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Community-based Vegetable Seed Production for Agricultural Sustainability and Food Sovereignty in Bangladesh

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ABSTRACT

Agriculture is the backbone of Bangladesh's economy, with the vegetable sector playing a pivotal role in ensuring food and nutritional security. However, challenges such as low-quality seeds, high dependence on imported seeds, and weak market linkages hinder productivity and profitability for smallholder farmers. Quality seeds are essential for higher yields, disease resistance, and climate resilience, yet access to affordable, certified seeds remains limited for many farmers. To address these challenges, a community-based vegetable seed production model was implemented through cooperative systems, leveraging technical support from the Bangladesh Agricultural Research Institute (BARI) and the organizational strength of the Sara Bangla Krishok Society (SBKS). The project, titled *"Community-Based Sustainable Vegetable Production: Elevating Quality Seed Production, Processing, Marketing, and Expansion of BARI Released Varieties in Bangladesh,"* was funded by Dutch Bangla Bank PLC. The initiative engaged 137 farmers across three seasons (Winter 2023-24, Summer 2024, and Winter 2024-25) in cultivating 24

vegetable types and 31 BARI-released varieties, including tomato, brinjal, sweet pepper, gourds, beans, leafy greens, and okra. The total cultivated area spanned 20.50 hectares (5064 decimals), producing 16,923.7 kg of seeds with an average productivity of 765.35 kg/ha (peaking at 927.78 kg/ha in Winter 2023-24). Capacity-building efforts included 8 training sessions on seed production and marketing, 6 farmer exchange visits, and a baseline survey to assess market potential. Post-harvest activities—such as seed extraction, drying, quality testing (germination, purity, vigor), packaging, labeling, and storage—were conducted under the supervision of BARI breeders. The seeds were marketed through SBKS's cooperative networks, reaching local farmers, NGOs (e.g., ActionAid Bangladesh, USS), and other buyers. SBKS, a registered apex producers' organization with 115 member groups and over 8,000 farmers across Barind and Coastal regions, played a key role in strengthening farmer-led seed systems. The initiative reduced dependency on external seed suppliers, improved seed quality, and enhanced market access, ensuring better income for farmers. This collaborative model demonstrates how community-based seed production can enhance food security, farmer livelihoods, and sustainable agriculture in Bangladesh. Scaling up such initiatives can further empower smallholder farmers, strengthen domestic seed systems, and align with national agricultural development goals. By integrating research, cooperative networks, and market linkages, this approach offers a replicable framework for resilient and self-sufficient agriculture in similar contexts.

Keywords: Vegetable, nutritional security, quality, seeds, sustainable, community-based, cooperative, and market-linkages

INTRODUCTION

Vegetable seed production in Bangladesh is an essential component of the country's agriculture sector, playing a critical role in ensuring food security and economic growth. Blessed with fertile soils and a favourable climate, Bangladesh has the potential to produce a wide range of vegetable seeds. Over the years, government initiatives, non-governmental organizations, and private seed companies have been working to enhance seed production and distribution to meet the growing demand for high-quality seeds. However, the sector still faces significant challenges, including dependency on imported seeds, inadequate storage and processing facilities, and limited research on indigenous seed varieties. Despite these obstacles, the increasing adoption of hybrid seeds, farmer training programs, and technological advancements indicate a promising future for vegetable seed production. With proper investment and policy support, Bangladesh could achieve self-sufficiency and emerge as a competitive player in the global seed market. Community-based vegetable seed production is vital for ensuring agricultural sustainability and food sovereignty, particularly in regions like Bangladesh, where agriculture is the backbone of the economy and livelihoods. Bangladesh's agricultural sector faces numerous challenges, including climate change, land degradation, and dependency on imported hybrid seeds, which often do not perform well under local conditions. These challenges highlight the need for locally adapted, high-quality seed systems managed by communities to foster resilience, reduce costs, and ensure food security. Community-based vegetable seed production holds immense importance in Bangladesh, where agriculture serves as a backbone for rural livelihoods and food security. This localized approach empowers

smallholder farmers to produce, preserve, and exchange high-quality vegetable seeds within their communities, reducing dependency on costly imports and commercial seed markets. It ensures the availability of regionally adapted seeds, enhances crop diversity, and supports sustainable agricultural practices.

Additionally, community-based seed systems foster knowledge sharing and strengthen social cohesion among farmers. In Bangladesh, such initiatives are particularly significant in addressing challenges like climate change, resource constraints, and rising demands for nutritious vegetables. With proper training, financial support, and policy integration, community-based vegetable seed production can become a vital tool for ensuring food sovereignty and improving rural livelihoods across the country.

Bangladesh Agricultural Research Institute (BARI) is a public funded organization mandated to release vegetable variety, produce breeder seeds of major vegetable crops and deliver them to BADC for onward multiplication and distribution as a mandate. BADC multiplies foundation seeds, produces certified and truthfully labelled seeds (TLS) in seed multiplication farms or through contact growers, and distributes them to public and private agencies and farmers. However, the quantity of these breeders' seeds, foundation seeds, and TLS is not sufficient to fulfil the total amount of seeds. Fulfilling the rest of the seed, the private seed companies are playing a significant role. The effort is not sufficient as a whole, because a significant amount of seed is used by the farmer from their own saved seed or local market seed, which is not up to the mark in quality and quality seed becoming expensive and unaffordable. Bangladesh Agricultural Research Institutes will produce quality seeds of vegetable varieties, parents (of hybrids) and give these seeds of these varieties/parents providing hands-on training to the farmers. Simultaneously BARI will demonstrate some field demonstrations of the popular vegetable varieties/ hybrids so that farmers can understand the productivity of those vegetables at their locality. The farmer will plant the varieties under proper rules, inspection by vegetable breeders and produce quality seeds. Then after seed processing, seed packaging, and marketing to the members of their cooperative farmers. This seed production chain must be done under the direct supervision of vegetable breeders, only then this benefit will be visualized.

Nowadays, there are not enough seeds available from research institutes to distribute to the farmers directly. So, if quality seeds can be produced through experienced farmers' organizations, then the varieties of vegetables will be disseminated quickly. As a result, the production of vegetables will increase, and the financial capacity of farmers will be increased. As the rural youth will be involved in the seed production and marketing system, new employment will be created and will contribute to the development of the country. Community-based vegetable seed production is a collaborative approach where community members come together to produce vegetable seeds locally. This practice empowers communities to meet their seed requirements, preserve seeds, promote food security, and foster self-reliance. The agricultural family is the primitive organization of technological innovation, nurturing, and development. If quality seed production technology is brought under the use of farmers' organizations and related cooperative institutions with appropriate training and technical assistance to farmers, the agricultural family members, basic capacity and success will be

achieved by using modern technology, producing quality varieties, and distributing them through farmers' organizations through mini seed packet. Nowadays, there are not enough seeds available from agricultural research institutes to distribute to the farmers directly. So, if quality seeds can be produced through experienced farmers' community-based organizations, then the varieties of vegetables will be disseminated quickly. As a result, the production of vegetables will increase, and the financial capacity of farmers will be increased. As the rural youth and women are involved in the community-based vegetable seed production and marketing system, new employment will be created and will contribute to the development of the country.

ACTIVITIES IN COMMUNITY-BASED VEGETABLE SEED PRODUCTION FOR AGRICULTURAL SUSTAINABILITY AND FOOD SOVEREIGNTY

Community Mobilization and Awareness Building

Organize workshops and meetings with farmers to raise awareness about the benefits of community-based vegetable seed production. In Bangladesh, local NGOs such as SBKS have conducted seed production activities in rural areas like Rangpur to inform farmers about seed sovereignty and the importance of preserving local varieties.

Formation of Farmer Groups and Cooperatives

Establish farmer groups or cooperatives to encourage collaboration in seed production, exchange, and knowledge-sharing. Farmer cooperatives have been formed by SBKS to manage quality vegetable seed production, fostering inclusivity and shared responsibility.

Selection of Suitable Vegetable Crops and Varieties

Identify locally adapted vegetable varieties that meet community preferences and agroecological conditions. Economically profitable vegetable varieties were selected in this case to sustain the farmers' livelihood. A wide range of OP and hybrid varieties will be selected for the benefit of farmers.

Capacity Building and Training

Provide training on seed selection, production, harvesting, processing, and storage to ensure seed quality and viability. The Olericulture Division of Horticulture Research Centre, BARI conducts regular training programs for farmers on quality seed production, roguing, harvesting, extracting, drying, grading, and packaging techniques.

On-farm Seed Production

Facilitate on-farm production of vegetable seeds, ensuring that the process aligns with sustainable agricultural practices and crop rotation. Farmers integrate vegetable seed production with compost-based farming to enhance soil fertility. To produce quality disease-pest free seed production, regular field inspection, and management were done time to time. The very important thing in this activity is to produce quality seed of OP and hybrid seeds at the farmers' level. The training program was to help the farmers to produce quality seeds. Besides this activity, the vegetable breeders and seed production specialists monitored these activities. BARI developed standard seed production, processing, and packing practices that were followed.

During the first season [Winter 2023-24]**:** In the seed production program, 2946 decimal areas were used for quality seed production, while the seed production was 11065.7 kg with a seed yield productivity of 927.78 kg/ha (Table43). In the second season [summer 2024]**:** In the seed production program, 999 decimals area were used for quality seed production, while the seed production was 2837 kg with seed yield productivity of 701.44 kg/ha. In the third season [Winter 2024-25]**:** In the seed production program, 1119 decimal areas were used for quality seed production, while the seed production was 3021 kg with a seed yield productivity of 666.83 kg/ha. The vegetable and varieties were mentioned in Appendix-I, iii, v.

Farmer Participation and Crop Diversity:

- **Farmer engagement:** The highest number of farmers (78) participated in Winter 2023-24, which declined significantly in Summer 2024 (22) before slightly recovering in Winter 2024-25 (37). This suggests that winter seasons are more favorable for seed production, possibly due to better climatic conditions and higher market demand.
- **Vegetable types and varieties:** A total of 24 vegetable types and 31 varieties were cultivated across all seasons. Winter 2023-24 had the highest diversity (10 vegetables, 14 varieties), while Summer 2024 and Winter 2024-25 had fewer (7 vegetables each). This could indicate that farmers prefer growing a wider range of vegetables in winter, possibly due to lower pest pressure and better yield stability.
- **Production of OP and hybrid varieties**: There were two types of varieties, viz., OP and hybrid varieties, and the seed production system was different for those varieties. To supply quality seed (OP and hybrid) to the farmers, BARI has produced 800 kg of breeders' seed of OP and parents for hybrid varieties.

Land Utilization and Seed Production:

- **Land area:** The total cultivated land was 20.5 hectares (ha), with the highest area (11.9 ha) in Winter 2023-24. The summer season had the smallest area (4.0 ha), likely due to higher temperatures and water scarcity affecting cultivation.
- **Seed production:** The highest seed yield (11,065.7 kg) was recorded in Winter 2023-24, followed by Winter 2024-25 (3,021 kg) and Summer 2024 (2,837 kg). This reinforces that winter is the most productive season for quality seed production.
- **Seed production productivity (kg/ha):** Productivity was highest in Winter 2023-24 (927.78 kg/ha) but declined in subsequent seasons (701.44 kg/ha in Summer 2024 and 666.83 kg/ha in Winter 2024-25). The drop in productivity could be due to varietal differences, climatic variations, or changes in agronomic practices.

Seasonal Variations and Challenges:

- **Winter vs. summer production:** Winter seasons consistently outperformed summer in both seed quantity and productivity. High temperatures and water stress in summer may reduce seed viability and yield.
- **Sustainability concerns:** The declining productivity from Winter 2023-24 to Winter 2024-25 suggests possible issues such as selection of less weight seed like tomato, brinjal, pumpkin, etc., soil nutrient depletion that need addressing.

Recommendations for Improvement:

- **Farmer training:** Since winter seasons show better performance, training programs should focus on optimizing winter seed production techniques.
- **Summer-season adaptations:** Introducing drought-tolerant varieties and efficient irrigation methods could improve summer seed yields.
- **Soil health management:** Declining productivity trends call for soil testing and integrated nutrient management to sustain long-term seed production.

Table 1: Seed production in different districts at farmers' field

Activities	Number of farmers	Number of vegetables	Number of varieties	Area covered (decimal)	Area covered (ha)	Total seed production (kg)	Number of locations	Seed productivity (kg/ha)
Winter 2023-24	78	10	14	2946	11.9	11065.7	3	927.78
Summer 2024	22	7	8	999	4.0	2837	3	701.44
Winter 2024-25	37	7	9	1119	4.5	3021	3	666.83
Mean	45.7	8.0	10.3	1688.0	6.8	5641.2	3	765.4
Std. Dev	28.5	1.7	3.2	1073.1	4.3	4614.6	0	133.0
CV (%)	62.3	21.6	31.1	63.6	63.7	81.8	0	17.4
$LSD_{(0.05\%)}$	81.9	5.0	9.3	3089.5	12.5	13284.1	0	383.0

Std. Dev = Standard Deviation; CV = Coefficient of Variation (%); LSD = Least Significant Difference at 5% significance level

The data highlights that winter is the most productive season for quality vegetable seed production, with higher farmer participation, land utilization, and yields. However, the decreasing productivity trend in subsequent seasons indicates a need for better agronomic practices and climate-resilient strategies. By addressing these challenges, farmers can enhance both the quantity and quality of seed production, ensuring sustainable and profitable outcomes.

Seed Processing and Storage

Train farmers to process, clean, and properly store seeds to maintain their quality and viability for the next planting season. Quality seed storage materials and systems were provided and also trained to the farmers' group to ensure quality seed. Community-based seed store in Rangpur is equipped with low-cost storage facilities to prevent seed spoilage due to high temperatures and humidity.

Seed Exchange and Distribution

Establish systems for exchanging seeds among community members and distributing them to marginalized farmers at low cost. In rural Bangladesh, traditional seed fairs (locally called Mela) enable farmers to exchange indigenous vegetable seeds, ensuring access to diverse crops.

Participatory Monitoring and Quality Control

Implement participatory monitoring systems to ensure the quality and consistency of seeds produced by the community. Farmer groups collaborate with vegetable seed production

experts to observe the quality production, test germination rates and other quality parameters of their seeds.

Market Linkages and Value Addition

Connect farmers' groups to local and regional markets to sell surplus seeds, ensuring economic viability and incentivizing seed production. Before selling the seeds, quality seed packets are needed to sell seeds. So, community-based seed producers may sell truthfully labelled vegetable seeds to open markets, which will create an additional income source to the community.

Policy Advocacy and Institutional Support

Advocate for supportive policies, subsidies, and technical assistance from the government and NGOs to sustain community seed systems. Bangladesh Agricultural Research Institute (BARI) supports community-based seed production to the farmers level by supplying breeders seed, and parents of hybrid varieties, offering training programs to farmers and regularly roguing the seed field.

Integration of Indigenous Knowledge and Modern Techniques

Blend traditional seed-saving practices with modern agricultural technologies to optimize outcomes. Farmers combine traditional seed preservation methods with scientific practices like vacuum-sealed packaging for long-term storage.

Adaptation to Climate Challenges

Focus on breeding and producing seeds for climate-resilient vegetables, ensuring sustainability under changing environmental conditions. For example, in coastal areas like Satkhira, farmers are producing seeds of saline-tolerant vegetables like gourds and eggplants to address the impacts of rising salinity. In the Rajshahi region, the farmers are producing drought-tolerant vegetable varieties which can be utilised in the community-based seed production system in future.

Development of Business Model for Sustainable Vegetable Seed Production in BARI

Developing a business model for sustainable vegetable seed production involves integrating environmentally friendly practices, economic viability, and social equity. Here's a structured approach to crafting such a model

Production of Quality Seed:

To disseminate any popular variety, it is needed to produce sufficient seeds. First time about 35 types of quality varieties (20 vegetables) were selected to produce seeds. There are two types of varieties viz., OP and hybrid varieties, and the seed production system is different for those varieties. To supply the quality seed (OP and hybrid) to the farmers, BARI produced sufficient breeders' seed of OP and parents for hybrid varieties. These activities were done at a station and farm. The plot size both on the station and on the farm for each variety was 400 m^2. BARI developed standard seed production, processing and packing were followed.

Field Demonstration (FD) of Popular OP and Hybrid Variety to the Farmers' Area (on Farmer's Field):

To disseminate any variety, it is needed to conduct field demonstrations for the farmers, so the farmers can make decisions viewing the performance of that variety. So, in project activity, several FD programs were chalked out of different popular varieties (OP and hybrid) in a 2 decimal (80 m^2) land of 100 farmers (cooperative member) across the country partial cost were borne from the project.

Production of OP Seeds and Hybrid Seeds at the Farmers' Level (On Farmer's Field):

The very important thing in the activity was to produce quality seed of OP and hybrid seeds at farmers' level. The training program helped the farmers to produce quality seeds. Besides this activity, the vegetable breeders monitored these activities from time to time. The plot size both on the station and on the farm was 400 m^2. BARI developed standard seed production, processing and packing were followed.

Demonstration of OP and Hybrid Variety Using the Farmers Produced Seed (On Farmer's Field):

Before marketing the seed, the seeds should be demonstrated in farmers field to confirm the quality and purity of the farmers' produced seed were tested in a 2 decimal (800 m^2) land of 80 farmers (cooperative member) across the country partial cost were borne from the project

Training Program for Quality Seed Production to the Farmers:

To produce quality seed by the farmers, it is very much needed to provide hands-on training to the farmers. The training helped the farmers to produce quality seeds.

Seed Packaging, Labelling, and Marketing the Seeds:

After seed production, there are several activities to be done at the farm level. The main activities viz., seed extraction, drying, moisture, purity, vigour, germination, etc. are to be done. Then the packaging is done with proper packet, labelling and information.

Distribution of these Seeds:

"Sara Bangla Krishak Society" has 8,000 farmers, so the marketing channel is very easy to distribute the seed (OP and hybrid) to the concerned farmers. The seed cost were ensured by the purchasing of the cooperative farmers.

DEVELOPMENT OF BUSINESS MODEL: COMMUNITY-BASED VEGETABLE SEED PRODUCTION BY BARI & SBKS

A collaborative model where the Bangladesh Agricultural Research Institute (BARI) partners with SBKS (a cooperative society) to produce and distribute high-quality vegetable seeds through smallholder farmers. This community-based seed production system ensures sustainable supply, improves farmer income, and enhances food security.

- Farmer-centric approach: Smallholder farmers are trained and engaged in quality seed production.
- Research-backed: BARI provides improved varieties, technical guidance, and quality control.

- Finance group engagement.
- Cooperative-led marketing: SBKS facilitates collective seed storage, branding, and sales, ensuring fair prices.
- Sustainability: Reduces dependency on imported seeds while strengthening local seed systems.

Table 2: Value proposition of business model

Stakeholder	Value Added
Farmers	▪ Higher income from quality seed production ▪ Access to training & improved varieties ▪ Reduced input costs (own seed supply)
BARI	▪ Wider dissemination of improved varieties and breeders seed ▪ Strengthened farmer-research linkage ▪ Strong monitoring ▪ Data for further R&D
SBKS (Cooperative)	▪ Increased member engagement & revenue ▪ Purchase seeds from farmers with premium price, store in cool room and pack the seed ▪ Stronger market position as a seed supplier ▪ Sustainable business model
Buyers (Farmers, Traders, Agri-businesses)	▪ Reliable source of quality seeds ▪ Lower cost compared to commercial hybrids ▪ Locally adapted varieties
Financial organization	▪ If farmers of SBKS need any financial support can get from the financial organization
Government & NGOs	▪ Enhanced food & nutritional security ▪ Reduced seed import dependency ▪ Climate-resilient farming

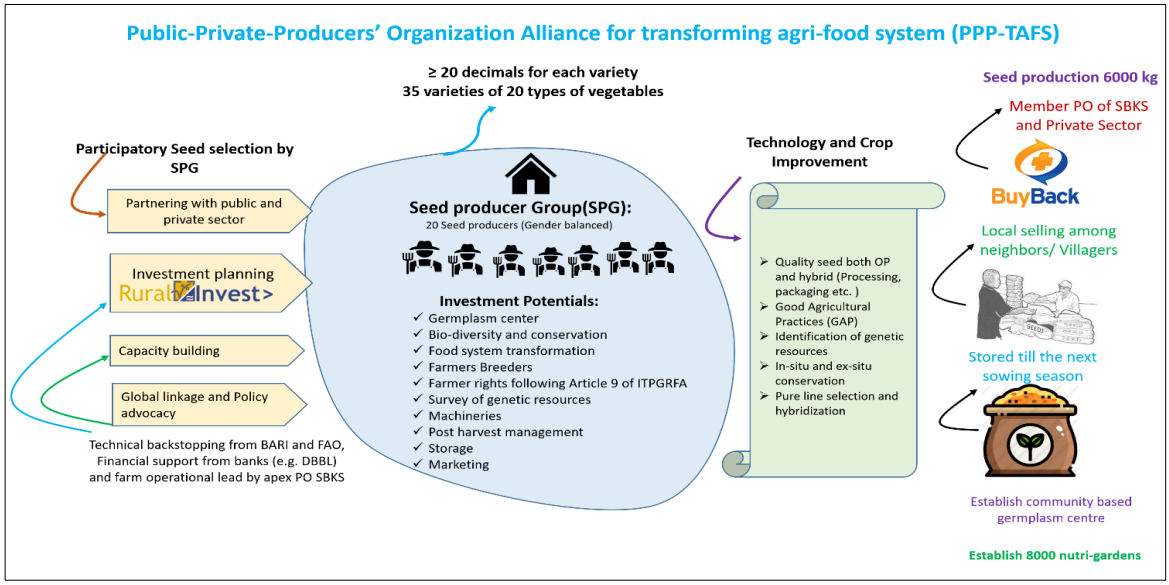

Fig 1: Business model of Public-Private-Producers' Organization Alliance for transforming agri-food system

By systematically implementing these activities, Bangladesh's community-based vegetable seed production initiatives contribute to agricultural sustainability, enhance biodiversity, and ensure food sovereignty, empowering farmers and fostering resilience against external challenges.

CONCLUSION

The collaborative initiative between the Bangladesh Agricultural Research Institute (BARI) and Sara Bangla Krishok Society (SBKS)—a farmer-led cooperative—has proven highly effective in advancing community-based vegetable seed production, demonstrating measurable improvements in seed accessibility, farmer livelihoods, and agricultural sustainability. Implemented across three growing seasons (Winter 2023–24, Summer 2024, and Winter 2024–25), the program engaged 137 smallholder farmers in four key regions, cultivating 24 vegetable crops spanning 31 high-yielding, climate-resilient varieties. Production covered 20.5 hectares of land, yielding 16,923.7 kg of certified-quality seeds—an average productivity of 765.35 kg/ha, a figure that surpasses conventional benchmarks for domestic vegetable seed systems. These outcomes underscore the model's potential to significantly elevate output when paired with scientific expertise, structured cooperatives, and targeted capacity development. Central to the project's success was its multifaceted capacity-building approach, which included: eight specialized training sessions on seed production, post-harvest handling, and market linkages and six farmer exchange visits to foster peer learning and adoption of best practices. Crucially, the initiative integrated farmers into SBKS's cooperative marketing channels, creating a self-reinforcing cycle of economic empowerment. By linking production to verified buyers (including NGOs and regional distributors), the project: reduced dependency on imported seeds, stabilized local seed economies, and increased profit margins for farmers through collective bargaining. This farmer-centric model not only strengthens food security but also establishes a blueprint for scalable, sustainable agriculture in Bangladesh. Its success highlights the transformative power of combining institutional research, cooperative networks, and market-driven solutions to build climate-resilient, self-sufficient farming systems. By embracing and expanding such initiatives, Bangladesh can strengthen its agricultural resilience, ensure food security, and uphold the principles of food sovereignty, setting an example for other nations to follow.