Economic Affairs, Vol. **69**(01), pp. 755-767, March 2024
DOI: 10.46852/0424-2513.2.2024.37

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CASE STUDY

Sustainable Economic Impact of Seed Replacement Rate on Production of Mustard Seed: A Case Study on Murshidabad District of West Bengal, India

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Received: 22-11-2023 **Revised:** 07-02-2024 **Accepted:** 22-02-2024

ABSTRACT

Quality Seeds are the critical determinant of different agro-climatic zones for sustainable planning in agricultural production. It is necessary to raise the supply of quality seeds of different crops in sufficient quantity at reasonable prices for farmers at the right time in the state. New seeds are either Certified Seeds (CS) or Hybrid Seeds. A better Seed Replacement Rate (SRR) presents a better application of Certified or Quality Seed or Hybrid Varieties Seeds (HYV). It plays a major role in agriculture to raise the production of crops. In this research paper, we have analysed the impact of Seed Replacement Rate on the production of Mustard Seeds during the period 2022-23 in the Jarur Gram Panchayat (GP) of Block Raghunathganj-I, Murshidabad District, West Bengal. The data have been collected by the stratified random sampling procedure. With the help of collected data, we have formed a Coob-Douglas Type of production function and which is estimated by the Ordinary Least Square Method. From the collected data, it has been observed that the average Seed Replacement Rate is 38.52 percent which is below the state average (53.2%). We have also noticed that 30.43 percent farmers have used farm-saved seeds and only 17.4 percent farmers have used hundred percent new seeds. The estimated result has proved that Seed Replacement Rate is a key determinant to raise both production, productivity and economic benefits. If Seed Replacement increases production also will increase and thereby there would be economic leverage. It has also been found that farm size with Seed Replacement Rate is not a significant factor in increasing the production of Mustard Seeds. Another interesting finding is that seventy percent of farmers have used inorganic fertilizers. They have applied excessive chemical fertilizers which is greater than the government's prescribed norm. However, from the estimated result we have observed that the Seed Replacement Rate according to different farm sizes with excessive application of fertilizers does not influence both the production and productivity of Mustard Seeds. From an economic standpoint of view, new seeds are better than farm-saved seeds (old seeds) as their gross income increases.

HIGHLIGHTS

- A Case Study is conducted on sustainable economic impact of seed replacement rate on production of mustard seed in Murshidabad District of West Bengal, India.
- The study is based on both primary as well as secondary data. Data has been estimated by using EViews software.
- The study found that the seed replacement rate is a key determinant to raise both production, productivity and economic benefits.
- If seed replacement increases, production will also increase and thereby there would be economic leverage. Firm size with seed replacement has no impact on production of mustard seed.

How to cite this article: Hoque, Sk T. and Biswas, N. (2024). Sustainable Economic Impact of Seed Replacement Rate on Production of Mustard Seed: A Case Study on Murshidabad District of West Bengal, India. *Econ. Aff.*, **69**(01): 755-767.

Source of Support: None; **Conflict of Interest:** None

- It is also found from the case study that there is immense economic impact of seed replacement rate on production of mustard seed in the area under the study.

Keywords: Economic, Sustainability, Seed Replacement Rate, Productivity, Founder Seed, Breeder Seed, Chemical Fertilizers

West Bengal is a predominantly agricultural state. The diverse and varied agro-climatic environment exists in the state which is highly conducive for cultivating multiple varieties of crops. This state occupies only 2.7 percent geographical area of the country and provides accommodation near about eight percent of the country's population. In this state, 96% of cultivators are in the group of small and marginal farmers (Government of West Bengal, 2020-21). The crop intensity is 184 percent though the average size of land holding is less than one hectare (0.77 hectare) (Government of West Bengal, 2020-21). The net crop area is comprised of 68 percent of the geographical area and 92 percent of arable land. The state has often faced various types of unpredictable natural calamities like floods, cyclones, hailstorms, etc. as it is located in the humid tropical zone. The state has occupied a satisfactory place in the point of view in production of rice, vegetables and potato but a huge difference exists between the necessity and supply in few important pulses, oilseeds and maize. Due to blind myths about HYV technology, the farmers have been using excessive chemical fertilizers in agricultural fields that finally reduce the soil health condition which creates an environmental hazard in agricultural fields. Besides, various big challenges exist behind the satisfactory growth of agriculture. Among them, the major challenges are insufficient supply in quantity of better quality seeds, scanty farm mechanization, unorganized marketing structure, lack of minor and major irrigation facilities, etc. Despite the above challenges, agriculture is still the major single vital livelihood security of the rural masses in Bengal. It is also the last resort of the lifespan for a big chunk of rural people still. Therefore, the government has implemented various schemes and policies such as *Bangla Sasya Bima* (*Kharif* 2019), Matir Katha, Capacity Building & Skill Development, Implementation of e-governance in Agriculture, Information and Communication Technology (ICT), National Food Security Mission (NFSM), Financial Support Scheme for Farm Mechanization (F.S.S.M), Diversified Cropping Programme, Bangla Krishi Sech Yojana (BKSY) (2019), Agricultural Research, *Paramparagat Krishi Vikas Yojana* (PKVY), Krishak Bandhu (2019), Watershed Development, Soil & Water Conservation, One-Time Assistance for Small Farm implements (OTA-SFI) etc. with the objective of "Double farmers' income by 2020 by ensuring farmers' access to Skills, Technologies, Markets and Financial inclusion".

Like the state economy, the economy of Murshidabad district is predominantly an agricultural based from the point of view of livelihood security and employment of the people and also for the raw materials of leading industries. In the district out of total land about 76.17% land is suitable for cultivation and 64.61% of the cultivable land is enjoyed the facility of irrigation ((District Survey Report of Murshidabad District (Work Order No: MDTC/PM-5/160/66, 20.01.2020)). Rice, Wheat, Pulses, Oilseeds, potato and jute are the principal agricultural crops in the district. Besides, throughout the district Sugarcane, Cabbage, Cauliflower and Brinjal are produced by farmers in considerable quantity.

The average size of land holding in West Bengal and Murshidabad district are 0.77 and 0.73 (Murshidabad District Statistical hand Book, 2014) hectare respectively. Again out of total farm families, the percentage of small and marginal farmers in West Bengal and study district are 96 and 93 percent respectively (Source: Agricultural Census, West Bengal).

Mustard occupies the first position among the Oilseeds in the State. Nearly 53% area of land has been captured by Mustard alone compared to other oilseeds. The productivity of it was 1212 kg/hectare (average) in West Bengal, lower than the country's average of 1511 kg/hectare in 2018-19. The Murshidabad district also occupies a remarkable and significant position in the group of Mustard producing districts. In the list of Mustard producing districts, it was in top position from the viewpoint of area and production in 2019-20. The average yield rate of Mustard was 1323kg/hectare, lower than the state average in 2019-20. In this scenario, it will be

possible to increase the productivity of Mustard in the district by associating High Yielding Varieties of Seeds with modern technology ((*Source*: Booklet published by Additional Director of Agriculture (Admin.) Jangipur Sub-division, Murshidabad, December 2021)).

The Targeted Rice Fallow Area (TRFA) programme was launched by the Central Government during 2016-17 in fifteen districts of six Eastern states of India such as Assam, Bihar, Chattisgarh, Jharkhand, Odisha, and West Bengal. The basic objective of the programme was to expand the area of Rabi pulses in the Rice fallows area **(**Government of India). In West Bengal launched the said programme has launched in the Study district during the year 2019-20 under the umbrella of National Food Security Mission (NFSM) scheme for increasing the production of Mustard.

The scenario of Seed Replacement Rate (SRR) for Rapeseed/Mustard is represented by the Fig. 1. It is noticed, the Seed Replacement Rate has been raised in West Bengal continuously but not satisfactory as compared to the Country level. The SRR was 30% in 2000 and has increased to 53.50% in 2022 for West Bengal. But in case of India, it was 38.39% in 2000 and has touched to 74.12% in 2022.

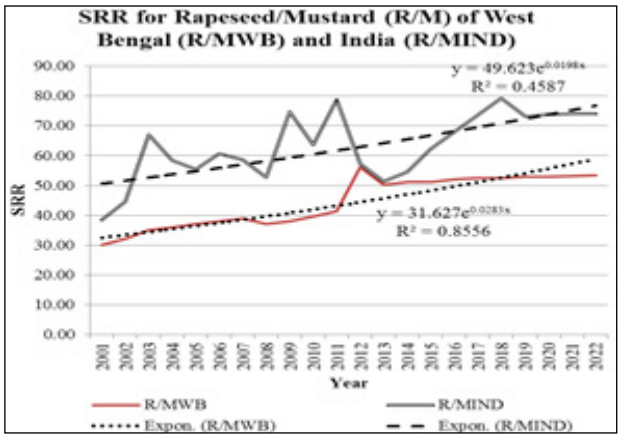

Fig. 1

Objective

Dutta and Sundharam (2018) in their book 'Indian Economy' have quoted that "seed is basic and crucial input for attaining sustained growth in agricultural production. Seed is the carrier of new technology to crop production, propagation and multiplication". Accordingly, in this research article we want to study the sustainable economic impact of Seed Replacement Rate (SRR) on production of Mustard Seed during the period 2022-23 in the Gram Panchayat (GP), Jarur of Murshidabad District, West Bengal. It is a cross section analysis. The SRR is known as 'the percentage of area sown with Certified /quality seeds (new seeds) out of the total cultivated area under a crop season' (Sigh and Chand (2011)).

For analytical simplicity, the district of Murshidabad from the state of West Bengal has been selected. We have followed the stratified random sampling procedure. First of all, Raghunathganj-I has been selected among all Blocks of the district. In this Block, we have fixed one Gram Panchayat (GP), Jarur. Again, the crop Mustard is preferred from the list of winter crops.

The government of India had implemented the National Food Security Mission (NFSM) in 2007-08 (Government of West Bengal, 2010-11) to the selected district of the state intending for raising yield of rice, wheat, and pulses on a continuous basis to secure the availability food-grains in the country. This scheme was also extended for other crops such as Mustard from the year 2019-20. It helps to maintain the sustainability in the production of crops. The district Murshidabad also comes under the umbrella of the said scheme from 2019-20 for Mustard. The Targeting Rice Fallow Area (TRFA) of the Government of West Bengal was a sub-scheme under the NFSM. The NFSM scheme is a hundred percent centrally sponsored project. The crop, Mustard is also included under the Targeting Rice Fallow Area (Oil Seed) scheme of the State Government. Nearly 1100 hectares' land from Total 37 Mouza of four Blocks has been projected by the Additional Director of Agriculture (Admin.) of Jangipur Sub-division in Murshidabad district to demonstrate the effectiveness of the TRFA (Oil Seed) scheme in the year 2021-22 ((Source: Booklet published by Additional Director of Agriculture (Admin.) Jangipur Sub-division, Murshidabad, December 2021)).

On this ground, we have selected the Jamuar Gram Panchayat (GP) of the Block, Raghunathganj-I. The Jamuar Gram Panchayat (GP) was under the said scheme in the year 2021-22. The survey data have been collected during the year 2022-23 from this Gram Panchayat (GP). We have collected data from two hundred thirty farmers of the different farm

Table 1: Demonstrated area, Hybrid Mustard, Papeseed (Yellow Serson) and Tori in the TRFA (Oil Seed) Scheme under NFSM

Year	Block/s	Varieties of Mustard Seed	Gram Panchayat (GP)	Number of Mouza	Number of Benefited Farmers
2021-22	Raghunathganj-I, Suti-I, Farraka, Saghardighi	Kesori Gold K-5111, G.K.M.S-8532, Khoral-432, K-5111, PM-28,B-54	Total-13,	37	6,275 (In Jamuar GP-265 farmers and Jarur GP-250 farmers)
2022-23	NA	NA	NA	NA	NA

Source: *Booklet published by Additional Director of Agriculture (Admin.) Jangipur Sub-division, Murshidabad, December 2021, NA-Not Available.*

sizes with the help of a suitable questionnaire by the tool of simple random sampling procedure.

The important reasons behind selecting the Jamura Gram Panchayat (GP) of the Block, Ragunathganj-I are:

- Three crops, such as Aman Paddy, Mustard, and Boro Paddy are cultivated by the farmers of the Jamura Gram Panchayat (GP) simultaneously. In this area artificial irrigation facility is available. The farmers cultivate the Boro Paddy as a commercial crop. The farmers preferred only such types or types of Mustard seed for which the gap of the period between cultivating and harvesting (crop duration) is 65 days to a maximum of 75 days otherwise next crop (Boro Paddy) will be hampered. They are highly economically will be looser. So from the management and also from the economic point of view, they select such varieties of Mustard Seed that belong to the Tori Group and varieties are B-54, T-9 (Tori), Government Certified Seed (West Bengal), T.W.C-3 etc. The average production is 70 kilograms to 1.50 quintals per thirty-three decimals (as per the respondents, farmers).

This analysis is also completed by the primary data and the necessary data have been collected and complied by the field survey from selected Gram Panchayat (GP).

Review of Literature

'Quality seed' is the basic prime factor for increasing the agricultural productivity but the farmers give the least attention to it (Nandi, A.K. *et al.* 2021). Due to a lack of knowledge of the difference between quality seed and farmer-saved seed, they (farmers) still depend on the old quality of farmer-saved seed. According to them, the farmers believe in farmer-saved or locally available seed rather than quality seed as there is a shortage of supply of quality seed timely and psychological setup of farmers on quality seed. They followed the simple random sampling without replacement (SRSWOR) technique for collecting the necessary data from the study field (lower Indo-Gangetic Basin). They have examined the various issues related to varied performances of paddy, sources of paddy seed and seed replacement rate (SRR), seed supply system, and policy aspects in the high cropping intensity areas to the study zone. They have noticed that SRR of paddy is very low (that is, eighteen to twenty six percent) than that of vegetables (eighty-six percent ninety-nine percent). It is necessary to maintain continuity in seed replacement rate within a specific time gap that is four years for getting a satisfactory yield rate for various crops. Besides, for essential food grains with seed replacement, it is also essential to keep the storage of genetic characteristics of seeds.

In the global seed market, India's share is 4.4 percent and it is also the fifth-largest seed market in the World. The country is also self-sufficient in respect of good quality seeds for a few horticulture crops such as fruits and vegetables, flowers, and also a few field crops (Nagesh Kumar, M. V.et al, 2018). Besides Indian hybrid seeds industries are expected to grow for paddy, maize, and vegetables during the last five years. In this respect, the government's policies are more conducive to the development of India's seed industry.

Analysts Pattanaik (2013) stated that "crop improvement and seed improvement are the two important wheels of agricultural sustainability and both factors co-exist and play supplementary acts to boost the productivity of crops". He said that to achieve this goal, it is necessary to take appropriate

steps for delivering a sufficient quantity of High Yielding Varieties (HYV) seeds or breeder seeds to the hands of farmers. This is possible by improving or upgrading the few significant steps that are co-related with the production of seed, collections of germplasm, plant breeding, and delivery of seed (Ghosh 2013).

Sigh and Chand (2011), in their article "The Seed Bill, 2011: Some Reflections", have stated the "the Seed Replacement Rate (SRR) is the percentage of area sown with Certified /quality seeds out of the total cultivated area under a crop season". It also means that the Seed Replacement Rate (SRR) is an indication of the cropped area covered with certified/quality seed. They have also quoted that "the Seed Replacement Rate also indicates how much of the total cropped area is sown with certified/ quality seeds in comparison with farm-saved seeds".

Researchers Singh and Singh (2016) have observed that Jharkhand is a predominantly rained-fed agricultural zone where the differential types of planting material are used by farmers among which nearly seventy-five percent are farm-saved seeds. They have also noticed that due to the existence of various types of obstacles such as poor infrastructure, poor technological adaption, mono-cropping, shortage in supply of good qualities seeds, poor technology, etc. the seed replacement rate is very poor for cereals (except rice), pulses and oilseeds. They also have found that the improved varietal replacement rate (VRR) and seed replacement rate (SRR) both play significant roles in raising the productivity of rice, wheat, pulses, and oilseeds that help to boost the food security in the state of Jharkhand. Singh (2013) in his article bearing the title 'Issues and strategies to correct missing links in the seed sector of India' quoted that "the contribution of quality seeds in the total production is about fifteen to twenty percent". Again depending on the types and nature of crops, the quality seeds can be able to raise production further up to forty to fifty percent (Natrajan, S. *et al.* 2009). In that situation, they pointed out that the other factors should be used effectively. From another important empirical study done by Singh and his followers (2022) through field survey in the state of Uttar Pradesh, India it has been found that the seed replacement rate is not satisfactory for the study crop among different farm communities. According to them, seed replacement is the highest in the marginal community of farmers (37.39%).

The analysist Hajong (2019) in his article bearing the title "Seed Replacement Rate in Crops: A Case Study from Arid Western Rajasthan", stated that the Seed Replacement Rate (SRR) is a key factor for measuring the extent of use of certified for different crops. His empirical analysis was based on the primary data in Ujaliya village of the district Jodhpur to the state of Rajasthan during the period 2017-18. He noticed that SRR for Cotton, Pearl Millet, Castor, and mustard were 100, 89, 69, and 78 percent respectively. But it was not satisfactory for other crops (less than fifty percent). He also remarked that SRR was affected by four factors such as, 'type of cultivar (variety/hybrid), presence or absence of informal seed sectors, whether the crop is grown for domestic or commercial purposes and availability of irrigation facilities'.

Research Methodology

To analyse the effect of Seed Replacement Rate on the production and yield rate of Mustard Seed, we can formulate a Cobb-Douglas type of production function. This model has been estimated by the ordinary least square method. The formal model (called population regression model) is:

$$Y = A(TIRR)^{\beta_1}(TCLAB)^{\beta_2}(TCOST)^{\beta_3}(TCPFER)^{\beta_4}e^{u_i} \quad \text{Number of farm sizes: } i = 1,2,3,.....230. \quad \ldots(1)$$

We take the log of the above model:

$$\log(Y_i) = \text{constant} + \beta_1 \log(TIRR_i) + \beta_2 \log(TCLAB_i) + \beta_3 \log(TCOST_i) + \beta_4 \log(TCPFEER_i) + u_i \quad \ldots(2)$$

To understand the effect of SRR on the production level we add another new parameter of the above function ((equation (2)) and the model will become:

$$\log(Y_i) = \text{constant} + SRR_i + \beta_1 \log(TIRR_i) + \beta_2 \log(TCLAB_i) + \beta_3 \log(TCOST_i) + \beta_4 \log(TCPFEER_i) + u_i \quad \ldots(3)$$

To examine the impact of SSR on the production of Mustard Seed according to the different farm sizes, the equation (3) can be rewrite in following form of equation ((equation (4)):

$$\log(Y_i) = \text{constant} + SRR_i + \delta_1(D_1 SRR_i) + \delta_2(D_3 SRR_i) + \beta_1 \log(TIRR_i) + \beta_2 \log(TCLAB_i) + \beta_3 \log(TCOST_i) + \beta_4 \log(TCPFEER_i) + u_i \quad \ldots(4)$$

$$D_1 = \begin{pmatrix} 1, \text{ if farmers belong to the Marginal Category} \\ 0, \text{ for others category} \end{pmatrix}$$

$$D_3 = \begin{pmatrix} 1, \text{ if farmers belog to the others (medium and large) Category} \\ 0, \text{ for marginal and small category} \end{pmatrix}$$

If $D_1 = D_3 = 0$, the farmers are belonging to the Category of Small Size.

[SRR=Seed Replacement Rate, TIRR = Total cost of Irrigation, TCOST = Total cost of Tractor (to plough), TCLAB=Total Labour Cost, TCPFER = Total cost on both fertilizers and pesticides]. For analytical simplicity, we have considered individual average data of Production (TPROD), yield (YIELD), TIRR, TCOST, TCLAB, and TCPFER.

RESULTS AND DISCUSSION

We already have noted that seed is the key factor to farmers to raise production and productivity. A better Seed Replacement Rate (SRR) presents a better application of Certified or Quality Seed or Hybrid Varieties Seeds (HYV). New seeds are either Certified Seeds (CS) or Hybrid Seeds. According to the farmers, Certified Seeds (CS) can be used two to three times. But Hybrid Seeds can be used only one time because the seed from their first generation does not reliably produce the same copies of their parents. So, it requires purchasing new seeds for every crop season. It takes at least three years' efforts to produce Certified Seeds from Breeder Seeds (GKTODAY, published: October 7, 2015). Both Certified and Hybrid seeds are the best to raise production and productivity. The Seed Replacement Rate is positively related to productivity. For example, during the survey time, it has been found that the average production of Mustard is 75 to 90 kilograms per 0.333 acre (one Bigha) of land (One Bigha = 0.333 acre) in the case of Farm Saved Seed (FSS). On the other side, it was 110 to 200 kilograms per 0.333 acre of land for Hybrid or Certified Seeds. So it has been noticed that the higher the SRR, the higher is production as well as productivity, that is, the sustainability in the production of crops is highly correlated with the SRR. Obviously, higher will be chance of achieving food security with nutritional security. It may be helpful to control food price inflation.

From table 1, it has been noticed that the average Seed Replacement Rate (SRR) is 38.52 percent which is below the state average (53.2%). It may happen because; Indian farmers do not capable to make distinction between grains and seed (Chand, 2007). It has been also observed that the variation of SRR is very high (96.96%) because the SRR varies from 0% to 100% from farmer to farmer which is noticed in Table 7. In this table, it has also been found that the SRR for 70 and 40 farmers are 0% and 100% respectively. For the rest of the farmers, it varies from 14% to 85% respectively. In this regard, we have pointed out some important logic behind the

Table 1: Descriptive Statistics of Selected Parameters

	AREAUC	SRR	TCIRR	TCLAB	TCOST	TCPFER	TPROD	YIELD	TKKG	TNKG	TPKG
Mean	1.89	38.52	2873.77	7313.55	3347.37	12263.57	679.38	363.82	76.48	57.12	69.26
Med.	1.67	30.00	2400.00	7000.00	3000.00	11379.69	602.50	344.25	65.70	52.40	64.00
Maxi.	5.33	100.05	10000.00	24000.00	9600.00	37606.25	6711.00	3355.50	264.00	227.20	252.00
Min.	0.33	0.00	400.00	1000.00	400.00	1632.94	100.00	210.00	0.00	9.60	11.70
S.D.	0.91	37.35	1870.70	4054.02	1851.16	6716.52	525.17	211.91	49.38	31.57	38.68
Skew.	0.71	0.61	1.56	0.99	0.87	1.04	6.84	12.30	0.94	1.30	1.25
Kurt.	3.65	1.95	5.64	4.81	3.58	4.43	77.00	174.24	3.83	6.30	5.58
C.V.	48.15	96.96	65.10	55.43	55.30	54.77	77.30	58.25	64.57	55.27	55.86

Source: *Authors own calculation from Survey Data.*

Max. = Maximum Value, Min. = Minimum Value, S.D. = Standard Deviation, Skew. = Skewness, Kurt. = Kurtosis, C.V. = Coefficient of Variation, TNKG = Total Nitrogen Consumption in Kilogram (in KG), TKKG = Total Potassium Consumption (in KG), TPKG = Total Phosphate Consumption in Kilogram (in KG), TPROD = Total Production (in KG), YIELD = Yield (KG/Acre), AREAFSS = Area under Farm Saved Seed (Acre), AREANS = Area under New Seed (Acre), AREAUC = Area Under Cultivation (Acre), TCIRR = Total Irrigation Cost (in Rupees.), TCLAB = Total cost of Labour (in ₹), TCOST = Total Cost for Tractor (in ₹), TCPFER = Total Cost on Pesticides and Fertilizers (in ₹)

low level of SRR. In our study zone, three crops such as Aman Paddy, Mustard, and Boro Paddy are cultivated by the farmers simultaneously. So, they prefer such qualities of Mustard Seed which requires a maximum of 60 to 70 days (crop duration) from cultivation to harvesting. Thus, according to their responses, most of the farmers always have chosen farm-saved seeds in place of new seeds. Besides, another argument of the farmers is that sometimes they have purchased new seeds and at that time the seller assured that it will require 60 to 70 days to get the final product. However, after cultivating new seeds, the farmers have noticed that it requires 90 to 110 days (crop duration) to collect the final product. In this situation, according to farmers, the next crop which is Boro Paddy is highly affected. A farmer cultivates the Boro Paddy as a commercial crop in the survey area. There will be a chance of financial loss. Besides, during the time of field survey in the year 2022-23, it has been noticed that in limited areas new Mustard Seeds which is Ray (the local name of these seeds) have been cultivated by farmers. It takes 90 to 110 days (crop duration) from cultivation to harvesting but production is very high (on an average of 160 kg to 250 kg per 0.333 acre) compared to farm saved seeds (FSS). But in this field, the cultivation of Boro Paddy is not possible (as per respondents, farmers).

The average total production (TPROD) and average yield rate are 679.38 kilograms (KG) and 363.82 kg/acre respectively (Table 1) but the variability of production and yield rate is very high (more than 50 percent). This happens due to a high-level variation of SRR from farmer to farmer. The variation in total consumption of fertilizers (TKKG, TNKG, and TPKG) is also not satisfactory. The Government of West Bengal ((Assistant Director of Agriculture (Admin.), Jangipur Sub-division, district of Murshidabad), in the 'Targeting Rice Fallow Area (Oil Seed)' scheme which is under the 'National Food Security Mission (NFSM)' instructed that the ratio of application N, P, and K per acre (in Kilogram) is 24:12:12 (N: P: K = 24:12:12) in scientifically for harvesting Mustard in the non-irrigated area. For the Irrigated area, this ratio (in kilogram) is slightly changed (N: P: K = 28:14:14). But, from table 5, it has been observed that the per acre consumption of the chemical fertilizers is not satisfactory (N: P: K= 30.24:36.66:40:48).

Again from table 3, it has been noticed that the types of the composition of fertilizer which have been used by farmers are-(a) N: P: K (10:26:26) and (b) S: S: P (0:16:0). As per data 73.91 percent of farmers have used fertilizers whose composition is N: P: K (10:26:26) and only 17 percent of farmers have used the fertilizer whose composition of is S: S: P (0:16:0). The government has suggested fertilizers are S: S: P (0:16:0) and M: O: P (0:0:60). These compositions of fertilizers will be fruitful to increase both production and productivity which is also helpful for maintaining the sustainability in the fertility power of the land. Again from the economic point of view, it is noticed that if a farmer selects the government's prescribed fertilizers combination, the farmers will be benefited. According to the Assistant Director of Agriculture (Admin.) of Murshidabad District, if a farmer chooses government rules about the application of fertilizers, both the production and also quality of Mustard Seeds have increased. In the present study, the majority of farmers are interested in inorganic fertilizers. We have noticed around 70% of farmers have applied inorganic fertilizers in the agricultural field to produce mustard in the survey area (table 4). However, from tables 9 and 10 it has been found that SRR according to different farm sizes with excessive application of fertilizers does not affect both production and productivity. Overall, excessive application of chemical fertilizers

Table 2: Farmers related information

Type of Farmers	No. of Farmers	% in respect of Total Farmers
Marginal	115.00	50.00
Small	100.00	43.48
Others	15.00	6.52
Total	230	

Table 3: Type of Composition Fertilizers (TYPECFER)

TYPEFER	**No. of Farmers**	**% of Farmers**
S:S:P (0:16:0)	40.00	17.39
N:P:K (10:26:26)	170	73.91
Others	20	87

Source: *Authors own calculation from survey data.*

Table 4: Type of Fertilizers and Used by Farmers (TYPEFER)

TYPEFER	No. of Farmers	% of Farmers
ORGANIF	71.00	30.87
INORGANIF	159.00	69.13
Total Farmer	230.00	

Table 5: Consumption of Fertilizers (N, P, K)

	In KG	KG/Acre
TNKG	13137.55	30.24
TPKG	15928.68	36.66
TKKG	17589.52	40.48

Table 6: Number of Farmers and SRR

Sl. No	No. Farmers	SRR
1	44	100%
2	70	0%
3	116	14% to 85%

Source: *Authors own calculation from survey data.*

Table 7: Relation between Seed Replacement Rate with Total Production (TPRODT) and Cost of Factors

Dependent Variable: LOG_TPRODT_
Method: Least Squares
Date: 02/02/24 Time: 15:47
Sample (adjusted): 1 229
Included observations: 229 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.552765	0.132161	-4.182525	0.0000
SRR	0.001105	0.000223	4.952690	0.0000
LOG_TCIRR_	0.130528	0.056311	2.317976	0.0214
LOG_TCLAB_	0.298500	0.071863	4.153735	0.0000
LOG_TCOST_	0.090096	0.073530	1.225291	0.2218
LOG_TCPFER_	0.344972	0.082722	4.170269	0.0000

R-squared	0.760390	Mean dependent var	2.761474
Adjusted R-squared	0.755017	S.D. dependent var	0.244985
S.E. of regression	0.121257	Akaike info criterion	-1.355955
Sum squared resid	3.278836	Schwarz criterion	-1.265988
Log likelihood	161.2568	Hannan-Quinn criter.	-1.319660
F-statistic	141.5357	Durbin-Watson stat	1.761622
Prob (F-statistic)	0.000000		

Source: *In this table the output obtained by the author after application of the EViews software.*

will damage soil health in the future. There were different arguments from the farmers behind the excessive use of chemical fertilizers in the survey area. According to them, since we want to cultivate Boro Paddy on the same field as a next crop so less quantity of fertilizers for Boro Paddy may be required and the cost of cultivation may be reduced.

The estimated results of the relation between Seed Replacement Rate (SRR) and total production are shown in Table 7. It appears that SRR is indeed an important determinant of production in the surveyed field. The computed *t-value* for the estimated coefficient of SRR is statistically highly significant (*p-value = 0.000*). It is also observed that a one-point increase in the level of SRR (i.e., one percent of SRR) brings about an improvement of production by 0.001105 point (i.e., 0.001105 percent). Similarly, the estimated results of the relation between Seed Replacement Rate (SRR) and yield are highlighted in Table 8. It appears that SRR is indeed an important determinant of productivity in the surveyed area. The computed *t-value* for the estimated coefficient of SRR is statistically highly significant (*p-value = 0.000*). It is also found that a one-point increase in the level of SRR (i.e., one percent of SRR) brings about an enhancement of yield by 0.001124 points (i.e., 0.001124 percent).

The calculated results of the relation between Seed Replacement Rate and Total Production (TPRODT) according to Farm Size are presented in Table 9. It also accepted that SRR is an important determinant of production in the surveyed zone.

Table 8: Relation between Seed Replacement Rate with Yield (YIELD) and Cost of Factors

Dependent Variable: LOG_YIELD_
Method: Least Squares
Date: 01/31/24 Time: 22:27
Sample: 1 230
Included observations: 230

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.594819	0.114225	22.71675	0.0000
SRR	0.001124	0.000197	5.705137	0.0000
LOG_TCIRR_	0.008005	0.049862	0.160537	0.8726
LOG_TCLAB_	0.017754	0.063690	0.278755	0.7807
LOG_TCOST_	-0.071570	0.065205	-1.097612	0.2736
LOG_TCPFER_	0.013386	0.072495	0.184649	0.8537

R-squared	0.144069	Mean dependent var	2.539141
Adjusted R-squared	0.124963	S.D. dependent var	0.114955
S.E. of regression	0.107533	Akaike info criterion	-1.596293
Sum squared resid	2.590199	Schwarz criterion	-1.506604
Log likelihood	189.5738	Hannan-Quinn criter.	-1.560115
F-statistic	7.540655	Durbin-Watson stat	1.894010
Prob (F-statistic)	0.000001		

Source: *In this table, the output obtained by the author after application of the EViews software.*

Table 9: Relation between Seed Replacement Rate with Total Production (TPRODT) and Cost of Factors according to Farm Size

Dependent Variable: LOG_TPRODT_
Method: Least Squares
Date: 01/31/24 Time: 22:35
Sample (adjusted): 1 229
Included observations: 229 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.431536	0.156597	-2.755715	0.0063
SRR	0.001471	0.000338	4.347767	0.0000
LOG_TCLAB_	0.273814	0.073977	3.701317	0.0003
LOG_TCIRR_	0.129934	0.056468	2.300998	0.0223
LOG_TCOST_	0.092454	0.073560	1.256859	0.2101
LOG_TCPFER_	0.335929	0.083043	4.045257	0.0001
D_1_SRR	-0.000560	0.000385	-1.452847	0.1477
D_3_SRR	0.000172	0.000969	0.177210	0.8595

R-squared	0.762743	Mean dependent var	2.761474
Adjusted R-squared	0.755228	S.D. dependent var	0.244985
S.E. of regression	0.121205	Akaike info criterion	-1.348357
Sum squared resid	3.246635	Schwarz criterion	-1.228402
Log likelihood	162.3869	Hannan-Quinn criter.	-1.299964
F-statistic	101.4971	Durbin-Watson stat	1.782562
Prob (F-statistic)	0.000000		

Source: In this table, the output obtained by the author after application of the EViews software.

Table 10: Relation between Seed Replacement Rate with Yield (YIELD) and Cost of Factors according to Farm Size

Dependent Variable: LOG_YIELD_
Method: Least Squares
Date: 01/31/24 Time: 22:38
Sample: 1 230
Included observations: 230

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.631482	0.135088	19.47970	0.0000
SRR	0.001313	0.000301	4.363951	0.0000
LOG_TCIRR_	0.010418	0.050147	0.207759	0.8356
LOG_TCLAB_	0.003781	0.065779	0.057475	0.9542
LOG_TCOST_	-0.069053	0.065409	-1.055698	0.2923
LOG_TCPFER_	0.013165	0.072893	0.180610	0.8568
D_1_SRR	-0.000277	0.000341	-0.812112	0.4176
D_SRR	-0.000529	0.000862	-0.613474	0.5402

R-squared	0.147772	Mean dependent var	2.539141
Adjusted R-squared	0.120900	S.D. dependent var	0.114955
S.E. of regression	0.107783	Akaike info criterion	-1.583238
Sum squared resid	2.578992	Schwarz criterion	-1.463653
Log likelihood	190.0724	Hannan-Quinn criter.	-1.535000
F-statistic	5.499105	Durbin-Watson stat	1.887918
Prob(F-statistic)	0.000008		

Source: *In this table the output obtained by the author after application of the EViews software.*

The computed *t-value* for the estimated coefficient of SRR is statistically highly significant (*p-value = 0.000*). It is also observed that a one-point increase in the level of SRR (i.e., one percent of SRR) brings about an increase of production by 0.001471 points (i.e., 0.001471 percent). But here SRR according to farm size is not a significant factor in raising production. However, 93.28 percent of farmers belong to the category of small and marginal (Table 2).

In the same pattern, the results of table 10, also pointed out that SRR is an important determinant of yield in surveyed area. The computed *t-value* for the estimated coefficient of SRR is statistically highly significant (*p-value = 0.000*). It is also stated that a one-point increase in the level of SRR (i.e., one percent of SRR) brings about an increase of yield by 0.001313 points (i.e., 0.001313 percent). Though 93.24 percent of farmers are in group of small and marginal yet SRR according to farm size is not a significant factor in increasing yield.

We want to calculate the average gross gain per 0.333 acres of land for cultivating mustard at the current selling price. The current selling price of mustard varies from ₹ 5000 to 6000 for 100 kg (in average ₹ 5500.00 per 100 kg, per kg. = ₹ 55.00) at the time of harvesting as per the respondents. We have noticed that the farmers cultivated two types of mustard seeds; farm-saved seeds and new seeds. In the case of farm-saved seeds, the production varies from 80 kg to 100 kg per 0.333 acre. Again, new seeds have been classified into two categories based on time. One type of new seed takes 60 to 70 days and production varies from 110 kg to 150 kg per 0.333 acre (according to farmers). Another variety (Ray mustard; local name) takes 90 to 110 days and production varies from 160 kg to 250 kg per 0.333 acre (as per respondents).

The cost of inputs is given in table 11.

Table 11: Input Cost per 0.333 Acre Land (Average value) at the current Price

Sl. No	Input	Cost (₹)
1	Labour	1500
2	Irrigation	600
3	Tractor Cost (plough)	700

4	Transport Cost	550
5	Pesticides Cost	275
6	Seed Cost	150
7	Fertilizers Cost (N: P: K)	1703.25
	Total Cost	5478.25

Source: *From the field survey as per the respondents.*

Number of labour = 6 (per 0.333 acre), wage rate = ₹ 250.00 per labour, Transport Cost (to carry the crop from field to farm-house) = ₹ 550.00, [One combination of fertilizers combination: 10:26:26 = IFFCO, Urea = 46% Nitrogen (N), average price of 50kg IFFCO = ₹ 1750.00, average price of 40 kg Urea = ₹ 375.00, In 0.333 acre in average 50 kg IFFCO and 15 kg Urea; Total cost of fertilizers = ₹ 1891.00]; [Second combination fertilizers: Single Superphosphate (SSP = 0:16:0), Muriate of Potash (MOP = 0:0:60), Average price per packet (50 kg) of SSP = ₹ 555.00 , one packet (50 kg) MOP = ₹ 1800.00; for 0.333 acre in average 65 kg SSP, 15 kg MOP and 15 kg UREA is required; in this combination Total cost of fertilizers = ₹ 1515.50]. Average total Fertilizers Consumption = (₹ 1891.00 + ₹ 1515.50) = ₹ 1703.25. (***Note:*** Cost of Organic fertilizers is excluded)

The gross income of the farmer in case of three different situations is explained one by one:

(i) Farm-saved seed: average production per 0.333 acres is (80 kg to 100 kg.) = Average 90 kg. Gross Income = ₹ ((90*55) – 5328.25) = ₹ (4950.00 – 5328.25) = ₹ (-378.25), that is loss.

(ii) For the first category of new seeds: average production per 0.333 acre = (110 kg to 150 kg.) = Average 130 kg. Gross Income = ₹ ((130*55) – 5478.25) = ₹ (7150-5478.25) = ₹ 1671.75 (gain).

(iii) The second category of new seeds is known as Ray Mustard (as per the local name). Its selling price varies from ₹ 4500.00 to ₹ 4700.00 per 100 kg (in average ₹ 4600.00 per 100kg, per kg. = ₹ 46.00). Average production per 0.333 acre = (160 kg to 250 kg) = Average 205 Kg. Gross Income = ₹ ((205*46)-5478.25) = ₹ (9430.00-5478.25) = ₹ 3951.75 (gain).

However, from this information, we have noticed that a farmer has benefited more by cultivating Ray Mustard Seeds in the field. But the reasons, why very small numbers of farmers have preferred Ray seeds, already quoted in the previous discussion.

CONCLUSION

In our study, it has been noticed that the genetically improved and better quality of crop seed is the key factor of livelihood among the farming communities. It is also widely accepted and side by side acknowledged that with a slight modification or variation in seed expenses, a significant development has occurred in the productivity of the crop.

In the modern agricultural system, a better Seed Replacement Rate (SRR) highlights the better utilization of Certified/Quality Seeds. In the state of West Bengal, the Seed Replacement Rate has been raised continuously but not satisfactory as compared to the Country level. The SRR of Mustard Seeds was 30% in 2000 and has increased to 53.50% in 2022 for West Bengal. But in the case of India for the same crop, it was 38.39% in 2000 and has touched to 74.12% in 2022.

A better SRR helps maintain sustainability in the production of crops. From this analysis, it has been noticed that the average Seed Replacement Rate (SRR) is 38.52 percent which is below the state average (53.2%). It happens mainly due to the high-level dependence on farm-saved seeds. Further, it has also been found that the SRR for seventy (70) and forty (40) farmers are zero (0%) and one hundred percent (100%) respectively. For the rest of the farmers, it varies from fourteen (14%) to eighty-five (85%) percent respectively. Also, it appears that SRR is indeed a key factor of production in the surveyed field. Both production and productivity of Mustard Seeds are highly influenced by seed replacement rate during the survey period. Another interesting observation is that, though more than ninety percent (93.48%) has fallen in the group of small and marginal indeed farm sizes do not influence to increase production with the variation of seed replacement rate. However, the different farm sizes have applied excessive fertilizers in the field to raise production. Overall, excessive application of chemical fertilizers will damage soil health in the future. However, from the economic point of view, it is noticed that if a farmer selects the government's prescribed combination of fertilizers, according to the Assistant Director of Agriculture (Admin.) of Murshidabad District, both the production and also quality of Mustard Seeds will be increased. Finally, we have also observed that if a farmer cultivates Ray Mustard Seeds (the local name which is used by

farmers) in the agriculture field, their gross income increases. But, as per respondents, the crop duration (90 to 110 days) is very high for Ray Mustard and if a farmer cultivates Ray Mustard in a land, then there is a least chance to cultivate the next crop that is, Boro Paddy in the same land. There is a possibility of financial loss since; Boro Paddy is an important commercial crop for farmers in the survey zone.

SUGGESTIONS

It is necessary to increase the supply of Certified/ Breeder Seed by the Department of Agriculture of the Government of West Bengal in sufficient quantity. The Government may arrange different seminars with the farmers before cultivating the crops and try to develop the confidence of farmers about the Certified or Hybrid seeds. It is also necessary to motivate the farmers to use chemical fertilizers as per government rule which is prescribed by the Additional Director of Agriculture (Admin.) of the different Subdivisions on behalf of the Government. Otherwise, the current motive of the farmers about chemical fertilizers deteriorates the soil health condition in the future. The fertility power of the land will be lost. We have observed that if a farmer cultivates new Hybrid Seeds which take one hundred ten days to one hundred twenty days, the production is much more compared to other ordinary seeds. During the survey time we have noticed that due to the next crop (Boro Paddy), farmers prefer such quality seeds which take sixty-five days to a maximum of eighty days. However, the cultivation of Boro Paddy is highly dependent on artificial irrigation systems in the study zone. It is also an important environmental issue. In that situation, the Government may take the proper management tool to control the excessive use of groundwater.

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