and weak extension programs. So one of the best possible solutions for seed sector post-corona can be enough subsidies, investments for research over plant breeding, seed production sectors and seed trade, with more trained manpower recruitment for field work to lab as technicians, with supportable and trustable marketing teams. Small seed enterprises, CBSPs and CSBs can work more vividly on decentralization of seed production and provisioning.

### *5.9.2 Following of National legislation on Seed Sector by Informal system*

Several seed policy instruments were formulated in last two and half decades. But formulating legislations and policies is one thing, the more important aspect is how effectively they were implemented and whether or not the policy instruments produced intended results/changes in a given situation and timeframe. Lack of political stability, weak law and order situations, prevailing socioeconomic conditions, population dynamics and external factors are the mainly cause of failure in case of Nepal. Most of the seed policies and regulations prepared and implemented so far largely consider the formal seed systems (except in case of landraces and indigenous knowledge) that operate with a few released and registered crop varieties. Informal seed systems in Nepal probably enjoy most flexibility as farmers do not have to comply with any seed regulations. In Nepal, due to the dominance of informal seed system, demand for crop variety depends on how widely any crop variety is known and used already. Any such demand is created due to the popularity rather than agronomic performance and genetic merit of the varieties.

Such a system favors production of outclassed varieties unless a systematic advertisement campaign for new varieties is in place. New varieties are less demanded because farmers are not aware about the better available options as the availability of private, public sectors supporting formal system are limited in numbers, and not enough to cover rural areas. This shows that even the regulations of policies and rules are not always enough to run a productive system in country unless those rules are not implied by governments strongly. There are many examples of developed countries country like Canada, where some restrictions among the formulated ones are followed by FSS or ISS. So, after the opening and loosening up of lockdown after corona, this sector can be improved by Government.

As this gives opportunity for informal and formal sectors to work hand-on-hand for providing seeds as per demand to the farmers. Informal seed system will benefits from a dynamic formal seed system that is fully linked with modern advances in plant breeding. New recovery model can also be created for the informal system from the legislative under seed sector to make availability of seeds on reliable sides for everyone. Similarly, formal seed system will benefit from the informal system in many ways and most importantly in terms of acquiring precious landraces and indigenous knowledge associated with the traditional varieties for using in pre-breeding research. Strong and live interactions, learning and sharing between the two systems for continuously internalizing good practices will make overall seed system more dynamic and responsive to the needs of the farmers and country as whole.

### *5.9.3 Encouraging Farmers for Seed Replacement*

The quality seeds of popular high yielding or hybrid varieties are the good seeds preferable to the farmers for cultivation. The productivity in agriculture will increase by many-folds if bad seeds are replaced by good and quality seeds. The farmers will be very encouraged and benefitted by replacement of the bad seeds by the good ones (Hasanuzzaman et al., 2015). Since the quality of farmer's saved seeds is poor, the availability of quality seeds will not only improve seed replacement rate but also help saving of seeds by using lower dose of seed per unit area (Hasanuzzaman et al., 2015).

### *5.9.4 Digitalization on Seed Sector*

As we went through the problems in seed sector in this pandemic, seed assessment was found to be one of the greatest problem. So, extension system should be flourished now, after post-covid situation. At present, Seed Quality Control Center (SQCC), Nepal Agriculture Research Council (NARC), the Centre for Crop Development and Agro Bio-diversity Conservation (CCDABC) and the Vegetable Development Directorate (VDD) are using paper-based data collection systems to record and plan seed production every year. Introduction of digital system for certification, assessment on information of new seeds, hybrid seeds, new rules and laws on restrictions, management can help in continuation of supply chain even in future disasters to occur where if transportation will be put in halt. It increases traceability including even in supply chain. Now-a-days, people have access to mobile phone, even at rural areas, so it will be an effective tool to access digital system at most of the areas.

The best thing about it is that, it can be a good tool to combat fraud in extension system. It can also be a time efficient tool. Digital solutions are critical to link the agricultural market with vital information so farmers can make decisions for better production and harvest. Another advantage provided by digital system in the context of Nepal is, till the date there has been introduction of such apps that gives information about the crop types based on regions, climatic factors to the farmers (Dawe, 2002). By enhancing that characteristics, more of seed regulated type of apps can be created that collects feedbacks from farmers on their preferred varieties of different crops, and also can function to provide information on newly introduced varieties seeds in the market. It can liven up e-commerce platform among retailers.

### *5.9.5 Launching of SeedNL in Nepal*

On the 16th of October, international World Food Day, SeedNL was launched. SeedNL is a public-private partnership with as its goal to strengthen the seeding industry in developing countries to improve the productivity of local growers. The partnership consists of the Ministry of Agriculture, Nature and Food Quality, the Ministry of Foreign Affairs, and Plantum, the trade association for companies working with seeds and young plants. The projects of SeedNL aim at training the growers to grow better crops and to generate more income with them. The projects pay special attention to the availability of good seeds (FAO, 2019). To realize this, good and practical rules are being made to follow if wanted. By working on the availability, access, and the use of good quality food crop seeds, SeedNL aims to contribute to the accessibility of safe, nutritious and plentiful food, countering malnutrition and raising the sustainability of food production (FAO, 2017b). Since it's a new scheme established in the seed world, so by associating with SeedNL, various new projects under seed improvement with other international partners can also help in uplifting of seed sectors.

### *5.9.6 Increase in association with international companies*

Eighteen index companies report having a presence in Nepal. While six companies indicate having testing locations in the country. Advanta and Lal Teer seed are the only two companies producing seed. And, Lal Teer Seed is the only company that has a full seed value chain in Nepal from breeding to extension services. At the current situation, processing plants and dedicated extension services are the major areas of improvement for companies (Srinivasan, 2000).

Leading this discussion, Nepal can work on increasing association with those international companies that work in especially those two sectors, with high ranks in seed indices among seed companies like Advanta, Acsen Hy Veg, etc. By taking inspiration from Africa; a country that has been facing many crisis since decades and decades where breakout of HIV/AIDS, Ebola, locusts plague had taken place and had led to them for food insecurity for innumerable times, as they are one of the exemplary and prominent country to work for sustainable agriculture and have achieved it by great extents too. Africa also has lots of public seed companies that ranks pretty high in seed indices too. So by enhancing the existing seed companies like Annapurna, Lumbini, NSC, NSCL, Unique seed and we can open even more of such companies for being self-reliant in producing seeds ranging from breeding to extension services.

### *5.9.7 Enhancing the Genetic Factors of Seeds through Breeding*

The most initial part during seed production is the breeding part. So, to enhance the genetic make-up of the seeds, we need to take care of the part of pollination. According to the ITPGFRA, acknowledging that the conservation, exploration, collection, characterization, evaluation and documentation of plant genetic resources for food and agriculture are essential in meeting the goals of the Rome Declaration on World Food Security and the World Food Summit Plan of Action and for sustainable agricultural development for this and future generations. The Treaty's truly innovative solution to access and benefit-sharing is its declaration that 64 of our most important crops - crops that together account for 80 percent of all human consumption - will comprise a pool of genetic resources that are accessible to everyone.

By implementing multi-lateral treaty by ITPGFRA, breeders of various scientific institutions and private sector gets the opportunity to work with potentially and improved materials stored in gene banks of regional, national and international level of various countries gives exposure to wide range of genetic diversity to seeds. Also by facilitating research, innovation and exchange of information without restrictions, this cuts down on the costly and time consuming need for breeders to negotiate contracts with individual gene banks. Through which, desired inoculation of required traits can be done, and even more experimentation can be done to produce more advanced seeds. This can also promote on more use of farmer's right to save, use, exchange and sell farm-saved seed and other propagating material, and to participate in decision-making regarding, and in the fair and equitable sharing of the benefits arising from, the use of plant genetic resources for food and agriculture.

It is vital to use indigenous plant genetic resources for food and agriculture through pre-breeding process to develop climate resilient crop varieties with high yield and better agronomic performance. Coordination between all the institutions for PGR exchange needs to be in place to regulate the exchange of plant genetic resources for food and agriculture in the best interest of the country. Popularising and institutionalising 'truthfully labelled' seeds as flexible means of promoting seed trade in the rural areas by informal, semi-formal systems and formal systems can directly contribute to strengthening food and nutritional security as well as create additional business opportunities in seed industry.

### *5.9.8 Providing Seeds on Kitbox as Relief Package*

As the lockdown as going in countries, many times news about relief packages were hitting too. More refined form of this system as a new act in Seed sector can be continued as "New Normal" by initiating this thought with a kitbox which not only includes foods, clothes and other things but also includes seed packages of main cereal crops and vegetable crops. Even, this thought can be initiated as a part of effective promotion of recently introduced varieties in Nepal. Provision of supplying seeds in packages within a certain group by acting them as a significant unit. So, farmers can investigate on those varieties as per their favorability and preferences in many terms, with low monetary act and reduced risk even if it doesn't go good. In another side it acts as a benefit for seed producing and seed importing units for intensifying the popularity of newly adopted varieties among rural farmers. Moreover, continuous inspection on those farmers can be done to know about the behavior of given varieties in long term uses; so that if any dysfunction found in it, it can be helpful for further biotechnological improvement on them to secure food for future generations.

### *5.9.9 Increased Seed Storing Facilities*

For successful and systemized production of quality seeds and for prolonged flow of it in seed-chain, one of the most important factor for it is seed storage units in Nepal. Building and repairment of seed storage units in new areas can be the new area of focus within seed sector as post-corona situation. For storing seeds, many things need to be considered like temperature regulation to maintain moisture content of seeds, to maintain viability of seeds; provision of protection from insects and mites, to successfully operate seeds' qualities. As we have already gone through the information that most of the seeds in value chain comes from farmers' seed system.

High temperatures and humid conditions combine to cause rapid deterioration of seeds in open storage, resulting in lost value, poor stand establishment, lowered productivity and a disincentive to invest in improved seeds. Most horticultural seeds in Nepal are locally produced or self-saved and stored without facilities for maintaining dryness that would greatly extend the seed longevity in storage. So more focus should be done for preparing storage units from farmers' preferences and requirements, with the inclusive concept of agro-climatic conditions of farmers'. Hermetic storage with plastic sealing, rustic storage (for potato) etc. are some of the popular choices as storage bags. More of such bags that are eco-friendly is an opportunistic area for exploration and improvement within seed sectors.

### *5.9.10 Introduction of Sanitary measures in Agriculture*

During the havoc of COVID-19, area of hygiene gained the most attention among all people, of all societies. Among many bad 'Old practices' that is being followed in agriculture, one of them is working under unhealthy and dusty operating environments of agriculture. Although it hasn't hit attention of many people but it is also a sector within agriculture that needed to be advocated. And it's all thanks to this pandemic, farmers are now getting more aware of their health. So, agricultural laws now should be inclusive about the sanitary habits among farmers, technicians, labors. As of now, provision of good masks, with sanitizers, access to clean water along with other necessities as per their suitable requirements should be given to them. Phytosanitary measures were always an attentive sector among seed exporters. But now, strong quarantine checkpoints need to be established in the border sides with technical knowledge in the given sector; to allow the access of healthy, safe seeds in country as per the vision of food safety.

### *5.9.11 Usage of micro-climatic condition in integration with workshops training*

Nepal has a diverse range of agro-ecological conditions ranging from tropical to sub-tropical and temperate due to altitude gradient from the southern plain of the terai to the hills and mountains. Topography and geology provide a multitude of agro-ecological pockets, many with favorable soil and water conditions that are suited to a wide range of annual and perennial crops, as well as location specific livestock breeds. Nepal's source of comparative advantage lies to its unique natural resource base. Comparative advantage refers to a situation where a country has relatively favorable factor conditions which can serve as the basis for developing competitive advantage in the marketplace. Such factor inputs may include natural resources, human resources, capital resources, physical infrastructures, and information infrastructure. The agro-ecological diversity has always been advantage for running agricultural practices. This is the reason why, people in Nepal can quickly adopt and adapt with agricultural practices because of gift of natural resources that promotes for agricultural development. There are numbers of regions that can act as main hubs for supplying main crops to people all around Nepal. But also the presence of pocket areas, off-season production is also one of the popular sector that is fostering in agriculture. These sites can also be utilized as seed breeding hubs either on or off seasons. In addition to agricultural development as per agro-climatic conditions, workshops for training local people with necessary knowledge should also take place. This is another sector that can be fostered after the pandemic for agricultural seed sector development.

## 6. CONCLUSION

Now, it's not a matter of wonder that nature is deteriorating in rapidly with the increased population, urbanization, industrialization; that has disturbed balance within complex, causing many climatic hazards. But, mother-nature knows how to heal herself, so once in a while World has

been hit by such pandemics since centuries which if not controlled can even lead to human extinction. UN has declared that in future too, we will be hit by pandemics worst even than we are going through. That's why, unlike pre-corona situation, we need to stop thinking about only present moment but also focus for sustainable future. Preparedness plans within agriculture sector needs to be done by revolutionizing seed sectors. So, that people won't need to go through situation of food crisis, hunger, lack of cultivating source materials. Lives of "New Normal" or "Better Normal" need to be adopted by people for better and sustainable environment.

## REFERENCES


Baer-Nawrocka, A., Sadowski, A. 2019. Food security and food self-sufficiency around the world: A typology of countries. PLoS ONE, 14 (3), Pp. e0213448. https://doi.org/10.1371/journal.pone.0213448

Dawe, D., 2002. The changing structure of the world rice market. Food Policy, 4, Pp. 1950–2000.

FAO, 2009. International Treaty on Plant Genetic Resources for Food and Agriculture

FAO. 1998. Seed and Plant Genetic Resources Service, 'Developing seed security strategies and programs for food security in developing countries', Proceedings of the International Workshop on Seed Security for Food Security: Contributions for the development of seed security strategies in disaster-prone regions, Florence.

FAO. 2006. Agriculture and Development Economics Division (ESA). Policy Briefs, Issue 2

FAO. 2015-16. Food self-sufficiency and international trade: a false dichotomy

FAO. 2017b. http://www.fao.org/fileadmin/user_upload/faoweb/plant-treaty/submissions/Farmers_Seed_Systems_in_Nepal_Review_of_National_Legislations.pdf

FAO. 2020a. http://www.fao.org/agriculture/crops/thematic-sitemap/theme/compendium/tools-guidelines/what-are-seed-systems/en/

Gauchan, D., 2015. Research and Support Services in Seed Production and Supply in Nepal Final Draft Thematic Paper for Seed Submit.

Hasanizzaman, M., 2015. Seed quality. www.hasanuzzaman.webs.com SeedNL.https://www.hortidaily.com/article/9154249/seednl-launched-to-improve-the-productivity-of-growers-in-developing-countries/

IFPRI, PPD MoAF, 2010. Food Security and Food Self-sufficiency in Bhutan.

Initiatives, L., 2018. Farmers' access to quality and diverse seed in Nepal: Implications for seed sector development.

Louwaars, N.P., De Boef, W.S., 2012. Integrated Seed Sector Development in Africa: A Conceptual Framework for Creating Coherence Between Practices, Programs, and Policies, Journal of Crop Improvement, 26 (1), Pp. 39-59. http://dx.doi.org/10.1080/15427528.2011.611277

McGuire, S., Sperling, L., 2011. The links between food security and seed security: facts and fiction that guide response. Development in Practice, 21 (4-5), Pp. 493–508. doi:10.1080/09614524.2011.562485

Mózo, B.S., 2017. 済無No Title No Title. Journal of Chemical Information and Modeling, 53 (9), Pp. 1689–1699.

Parimala, A.K., Subramanian, M.K.K.S., Vijayalakshmi, A.T.V.R., Subbiah, K., Vijayalakshmi, K.R., 2013. A Manual on Seed Production and Certification Centre for Indian Knowledge Systems. Chennai Revitalising Rainfed Agriculture Network.

Srinivasan, T.N., 2000. Poverty and undernutrition in South Asia. Food Policy, 3. https://doi.org/10.1016/S0306-9192(00)00006-3

WFP. 2020a. Nepal COVID-19 Food Security and Vulnerability Update 2

WFP. 2020b. Nepal COVID-19 Food Security and Vulnerability Update 3

Wyss, R., 2018. Farmer's Access to Quality and Diverse Seed in Nepal: Implications for Seed Sector Development, Bioversity International.