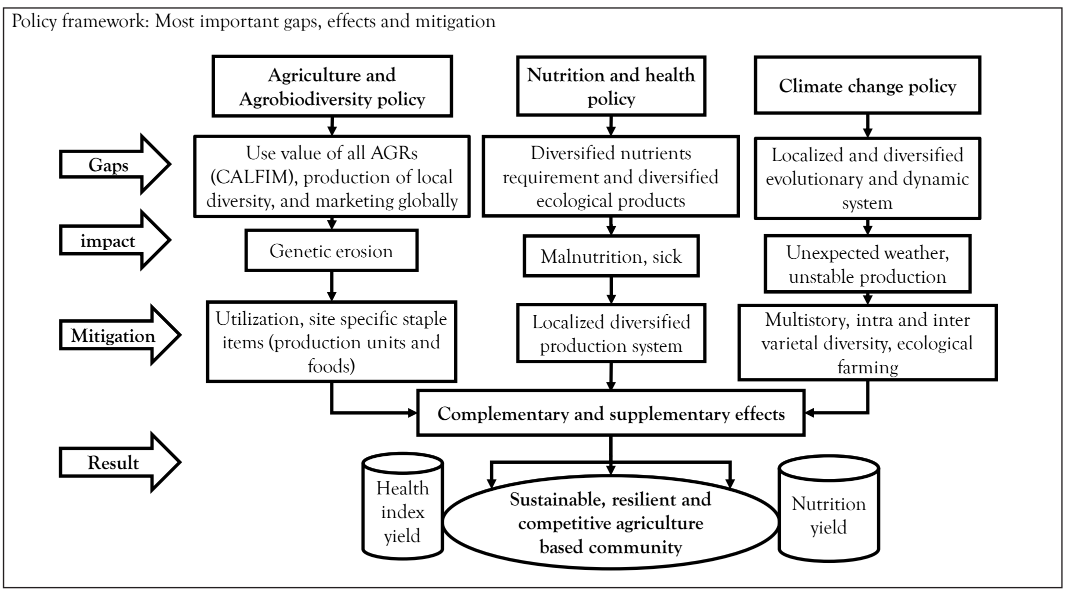

Figure 3. Most important gaps, effects and mitigation in three policy sectors

AGRs: agricultural genetic resources; CALFIM: crop, aquatic, livestock, forage, insect and microorganism *Source: (NABS & LI-BIRD, 2021)*

3.3 Localized evolutionary population and native landraces

Nepal has three agroecozones and 15 agroecosystems. Due to varied climates and landforms, a large number of unique and localized agricultural genetic resources are being evolved, maintained and used by farmers. Farmers keep handling such landraces by imposing less selection pressure which means giving nature to decide for survival and production. This process is also the same for livestock, forage, agro-insects, agro-microbes, and aquatic genetic resources. Such populations have high genetic variation within and between (Joshi et al., 2018), therefore, keep evolving as per the direction of natural factors. Yield advantages and disease tolerances of the genetically diverse population have been well established in many crops (Mundt, 2002; Rahmanian et al., 2014). Some localized and famous landraces are listed in Table 1. These are very potential for agri-business and getting geographical indication right. But due to the wide scaling of single and uniform varieties, such localized evolutionary populations and landraces are at risk of extinction. In addition, policy support is almost negligible for these resources. If there is a provision of providing a geographical indication tag to such products, landraces or heterogenous populations may not be necessary to register.

Table 2. Major localized and famous agricultural landraces and products

SN	Landrace/ product	Location	Unique traits
1	Ailaa (whiskey)	Kathmandu	Very strong, high market value
2	Akabare Khursaani	Ilam	Very hot but delicious with medicinal properties
3	Apple	Marpha, Dolpa and Jumla	Very delicious, juicy, high demand and market value
4	Bean	Jumla, Mustang, Humla, Rasuwa and Lukla	Very delicious, nutritious, high demand
5	Bhaktapur ko dahi (yogurt)	Bhaktapur	Very good taste, high market demand and value
6	Black gram	Ramechhap	Easy to cook, tasty
7	Cheese	Illam; Langtang, Jiri	Good taste and color
8	Digaam gud (sugarcane jaggery)	Gulmi and Tokha	Sweet, good smell, tasty
9	Hamsaraaj dhaan (rice)	Sudhur Paxchim province	Very soft, aromatic and tasty
10	Jumli maarshi (rice)	Jumla	Adapted to cold areas, tasty, nutritious, *aandilo*

SN	Landrace/ product	Location	Unique traits
11	Kaalo musuro (lentil)	Rasuwa	Delicious
12	Khoku ko suntalaa (mandarin)	Khoku, Dhankuta	Delicious
13	Kulekhaani ko asalaa (fish)	Kulekhaani	Delicious, high market value
14	Maadaale Kaakro	Pelakot, Aaruchaur, Rupakot, Syangja	Good for pickle, disease and insect tolerant
15	Mankamanaa ko suntalaa (mandarin)	Manakamana, Gorkha and Dhankuta	Juicy, tasty
16	Mudeko aalu, Bajhanko aalu, Hemjako aalu (potato)	Mude, Dolakha; Langtang; Hemja, Kaski and Bajhang	Soft, tasty, delicious
17	Naaphal (wheat)	Humla	Winter wheat, a high protein content
18	Oil (mustard)	Khokana	Tasty, good smell
19	Pharping ko naaspati (pear)	Pharping, Kathmandu	Delicious and juicy
20	Pyuthane mulaa (radish)	Pyuthan	Tasty, high-demand, shiny
21	Rumjataar ko suntalaa	Rumjataar, Okhaldunga	Sweet, juicy
22	Sugarcane	Dhunibensi	Soft, juicy
23	Timur	Salyan; Pyuthan	Pungency, good taste, medicinal value, high oil content
24	Trishuli ko maachhaa (fish)	Trishuli	Delicious
25	Tusaa (bamboo shoot)	Pokhara	Tasty and nutritious

3.3.1 Practices in the field

Formal and informal practices are found in the field. Informal practices maintain, promote and use genetic diversity and formal practices promote monogenotype on a wider scale (Table 3). Traditional agriculture values the genetic diversity in farmers' fields and houses, but modern agriculture pushed such genetic diversity either in the room as Genebank or replaced by distributing modern varieties. Almost all breeding methods in modern agriculture target to develop of uniform, and monogenotype with high economic yield in high input conditions. Informal practices are more nature-positive and old age which keeps high diversity at all five hierarchical levels and five types of diversity (Figure 2). These informal practices maintain broad genetic base populations, whose products can also be marketed well (Ceccarelli, 2017). The formal system has focused on very few crops and forage species. In addition, many seed suppliers have emerged for promoting the formal seed system (Sthapit et al., 2019).

Table 3. Current formal and informal practices in agricultural fields

SN	Practice	Features	Type	Policy dimension
1	Agro-eco zone specific genotype and technology	Consider only three agro-ecozones and few genotypes and technologies in large areas	Formal	Favored by policy
2	Chemical (fertilizer and pesticides)-based farming	The immediate impact on cultivars is costly and outside dependency	Formal	Favored by policy
3	Crop mixture	Different species growing together, balance agro-farming system, maintain species richness	Informal	Less favored by public sector agri-policies
4	Cultivar mixture	Production is secured, diversified and nutrition-dense production, diversity is conserved, and the population keeps evolving	Informal	Less favored by public sector agri-policies
5	Formal breeding and seed system	Develop monogenotype using diversity, recommend single variety to large scale, legal to market seeds and restricted seed production	Formal	Policy-based practice

SN	Practice	Features	Type	Policy dimension
6	Haatbazar (open-air market)	Direct connection between primary producers and consumers, even small amount of products can be sold	Informal	This is not policy guided
7	Household-specific landraces and technologies	Private genotypes and knowledge inherited within a family lineage, creation and maintenance of diversity by an individual family	Informal	There is a policy gap
8	Integrated farming	Circular agriculture, the production of all six components of agrobiodiversity (crop, forage, livestock, aquatic, insect, microbe), plays an important role in agrobiodiversity	Formal and informal	Limited policy guidelines and provisions
9	Mechanized farming	Imported machines for commercial and monoculture	Formal	Policy supported
10	Monoculture	Single genotypes over a large area, replace much genetic diversity in the field	Formal	Policy supported
11	Multi traits focused farming	Growing many different types of germplasm for the production of diversified traits (grain, vegetables, forage, etc.)	Informal	The policy does recognize at a limited scale
12	Natural selection and informal seed system	Does not have a separate mechanism for seeds and genetic diversity is handled by nature and utilized by farmers	Informal	The policy does not support
13	Open agriculture	Farming in a normal and open field favors natural factors to play	Informal	A very limited provision in the policy

SN	Practice	Features	Type	Policy dimension
14	Own seeds source	Maintain all planting materials over the years by farmers themselves, inherit the localized diversity	Informal	Less favored by public sector agri-policies
15	Protected agriculture	Farming in controlled condition, with natural factors controlled, need more care and inputs	Formal	Supported by policy
16	Seed business	Seeds for farmers are channelized through profitable businesses, and many different steps involved	Formal and informal	Supported by policy
17	Seed exchange	Farmers exchange seeds freely as gifts, barter system, or through a sale	Informal	Lack of promotional and supportive actions
18	Seeds from the agro vet and registered organization	In linear agriculture, farmers need to purchase seeds each season, creating a mechanism to involve seed merchants to make a profit from farmers	Formal	Policy favors this practice
19	Single trait-focused farming	Only focus on grain yield, ignore all agro-ecological factors to maximize the grain yield	Formal	Policy favors this practice
20	Traditional tools-based farming	Labour-intensive, agro-ecosystems undisturbed	Informal	Less favored by public sector agri-policies

3.3.2 Farmers' Expectations and Rights

Farmers are producing a diverse set of agricultural products in varying amounts. Two major expectations of farmers are market and irrigation assurance. Farmers can manage all types of agricultural inputs except irrigation and market. If there are market guarantees even for a single fruit or seed, farmers can produce a lot which ultimately helps to secure food and nutrition. To promote the marketing of local products, farmer's households should be considered as a shop and collection centers should be established in many locations. Year-round irrigation facilities on the other hand can boost the farmer's willingness to produce more and more diversified products. They want to ensure that the inputs are timely and available at affordable prices. A system or practice of self-dependent agri-business is always in demand.

Major farmers' practices and their rights are given in Figure 4. Many formal processes have transferred farmers' rights to other institutes and stakeholders. For example, many strategies have focused on increasing the seed replacement rate (SRR) which ultimately restricts on saving of seeds by farmers themselves. This SRR system makes farmers compulsion to buy seeds from the markets. Similarly, among the different seed classes in the formal seed system, farmers are not eligible to produce the seeds of many of these classes. But farmers have maintained landraces from generation to generation and have rich knowledge of seed production and maintenance. And such landraces should be considered private goods. We can observe specific lineages of landraces of many crops being maintained over many years and some farmers have also very unique landraces. Farmers should have, therefore, the right to handle such landraces as private goods.

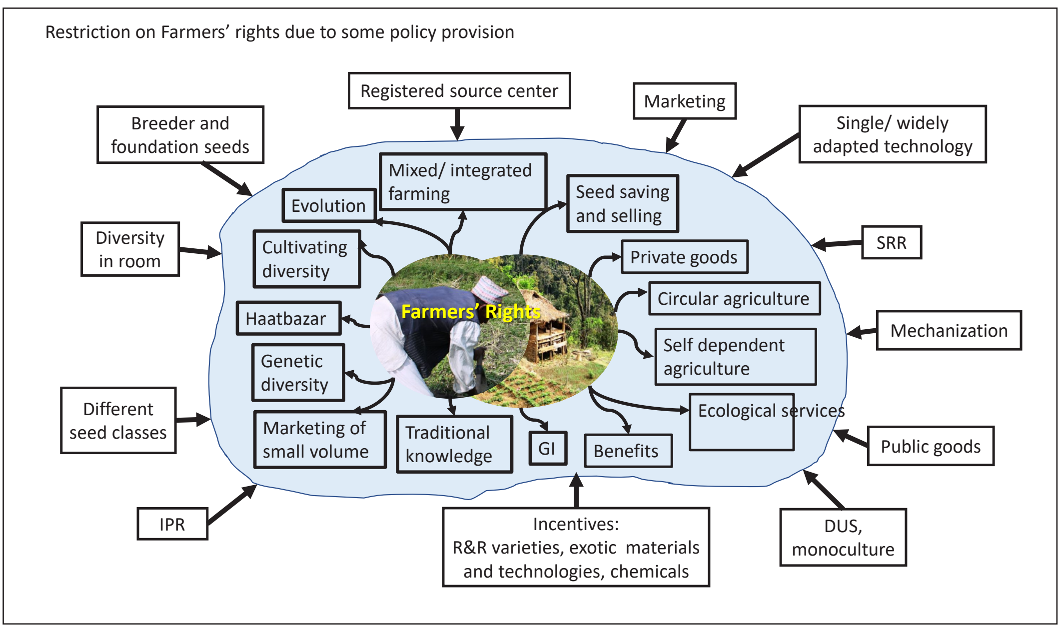

Figure 4. Farmers' rights (central part) endangered due to policy and formal system (outer rectangular boxes) of agriculture

GI, geographical indication; SRR, seed replacement rate; IPR, intellectual property right; DUS, distinctness, uniformity, stability; R&R, released and registered

3.3.3 Policy options for genetic diversity, the heterogenous and localized evolutionary population and native landraces

- Develop the standard protocols and practices for promoting polymorphic and heterogenous cultivars (e.g., landraces, cultivar mixtures and evolutionary populations) through a formal system. Identification keys of any type of all cultivars are necessary and therefore, it is important to identify such keys for handling and maintaining such cultivars. A system should be developed for the release or registration of such broad genetic base populations, native landraces and traditional knowledge. Regulation needs to revise for favouring variations within cultivars considering not only mean value but also minimum and maximum values, and standard deviation of important traits. The provision of an equal (or different) proportion of each variant in a population could be the simple method for maintaining, cultivating and distributing of population. Alternatively in the case of cultivar mixture and EP, either components, mixture, or population as such should be able to register by farmers and researchers. Another option is to create a provision of marketing products of heterogenous cultivars and populations without registration of seeds.
- Seed-related regulatory frameworks should have a provision of rewarding cultivar mixture, evolutionary population and contribution of an individual farmer or researcher in maintaining the landraces. The policy should support farmers to produce seeds themselves for next season's planting and marketing of seeds. Native and local landraces should be treated as private goods, which can be promoted and marketed not only the seeds but also their products.
- Develop and implement mechanisms and strategies to control the drivers of agrobiodiversity. The working principles of red zoning, red listing and germplasm rescue should be mainstreamed. Before the implementation of any project, the policy should have a provision for carrying out the agrobiodiversity impact assessment (AIA). Important native AGRs should be collected or relocated from such project sites as well as from farming areas where modern varieties are planned to be disseminated widely. For the overall conservation of AGRs in dynamic mode, there should be provision for establishing agro gene sanctuary (similar to a national park), agrobio garden (similar to a botanical garden), agrobio park (similar to a city park), agro-zoo (similar to the zoo).
- Recognize the roles of agrobiodiversity in food policy, nutrition and health policy, climate change and environment policy and intellectual property rights. There should be a conservation and utilization-focused agrobiodiversity policy;

a multiple commodities-based food policy; a multi traits-based climate change policy and a nature-positive product-based nutrition policy.

4. Conclusion

The management systems for agriculture and agrobiodiversity in Nepal exhibit significant differences between policy provisions and farmers' practices. The major policy gaps include lack of recognition of genetic diversity, both intra and inter-cultivar diversity, marketing of native agricultural genetic resources, site-specific landrace and food items development, complementary interlinkage among agrobiodiversity, nutrition, food and climate change, etc. Additionally, policies have not prioritized the promotion of localized evolutionary populations, though, evolutionary and heterogenous populations are crucial for ecologically resilient agriculture systems, as agrobiodiversity plays a multi-functional role in food, nutrition, health, business and environmental security. Despite this, the majority of farmers still follow the informal seed system and to meet their diverse needs and maintain agroecosystems, farmers adopt practices that promote and demand more diversity at species and genetic levels. Farmers have partly controlled both abiotic and biotic stresses through increased genetic diversity. Therefore, policies should include the provisions to promote increased genetic diversity and marketing of native AGRs and their products.

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Authors Contribution

Bal Krishna Joshi: Conceiving ideas; formulation of overarching research goals and aims; Development or design of methodology; Conducting a research and investigation process, data/evidence collection; Report initial draft and final revision

Subodh Khanal: Conducting a research and investigation process, data/evidence collection; Provision of study materials, materials; Report review

Ram Krishna Shrestha: Formulation of overarching research goals and aims; Development or design of methodology; Conducting a research and investigation process, data/evidence collection; Provision of study materials, materials; Report review

Conflict of Interest

The authors decleared no conflict of interest.

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