NRRI Research Bulletin No. 25

RESILIENCE

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RESILIENCE
Building Climate Resilience for Indian Small Holders (RESILIENCE)
SEED VILLAGE
Variety: Maudamani

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F O R E W O R D

Indian agriculture is mostly dominated by the resource poor marginal and small farmers with very small average land holding size that is being further fragmented. Indian agriculture's current challenges are rising population pressure, decreasing natural resources (land, water, and agro-biodiversity), increasing demand for diversified diets, higher frequencies of extreme climatic events (climate change) and increasing production costs. Regular and timely supply of quality seed of all crops and varieties at affordable prices at local level is a requirement in order to increase output and efficiency; and to reduce the adverse effects due to climate change. Although the formal seed sector makes a significant contribution in making quality seed available, it is not in a position to meet local farmers' demand for seed and varietal replacement fully. Although, globally Indian seed industry ranked 5th largest player with the robust growth, but domestically, only 24% sub-marginal and 29% marginal farmers replace seed every year against 40% by large farmers. The informal seed sector comprising mainly farm-saved seed (FSS), which accounts 65-70%. The FSS is not generally uniform in size and frequently under sized or shriveled grains are also being used as seed. Due to the presence of various seed and/or airborne pathogens and storage pests the quality of FSS is not as per the standards which ultimately culminate in poor germination and poor crop plant stand and thus significantly affecting yield and quality. Therefore, the production of good quality seed and distribution locally by involving farmers is an important approach.

The bulletin entitled "**Rice seed self-sufficiency with farmer to farmer (F2F) seed village model**" is an attempt to provide holistic information to its readers with a broad overview of identification of seed farmers, need assessment for quantity of seed and varieties replacement, capacity building of the farmers, production of quality seeds by the farmers themselves, processing, packaging and storage of seeds and its exchange among other farmers through farmer to farmer (F2F) exchange.

I appreciate the efforts of the authors in bringing out this bulletin and do hope that farmers, researcher, planners and extension agents will find this publication useful.

(D Maiti)
Director, ICAR-NRRI

PREFACE

Seed is one of the prime components in crop production endeavor. Healthy seed is the mother of a healthy plant. It is one of the major components to determine the final yield of the crop. Food security is dependent on seed security and ensuring the timely availability of quality seed in desired quantity at right time at appropriate price is fundamental to increase production and productivity. In India, where the major cereal crop is paddy, availability of quality seed to the farmers in time is always a challenge and most of the time farmers end up by utilizing previous year's seed for cultivation. It is noticed that there is lot of deficiency in the existing system of formal seed supply. At present National Seeds Corporation (NSC), State Seeds Corporation (SSC) and private companies are the agencies involved in seed production and distribution through registered seed growers throughout the Country. The private agencies involved generally concentrate on production and supply of hybrid seeds only due to higher margin of profits. With the greatest efforts of all these organized sectors, only 20 per cent of the total requirement of quality seed could be met. Thus, there exists wide gap in seed demand and supply particularly for self pollinated crop like rice. It was observed that the Seed Replacement Rate (SRR) of rice in Odisha is about 22% and farmers are using farm saved seeds year by year, resulting in gradual decrease in yield and eventually income per unit of land.

There is a scope to produce and distribute quality seeds of rice crop through establishment of seed village, which needs to be promoted to facilitate production and timely distribution of quality seeds of desired varieties at village level. In order to address the issue, a concept of seed sufficiency through an informal seed chain model i.e. “Rice seed self-sufficiency with farmer to farmer (F2F) seed village model” was discussed and implemented in two villages viz. Abhayapur (Block Tangi) and Sundarda (Block Niali) of Cuttack district that involve the production of quality declared seed (QDS) and exchange through F2F. The detailed information about the model is outlined in the present research bulletin. The bulletin discusses the background, methodologies and the steps involved in the implementation of the F2F seed village model in detail. The comparative advantages of this model have been elaborated and the way forward is described. The purpose of the bulletin is to provide an insight to the scope existing for establishment of seed villages based on the F2F seed village model through which assured quality of seed can be made available in time. The enterprise will benefit both the producer and the consumer who are in rural areas and hence assures the distribution of resources within the village.

We sincerely hope that this bulletin will be useful to rice farmers as well as researchers, extension workers and policy makers in understanding and implementing the proposed F2F seed village model.

Authors

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Rice seed self-sufficiency with farmer to farmer (F2F) seed village model

BACKGROUND

Agriculture is an important sector of Indian economy contributing about 16% to the gross domestic (GDP) and providing employment to over 40% of the population (GOI, 2020). Quality seed is considered as one of the most important factors that fuel agricultural development. It is the starting point which dictates ultimate productivity of other inputs. Just like any other crop, rice, the major cereal crop of the country requires good quality seed to increase the productivity. Good quality seed alone contributes about 15-20% towards yield enhancement (Chauhan et al., 2017). Among various challenges faced by Indian farmers, the most important are price, and availability of quality seeds. Most Indian farmers are resource poor and find it difficult to purchase high yielding quality seeds. Therefore, they continue to use their own seeds mostly of traditional varieties and land races which are less productive compared to High Yielding Variety (HYV) seeds. Moreover, the crops are mostly raised for consumption and sale in the market and only a small portion of the grains are kept as seeds for its use in the next season which may not meet the quality aspects as expected for a seed, ultimately resulting in low yield. To meet the potential challenge of food requirement of the burgeoning population in future, a significant increase in agricultural productivity is highly essential. One way to achieve this is to ensure production and distribution of high quality seeds of improved varieties to the farming community.

Good quality seed are genetically pure which are less infected by insects and diseases and help to improve the productivity of rice.

The current seed programme of the country mainly involves the participation of state government, state agricultural university system, public sector, cooperatives and private sector institutions. These programmes involve some kind of seed certification at institutional level. With the greatest efforts of all these organized sectors, only 20 per cent of the total requirement of quality seed could be met (Atwal, 2013). The present seed system is over dependent on formal sector which has been proven to be inadequate

to supply the quality seed of desired variety in time. Ideally, seed should be replaced every year for hybrids and every three to four years for inbreds. Due to non-availability of the quality rice seeds, the seed replacement rate (SRR) is quite low i.e., only about 22% in Odisha, for example (Anonymous, 2013). With all the best efforts, the varietal replacement and agro-ecology specific variety adoption has remained poor.

Only 20 per cent of the quality seed requirement is fulfilled by the public and private seed sector.

There is a scope to produce and distribute quality seeds of rice crop through establishment of seed village, which needs to be promoted to facilitate production and timely distribution of quality seeds of desired varieties at village level. In order to address the issue, a concept of seed sufficiency through an informal seed chain i.e. "farmer to farmer (F2F) seed village model" has been devised and being validated that involve the production of quality declared seed (QDS) and exchange through F2F.

FARMER TO FARMER (F2F)SEED VILLAGE MODEL

Farmer to farmer (F2F) seed village is a unit, where a trained group of farmers are involved in informal production of quality seed of rice crop to cater their own as well as need of neighboring farmers through F2F exchange (Box 1). Various steps and processes involved in F2F seed village model are shown in the flow chart (Fig. 1). This seed village will make the farmers' self-sufficient in production and distribution of quality seeds and improves the productivity and sustainability of the production system that will help in ensuring the food and livelihood security. The model also has the provision of growing the traditional rice varieties and landraces for maintaining and conserving the biodiversity.

Box 1

Objectives of the F2F seed village programme are to:

- Organize seed production in cluster (or) compact area;
- Improve production of quality declared seed (QDS);
- Increase seed and varietal replacement rate;
- Upgrade the quality of farm saved seeds;
- Meet the local demand, timely supply and reasonable cost;
- Replace existing local varieties with new high yielding varieties;
- Ensure availability of seed in contingent situation; and
- Self-sufficiency and self-reliance of the village.

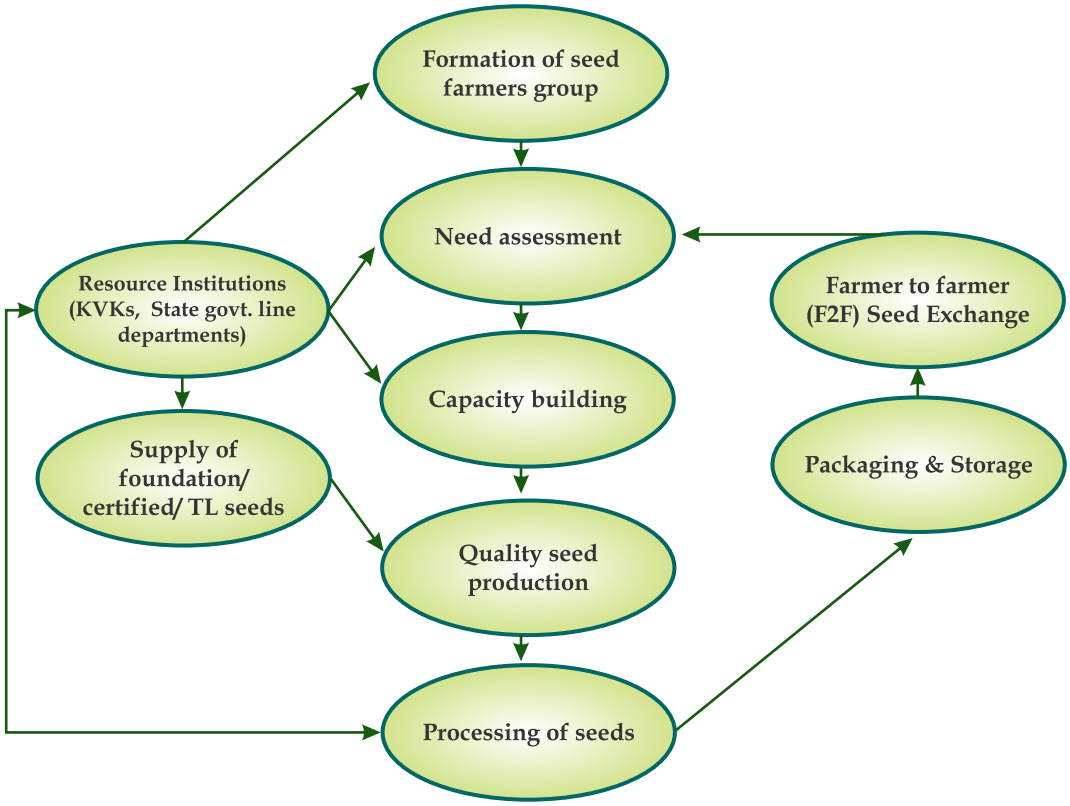

Fig. 1. Schematic diagram showing the process of F2F seed village model

ESTABLISHMENT OF F2F SEED VILLAGE

In order to validate the model and promote quality seeds for improving production and productivity, two blocks viz. Tangi and Niali in Cuttack district of Odisha were selected based on contrasting rice ecology and frequency of extreme climatic events such as drought, flash flooding and stagnant flooding. One village under each block at Abhayapur (Block Tangi) and Sundarda (Block Niali) was identified for implementation of the activities of F2F seed village model for development and strengthening of informal village seed system for production and distribution of quality declared seeds (QDS) through F2F exchange. Baseline survey of the villages conducted, total rice area in the two villages under different ecology estimated and need assessment was done for varietal requirement and seed production (Table 1). Based on the rice cultivation area and its ecology and kind of varieties being grown, need assessment was done for the suitable varietal requirement (Table 2) and the amount of seed to be produced. The following information was collected before taking up the quality seed production.

- Availability of irrigation facilities;
- Suitability of climatic conditions to raise the crop;
- Labour availability and knowledge of local farmers about the crop;
- Occurrence of pest and diseases;
- Past history of the area for suitability to raise seed crop; and
- Average rainfall and distribution

Table 1: Details of rice ecology, area, current varietal scenario, suggested new varieties and their seed requirement

Villages	Rice ecology	Rice Area (acre)	Rice varieties traditionally being grown	Suggested newly released varieties	Quantity of seeds required (in quintal)
Abhayapur	Lowland	127	Pooja, Pratikhya, Gayatri etc.	CR Dhan 407, CR Dhan 505	18
	Medium land	57	Swarna, Lalat etc.	Maudamani, CR Dhan 801, CR Dhan 310	8
	Upland	204	Khandagiri etc.	Sahbhagidhan, CR Dhan 206	26
Sundarda	Lowland	173	Pooja, Sarala, CR1018, Gayatri, Kalacahmpa, Nua Kalajeera etc.	CR Dhan 407, CR Dhan 505, CR Dhan 908	25
	Medium land	50	Swarna, Lalat etc.	Maudamani, CR Dhan 310	8

Table 2: Descriptions of the suggested newly released rice varieties

Variety	Duration (days)	Grain type	Special features
CR Dhan 307 (Maudamani)	135	Short bold	Moderately resistant to blast, neck blast, brown spot sheath blight, leaf folder, gall midge, white back plant hopper, hispa and thrips.
CR Dhan 206 (Gopinath)	115	Short bold	Suitable for aerobic situation, moderately resistant to leaf blast, brown spot, sheath rot, stem borer, leaf folder.
CR Dhan 801 (Subhash)	140-145	Short bold	Submergence and drought tolerant. It shows resistance against leaf blast, gall midge, leaf folder and moderately resistant to sheath rot, tungro virus, brown spot, sheath blight, yellow stem borer, brown plant hopper, white backed plant hopper and grassy leaf hopper.
CR Dhan 407	150	Long bold	Moderately resistant to neck blast.

CR Dhan 505	162	Medium slender	Moderately resistant to blast, neckblast, sheath rot, sheath blight, rice tungro virus, stem borer (both dead heart and white ear heads), leaf folder, whorl maggot, submergence tolerance, and elongation ability.
Sahbhagidhan	105	Long bold	Tolerant to drought, resistance to leaf blast, moderately resistance to brown spot, sheath rot, sheath blight and leaf folder.
CR Dhan 908	145	Medium slender (aromatic)	Moderately resistant to leaf blast, neck blast, bacterial leaf blight, brown spot, stem borer, leaf folder and WBPH.
CR Dhan 310	125	Medium slender	High grain protein (10.5%)

Step 1: Formation of seed farmers group

Focus group discussion (FGD) was conducted with the farmers of the villages to explain the concept of F2F seed village and the need and responsibility to establish the seed village (Fig. 2). Farmers that show interest were identified and seed farmers groups were formed to take up the activity of quality seed production.

Fig. 2. Focus group meeting to identify seed farmers group

Step 2: Need assessment

On the basis of need assessment, a seed roll out plan was developed (Table 3) and the amount of seed needs to be grown was quantified, keeping the target of 30% seed replacement. In developing seed plan of the village, only 90% of the total rice growing

area was considered for varietal replacement and remaining 10% area was left out for growing the traditional rice varieties or land races to maintain and conserve the biodiversity. In the seed plan, provision of additional requirement of 15% was made to meet out the contingency conditions such as nursery damage due to early season flash flooding, etc. The seed plan was made in such a way that all the varietal and seed requirements are fulfilled in a 4 year cyclic period. The suitable area for seed production was identified by the experts in consultation with the seed farmers group and seed production was initiated in the first year with two varieties. The foundation/ certified seeds were supplied by the ICAR-NRRI to the identified seed farmers in the area.

Table 3: Seed roll out plan for Abhayapur and Sundarda villages

Variety	Quantity of seed (quintal)							
	First year		Second year		Third year		Fourth year	
	Abhayapur	*Sundarda*	*Abhayapur*	*Sundarda*	*Abhayapur*	*Sundarda*	*Abhayapur*	*Sundarda*
CR Dhan 307 (Maudamani)	2	2	1	1				
CR Dhan 206 (Gopinath)	6.5		3		3		3	
CR Dhan 801 (Subhash)			1	1	1	1	1	1
CR Dhan 407			3	3	3	3	3	3
CR Dhan 505			3	3.5	3	3.5	3	3.5
Sahbhagidhan			3.5		3.5		3.5	
CR Dhan 908				2.5	1	1	1	1
CR Dhan 310					1	1	1	1
Total	8.5	2	14.5	11	15.5	9.5	15.5	9.5

Step 3: Capacity building

In order to harness the synergy between technologies and the community participation, special emphasis was given to capacity building through training and demonstration. Trainings were imparted on seed production and seed technology to the identified seed farmers. Farmers were trained on the whole aspects of seed production such as

- Agroecology specific HYV identifications (their characters and other traits; isolation distance);
- Sowing practices;
- Seed treatment;
- Other agronomic practices;

- Maintenance of seed plots;
- Plant protection measures;
- Identifying off types and their removal;
- Maturity status;
- Harvesting methods;
- Aspects of seed cleaning, grading, seed treating, bagging and storage.

The farmers were also appraised about the processing and storage of farm saved seeds to grow in subsequent years until further seed replacement (3 years).

Fig. 3. Farmers are trained for the production of quality seed

Step 4: Production of quality seeds

The role of the resource institutions in the developing F2F seed village model is to initially help the seed farmers group in making decisions for need assessment, their capacity building and linking the group to the source of supply of foundation/certified seeds (Fig. 1). In this programme, after completion of training, the quality seed production was initiated with the technical support of ICAR-NRRI. All the field activities were taken up by the farmers themselves with close, progressive and supportive monitoring by the experts. Various processes involved in the production of quality seed followed in theses villages are briefly explained below.

Fig. 4. Team of experts visiting the quality seed production fields for monitoring

Seed treatment **–** Seeds were treated with bavistine @ 2 g/kg seed and Imidacloropid 70 WS @ 5 g/kg seed.

Nursery raising **–** For preparing wet bed nursery, field were ploughed twice in dry condition and puddled in standing water (2-3 cm) 2-3 times to prepare seed beds. Fields were leveled perfectly and raised beds (10 m x 2 m) were prepared separated by channels (0.3 m). Total seed bed area is normally 10% of the main field to be transplanted. For 800 m^2 nursery area, 1 t of Farm Yard Manure (FYM) and 40 kg of DAP is recommended.

Field preparation **–** The fields were irrigated initially before land preparation to germinate any previous seed fallen in the field; after that fields were prepared thoroughly. Well prepared puddled field is most suitable for quality seed production.

Fertilizer application **–** Application of well decomposed FYM at the rate of 5 t ha^{-1} and application of chemical fertilizer at the rate of 80:40:40 kg NPK per ha is recommended. Full dose of PK and 25% of N is applied as basal, 50% N at maximum tillering and 25% at panicle initiation stage.

Transplanting **–** Twenty-one days old seedlings (3-4 leaf stage) were uprooted from the well-watered nursery (to avoid root damage) and planted at 15x20 cm spacing with two plants per hill. Gap filling is done twice at seven days after transplanting and fifteen days later.

Water management **–** Irrigations were provided as and when required to maintain 2-5 cm water height in the field throughout the growing season of the crop. During the topdressing of nitrogenous fertilizer, the field was drained out and again watered after 1 day. Water was drained out and field was kept dried before one week of the crop harvest.

Weed management **–** For 1 ha area, 4 kg Londex power mixed with 4 kg sand, was applied 5-6 days after transplanting (DAT) followed by mechanical weeding with cono- or mandua- weeder at 20-25 DAT.

Insect pests and disease management **–** Need based application of pesticides was done to ensure the insect and disease-free condition in the field.

Roguing **–** In the seed production programme, rouging is an important technique to be followed from field to storage in order to obtain physical and genetic purity. It is the process of removal of undesirable rice plants (the plant varieties of other than the variety grown for seed production), other crops, weeds etc. In this programme, rouging was done from the vegetative to the flowering stage.

Field day **–** During the harvesting of the crop, field days were organized to demonstrate the seed plots and creating awareness for the popularization of the seed programme among other farmers. This activity has helped in creating the interest and winning confidence of the other farmers who may take the seeds from the seed farmer for their use.

Fig. 5. Field day in quality seed production plot for creating awareness among the farmers

Harvesting **–** The harvesting of the crops was done only when the seeds attain physiological maturity, leaving the border rows. Optimum time of the harvest is when the seed moisture content is around 25%. For seed purpose, the most preferred method of seed harvesting is manual harvesting, as it will reduce the mechanical damage to the seeds. Leave the border rows and select the seeds from the middle rows for storage.

Every effort should be made to avoid chance of mechanical mixing, mechanical injury to seeds during harvesting, threshing, cleaning drying, and packing.

Step 5: Threshing and processing of the seeds

Post-harvest seed handling is a vital component of seed production and marketing of quality seeds produced. Threshing was done using power thresher soon after harvesting to avoid rewetting and to reduce grain breakage. The threshing area was properly cleaned to avoid any admixtures. The seeds were cleaned properly after threshing through winnowing and sieving with different gauge of sieves sizes in order to remove the debris, chaffs, and other improper sized seeds. The grains were dried immediately after threshing.

Mechanical threshing involving use of tractors needs to be avoided to prevent the mechanical damage to the seeds.

Fig. 6. Seed drying

In order to preserve seed viability and vigourity, seeds were dried (Fig. 6) to safe moisture content (12%) levels using seed moisture meter (Fig. 7) as early as possible without heaping wet seed.

Fig. 7. Seed moisture measurement

Step 6: Packaging, storing and exchange

The produced quality seeds were packed in a proper and systematic order in the hermetic storage bags (Grainpro® Supergarinbag® Premium RT) (Fig. 8 & 9). The specialty of these bags is that they are air tight and prevent entry of air/water from getting into the seeds stored in them. These bags preserve the contents by restricting the survival of pests due to the depletion of oxygen and production of carbon dioxide inside the bag; that results in creating unfavorable conditions for the existence of such pests. With these bags, no pesticides are required to treat such stored seeds or grains. It also controls the seed moisture content and maintains the viability of seed.

Fig. 8. Farmers are trained for proper packaging and storage methods

Fig. 9. Packaging of seeds

Advantages of F2F seed village model

- Direct involvement of farmer in seed production and quality assurance;
- Availability of agro-ecology specific high yielding varieties in right time and quantity;
- Involves quality declared seed by seed farmers that does not require cumbersome seed certification;
- F2F exchange does not involve formal marketing mechanism;
- Processing and packaging at local level and no long-distance transportation reduce costs; and
- Training and capacity build up also helps in maintaining the quality of saved seed.

Some of the comparative advantages of F2F seed village model over the formal seed systems are mentioned in Table 4.

Table 4: Comparative advantage of F2F seed village model over the formal seed system

Factors	Formal seed system	F2F seed village model
Seed certification	Certified seeds	Quality declared seeds
Seed distribution	Involvement of marketing system	Farmer to farmer exchange
Seed production	No realistic assessments are done	Need based seed production and no distress selling
Seed availability	Limited availability	Village level seed self-sufficiency
Intermediaries	Many intermediaries	No intermediaries for seed exchange
Varietal adoption	Remains poor	Agro-ecology based varietal adoption
Seed replacement rate	Poor	Increased seed replacement

During the implementation of the F2F seed village model there is fixed role and responsibility on the individual, groups and the resource institutions. All these stakeholders have to work in close coordination for the success of the programme. The highlights of the seed village model is given in Fig. 10.

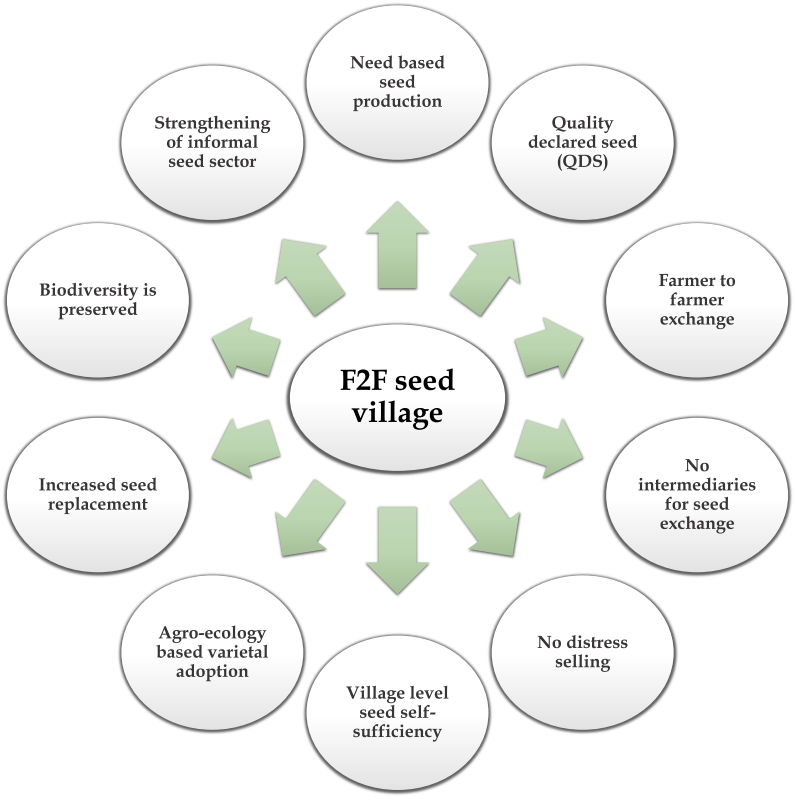

Fig. 10. Highlights of the rice seed self-sufficiency through F2F seed village model

Conclusion and way forward

Through the implementation of the seed village model, seeds can be made available at the door steps of the farmers at right time, at affordable cost and also confidence of the farmers on the quality can be increased because of known source of production. In the process, the producer and consumer are mutually benefited and fast spread of new cultivars can be ensured. A programme is considered successful, if it has the potential for self-sustaining. In future, other newly released climate resilient rice varieties that have potential of tolerating drought, submergence or both may be included under this programme to enhance resilience and productivity of stress- prone ecology. It will help also to increase the adaptive capacity of the farmers who are otherwise unable to get the quality seeds due to various reasons mentioned before.

References

Anonymous (2013) State Agriculture Policy-2013. Agriculture Department, Government of Odisha.

Atwal SS (2013) Successful entrepreneurship through seed production. In: Entrepreneurship Development through Seed Production, Kumar A., R. Kumar, A. Gupta and S.S. Atwal (Eds.). Indian Agriculture Research Institute, Regional Station, Karnal, Haryana, India.

Chauhan JS, Prasad RS, Pal S, Choudhury PR (2017) Seed Systems and Supply Chain of Rice in India. Journal of Rice Research 10, 9-16.

Government of India (GOI) (2020) Economic Survey 2019-20, Volume 2. Ministry of Finance, Department of Economic Affairs, Economic Division, North Block, New Delhi.

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