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INTRODUCTION

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NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

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RECOMMENDATIONS/SUGGESTIONS

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- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

ECONOMIC BENEFITS AND VIABILITY OF USING HEALTHY RICE SEED TECHNOLOGY OVER FARMERS: A STUDY OF SOME SELECTED AREAS OF BANGLADESH

DR. A.S.M. NAZRUL ISLAM
SAFEGUARD GOVERANCE OFFICER (CONSULTANT)
INTEGRATED AGRICULTURAL PRODUCTIVITY PROJECT
REGIONAL PROJECT IMPLEMENTATION UNIT
BARISAL

MONSURA ZAMAN
ASST. PROFESSOR
ASA UNIVERSITY BANGLADESH
SHYAMOLI

ABSTRACT

Lack of healthy rice seed is considered as one of the most important constraints to rice production and productivity growth in Bangladesh. This study was carried out to greater information about knowledge, adoption and economic profitability of healthy rice seeds technology. Data were collected from Gazipur district. Primary data from 60 respondents of Boro season were used. This study opted for descriptive and mathematical tools to analyze the collected data. The socioeconomic characteristics of healthy rice seed users and non healthy seed users were described using descriptive statistics. Profitability analysis was used to estimate and compare gross margin and net benefit in rice production for healthy rice seed users and non users. The results revealed that rice yield and net benefit from rice production with healthy seeds were higher than that with farmers' saved seeds. The per hectare incremental net benefit of healthy seeds was estimated at Tk.1735 for Boro, in Gazipur, respectively. Partial budget analysis showed that rice production with the healthy seeds was found to be more profitable than that with the farmers' saved seeds in Boro season. Partial budget analysis showed that healthy seed users get higher profit Tk 1653/ha respectively.

KEYWORDS

Integrated Pest Management, Healthy seeds plot, High Yielding variety, Modern Variety.

INTRODUCTION

Bangladesh is predominantly an agricultural country where agriculture sector plays a pivotal role in accelerating the economic growth.In FY2010-11, The food grains production was about 360.65 lakh metric tones (MT) according to DAE estimation (Bangladesh economic Review 2011).Rice is the livelihood for 135 million people of Bangladesh. Most of the people eat rice as their main food and main source of calories. In Bangladesh agriculture as it primary sector, contributing 20.29% to the Gross Domestic product (GDP). It provides nearly 48% of rural employment, about two-third of total calorie supply and about one-half of the total protein intake of an average person in the country. Rice sector contributes one half of the agricultural GDP and one sixth of the national income in Bangladesh.(BRKB 2012).Crops agriculture covers 83% of the total cropped area [BBS 2011], and plays an important role in attaining self sufficiency in food. At present, rice alone constitutes about 96% of the total food grains produced annually in the country. At present total rice production is 33.54 million metric tons per annum. The introduction and expansion of MV rice brought a dramatic change in annual rice production from 9.77 million metric tons in 1971 to 33.54 million metric tons in 2010-2011 (Hand book of Agricultural Statistics 2011, MOA). This increased rice production has been possible largely due to the growth of the adoption of modern rice varieties on around 66% of the rice land which contributes to about 73% of the country's total rice production(BRKB,2012).Rice supplies more than 80% of the total food requirement for the country. So to meet the great challenge of food deficit, production of rice must be increased. Modern varieties have been contributing to increase rice production. Many constraints are responsible for low level yield of rice out of which seed borne diseases, poor seed quality and poor management among others are most important. Therefore, the production should be accompanied by intensive cultivation of rice. Importance should also be given to increase production and adoption of MV rice and new technology at the farm level. Without increase of production and adoption of new technology, it will not be possible to reach the required level of self sufficient in food.

FUTURE RICE PRODUCTION SCENARIOS

To meet the future increasing demand, the possibilities for higher rice production are to be explored from sustainability point of view. Two most important determinants for higher rice production are yield and area under MV rice. The population is still growing by two million every year and may increase by 30 million over the next 20 years. Thus, Bangladesh will require about 27.26 million tons of rice for the year 2020(BRKB, 2012).During this time total rice area will also shrink to 10.28 million hectares. Rice yield therefore, needs to be increased from the present 2.74 to 3.74 t/ha. To combat the future situation we will need to consider:

- Replacement of local varieties by modern varieties in Boro season where possible.
- Limited increase in modern variety Boro area
- Replacement to the present varieties by superior inbred, hybrid and super high yielding varieties.
- Increment of irrigation areas in both Boro and T. aman season.
- The use of quality seeds.
- Mechanization of rice cultivation particularly minimization of post harvest losses.

IMPORTANCE OF CLEAN HEALTHY SEED

Seed health condition can be assessed in terms of the proportion of normal seedlings, lethal seed infection, rice mixtures, purity, fullyfilled seeds, 100- grain weight and discoloration. The importance of quality seeds in increasing yield has been widely recognized. It is important that clean healthy seeds be used as planting materials in order to increase rice productivity for eliminating poverty and calorie deficiency of Bangladeshi people. Healthy and high quality seed is an important requirement for high crop productivity. Another important determinant of seed quality is varietal purity. Varietal purity significantly influences the crop yields besides affecting the production practices. It is therefore, important that farmers become aware of the presence of contaminants in their seeds.

OBJECTIVES OF THE STUDY

The main objectives of the study were as follows:

1. To understand socio-economic characteristics of the rice growers.
2. To find out the knowledge, attitudes, perceptions and seed management practices of the rice growers.

3. To assess economic benefits and viability of using clean healthy seed technology (CHST) over farmers traditional one.

HYPOTHESE OF THE STUDY

The following hypothesis were tested-

1. Farmers of the study area do not have awareness of rice seeds management practices.
2. There is no significant difference on yield, different agronomic, insect and disease variables between clean healthy seed plot and farmers own seed

REVIEW OF LITERATURE

Empirical studies on rice seed health in Bangladesh are few. Some of the works are reviewed below:

Nazrul and Fakrul (2010) analyzed factots demand and elasticity of substitution of healthy rice seed. Lack of healthy rice seed was considered as one of the most important constraints to rice production and productivity in Bangladesh. Data were collected from two different rice growing environments, namely Chuadanga and Gazipur. Primary data from 120 respondents were collected from Boro and T-Aman seasons .Allen Partial Elasticities were estimated for Boro and T-Aman rice for both the study areas. Healthy seed price was highly elastic and the result showed that an increase in the price of healthy seed would decrease its demand. The result also showed that if the use of land increased then use of fertilizer, animal power. seed irrigation and human labour would increase. The estimates on elasticity of substitution indicated that the best substitutes are land-seed, land-animal power plus mechanical power and land labor in the Boro season. In the T-Aman season, the best substitutes were found to be land-irrigation in Chuaganga and land animal power plus mechanical power, land seed in Gazipur.

Hossain,M et al.(2004) conducted a farmer participatory experiment, demonstrated to participating farmers as well as to the farming community substantial gains that could be reaped by carefully managing the production,cleaning and preservation of seeds. Engaging the farmers in the experiments improved their awareness about the importance of seed health in crop production and earned their trust in adopting improved technologies for seed management.The result showed that rice yield could be increased by at least 10% just from using quality seeds.More widespread dissemination of information on the seed management practices could be done through the broader media coverage and through the agricultural extension services, and by creating a cadre of seed entrepreneurs among farmers in each union. It was estimated that yield gains from using quality seeds would translate to production gains of US$360 million a year if this practice is widely adopted by Bangladeshi farmers.

Mia et al.(2002)conducted an experiment at BRRI Gazipur on storage of rice seed. Four different containers were plastic drum, motka, metal drum and sack with polyethylene lining and tested additives were ash, chalk powder, dried neem leaves and naphthalene, respectively. Among different containers plastic drum and painted motka and some additives were reported to be effective for save storage of rice seed.

Fakir et al. (2000) stated that rice seeds while growing, maturing and ripening in the standing plant in the field, can be infected by different seed born diseases caused by fungal, bacterial and nematode pathogens. The dormant condition of the seed is highly favorable for the survival of these pathogens in it. Seed borne pathogens cause germination failure, rotting of seed, root and weight loss of the seed in addition to spotting and discoloration to the seed. Besides seed borne pathogens, seeds may also carry weed seeds, insect damaged seeds, other variety mixtures, inter matter, unfilled grains etc., which reduce the seed quality.

Hossain,M et al.(2000) conducted a study to understand farmers' knowledge, attitudes and practices regarding seed management in Bangladesh. During the survey period considerable geographical variation was noted in the responses on socioeconomic problems. A minority of farmers reported problems with the high cost of fertilizer. Low output price was the major problem. About 47% farmers could not identify specific insects and diseases. Others reported that the pest causing the highest yield loss were stemborers, rice bugs and rice hispa. The study also showed that seed vigor is greatly affected by improper drying of seed. They showed that many farmers harvest a selected portion of the field for seeds. Farmers are more concerned about the quality of the boro seeds, because boro is harvested during the monsoon season and hence the grain has high moisture content.

Alam ,et al.(1995) 0carried out a farm level house hold survey during 1995-1996 in six different agricultural regions of Bangladesh to overview the status of MV rice seed used by the farmers and the socioeconomic constrains on the use of better seed. Tabular and descriptive statistics were used to analyze the household level information on MV rice seed utilization pattern in different regions of Bangladesh. The study showed that more than 80% of the rice seed used in farmers' fields in all the study locations was the farmers' own preserved and seed use rate was much higher than the recommended rate. The study further revealed that about 50% of farmers usually select seed from the general crop lot and collect seed after harvesting without removing the off types.

RESEARCH METHODOLOGY

The study was conducted in Gazipur district. To carry out the present study two villages of Sreepur upazila under Gazipur district were purposively selected. Data were gathered using a structured questionnaire designed for the study. Information was generated from two villages in Gazipur district through formal interview of 120 farmers in Boro season.

PROFITABILITY ANALYSIS

THEORETICAL FRAMEWORK

Cost and return analysis is the most common method of determining and comparing the profitability of different farm enterprises, cropping patterns. Net return is defined as the difference between total revenue and total cost. The net return from rice production using clean healthy seed technology is defined as:

$\pi = TR - TC$

$$\pi = P_y \times Y - \sum_{i=1}^{n} \mathrm{P_{X_i}} \times X_i$$

Where,

$\pi = net\ return\ from\ healthy\ and\ farmers\ saved\ seed\ plot\ (Tk/ha)$
$TR = total\ revenue\ from\ healthy\ and\ farmers\ saved\ seed\ plot\ (Tk/ha)$
$TC\ = total\ cost\ from\ healthy\ and\ farmers\ saved\ seed\ (Tk/ha)$
$Y\ = quantity\ of\ output\ of\ healthy\ and\ farmers\ saved\ seed\ plot\ (Ton/ha)$
$X_i\ = quantity\ of\ i^{th}\ input\ (kg/ha)$
$P_y = price\ of\ output\ (Tk/ton) and$
$P_{xi} = price\ of\ i^{th}\ input\ (Tk/kg)$

BENEFIT COST ASSESSMENT

Profitability analysis is useful in analyzing and comparing the relative benefit of a new technology. Net farm income, benefit-cost ratio , returns to labor, returns to family labor, returns to capital and returns to management were computed by utilizing the *following formula-*

- $Net\ farm\ income = Gross\ farm\ income - Total\ farm\ expense$(Measures of return to family labor for their labor management)
- $Benifit\ cost\ ratio\ = Gross\ return\ divided\ by\ total\ full\ cost\ or\ by\ cash\ cost.$
- $Returns\ to\ labour = \frac{Gross\ return - Material\ input\ cost}{Total\ \ labour\ hours}.$
- $Returns\ to\ total\ capital\ = Net\ farm\ income - value\ of\ family\ labour.$
- $Returns\ to\ management\ = Net\ farm\ income - value\ of\ family\ labour - interest\ on\ operating\ capital.$

PARTIAL BUDGET ANALYSIS

In order to assess the breakdown of economic advantages of healthy seed method over the farmer's own seed used partial budgeting technique was employed.

SOCIO ECONOMIC PROFILE AND SEED MANAGEMENT PRACTICES

DEMOGRAPHIC CHARACTERISTICS

AGE, FAMILY SIZE AND EDUCATION

In Bangladesh, 80% of the rice seeds planted are obtained from farmers' own harvest, 10% are exchanged or purchased from neighbors, and 10% are certified seeds supplied by government, or non-government organizations (NGOs), and private seed companies. Table1 presents the socio-economic profile of farmers of Gazipur respectively. Average age of household head was above forty in Gazipur. Average family size of Gazipur was six members per household. More than 75% of the household income was reported to be from agricultural sources. The independent samples T-test reveals no significant difference in age of both sixes, years of schooling for male and female, family size, adult male, adult female and agricultural income, except of number of children aged below 12 years.

TABLE 1: HOUSEHOLD CHARACTERISTICS AND SOCIO-ECONOMIC PROFILE

Socio-economic Demographic Indicators	Gazipur
Age of household (Avg.)	45**(29.4)
Age of spouse (Avg.)	32**(145.9)
Family size (Avg.)	5**(30.3)
Adult male > 12 (Avg.)	2**(15.4)
Adult female > 12 (Avg.)	2**(19.4)
Children < 12 (Avg.)	1**(9.4)
Agril. Income (%)	79**(36.0)
Non agril. Income (%)	21**(9.4)
Farm size (Avg. hectare)	.70**(8.1)
Education of head of house hold (Years of schooling)	6**(11.3)
Education of spouse (Years of Schooling)	6**(3.9)
No. of male workers engaged in agriculture activity.	2**(19.1)
No. of female workers engaged in agriculture activity.	2***(20.849)
No. of male workers engaged in non-agriculture activity.	1**(9.0)
No. of female workers engaged in non-agriculture activity.	.07**(2.2)
House hold head spent hours in agricultural agricultural works (hours/day)	7.54**(62.0)
Spouse spent hours in agricultural agricultural works (hours/day)	5.85**(23.7)

Source: Field Survey

Figures in the parentheses indicate the "t" value

**Significant at 1% level

*Significant at 5% level

Analysis showed that male household head were working full time (8 hours/day) in agriculture.

PROFITABILITY ANALYSIS OF HEALTHY RICE SEED

COST AND RETURN ANALYSIS FOR HEALTHY SEED

Cost and return analysis measures the profitability of different enterprises and technologies and help the farmers to make decisions in selecting the technologies.

INPUT COST SHARE ANALYSIS OF BORO RICE

The cost share of Boro rice inputs in Gazipur are presented in Table 2About 43% cost was shared by labour in Gazipur and the remaining (Above 50%) was shared by non-labour inputs. Among non-labour inputs, irrigation was the most important input in Boro season, sharing about 13% at Gazipur of the total cost, other cost items are fertilizer, seed and power-tiller which contributed 7.17%, 3.76% and 2.62% respectively. (Table 2).

TABLE 2: INPUT COST SHARED IN BORO RICE PRODUCTION ON A PER HECTARE BASIS AT GAZIPUR

Description	Gazipur	
	Amount (Tk)	Percent
Labour	15485	43.39
Seed	1340	3.76
Fertilizer	2558	7.17
Irrigation	4550	12.75
Green manure	815	2.28
Bullock	934	2.62
Power tiller	104	.29
Interest on operating capital	277	.78
Variable cost	26065	73.03
Fixed cost	9624	26.97
Cash cost	18769	52.59
Non-cash cost	16919	47.41
Total cost	35689	

Source: Field Survey

The profitability of Boro rice production in Gazipur for healthy seed and farmers saved seed are compared in Table 3.

TABLE 3: COSTS AND RETURN (TK/ha) OF BORO RICE CULTIVATION AT GAZIPUR

Items	Gazipur	
	Boro	
	Healthy Seed plot	Farmers Saved Seed plot
Yield(Ton/ha)	5.19	4.75
Grain	33375	30545
Straw	8592	8592
Gross return(TK/ha)	41965	39137
Paddy price(TK/ton)	6431	
Cost of production(tk/ha)		
Full cost basis	35689	34512
Cash cost basis	18769	
Cost(Tk/ton)		
Full cost basis	6876	7266
Cash cost basis	3616	3951
Cost (TK/Kg)		
Full cost basis	6.88	7.27
Cash cost basis	3.62	3.95
Net return(TK/ha)		
Full cost basis	6278	4625
Cash cost basis	23197	20368
Gross margin	15902	14250
Benefit cost ratio(BCR)		
Full cost basis	1.18	1.13
Cash cost basis	2.24	2.08

Source: Field Survey

1. Net return (TK/ha) =Gross return-Production cost
2. Net return (Tk/ton) =Net return divided by yield
3. BCR=Gross return divided by total full cost or by cash cost.

For healthy seed the total cost of rice production in 1 hectare of land was estimated Tk.35,689/ha on full cost basis. In farmers saved seed plot on full cost basis Tk.34, 512/ha. The gross return of healthy seed was Tk.41, 965/ha and for farmers saved seed was Tk.39,137/ha respectively. (Table3) . Net return (Tk/ha) for healthy seed on full cost basis was Tk.6,278/ha and on cost basis it was Tk 23,197/ha. On the other hand farmers saved seed on full cost basis was Tk.4,625/ha and for cash cost basis it was Tk.20,368/ha respectively. The gross return of Boro rice production with healthy seed was estimated as Tk. 15902/ha and farmers saved seed at Tk. 1,4250/ha (Table 3). Therefore healthy seed technology gave higher yield, gross margin and het return in Gazipur district.(Table 3).

BENEFIT COST RATIO OF BORO HEALTHY SEED TECHNOLOGY OVER FARMERS SAVED SEED ONE

On full cost basis, benefit cost ratio (BCR) for the land with healthy seed in Gazipur was 1.18 while the BCR for the land with the farmers own seed was 1.13 for farmers saved seed. On the other hand, the benefit-cost ratios for healthy seed and farmers saved seed were 2.24 and 2.08 for Gazipur respectively, in terms of cash cost basis. Therefore, higher benefit cost ratio was observed for healthy seed in Boro season (Table 3.)

EFFICIENCY MEASURE FOR BORO RICE HEALTHY SEED TECHNOLOGY

The efficiency of labour, capital and management in the Boro season of Gazipur district was calculated.

RETURNS TO LABOUR

In Gazipur the labour market was higher on full cost basis for healthy and farmers saved seed. It was Tk.119/ha and Tk.108/ha on full cost basis and on cash cost basis Tk.130/ha and Tk.120/ha respectively (Table 4).

TABLE 4: RELATIVE ECONOMIC PERFORMANCE OF BORO RICE AT GAZIPUR

Items	Gazipur	
	Boro	
	Healthy Seed plot	Farmers Saved Seed plot
A.Gross margin	15902	14250
B.Cost per kg		
Full cost basis	6.88	7.27
Cash cost basis	3.62	3.95
C.Net return per kg		
Full cost basis	1.19	0.96
Cash cost basis	4.45	4.27
D.Returns to labour		
Full cost basis	119	108
Cash cost basis	130	120
E.Returns to total capital		
Full cost basis	1968	315
Cash cost basis	18887	16058
F.Returns to management		
Full cost basis	1136	-517
Cash cost basis	18055	15226

Source: Field Survey

RETURNS TO CAPITAL

It was Tk.1,968/ha and Tk.315/ha on full cost basis in healthy seed and farmers saved seed respectively. On cash cost basis return was Tk.18,887/ha and Tk.16,058/ha. The healthy seed returns to capital was higher compared to farmers saved seeds (Table 4.)

RETURNS TO MANAGEMENT

It was found that in Gazipur returns to management for healthy seed on full cost basis was Tk.1,136/ha and farmers saved seed was negative, on cash cost basis it was Tk.18,055/ha for healthy seed and for farmers saved seed it was Tk.15,226/ha. In the study area the returns to management was higher in healthy seed compared to farmers saved seed (Table 4).

PARTIAL BUDGET ANALYSIS BETWEEN HEALTHY AND FARMERS SAVED SEED

In order to assess the breakdown of economic advantages of healthy seed method over the

TABLE 5: PARTIAL BUDGETING OF BORO RICE CULTIVATION USING HEALTHY SEED VS FARMERS SAVED SEED AT GAZIPUR

Debit	Taka	Credit	Taka
1.Cost incurred for Boro rice cultivation using healthy seed	35689	1.Cost saved for not cultivating Boro rice using farmers own seed	34512
2.Revenue forgone for not cultivating Boro rice using farmers saved seed	39137	2.Revenue earned from Boro rice cultivation using healthy seed using	41967
3.Profit/Loss	+1653		
Total	**76479**		**76479**

Source: Field Survey

farmers saved seed method, partial budgeting technique was employed in Table 5 and analysis showed that, rice production with the healthy seed proved to be more profitable than the farmers saved seed method in Boro season at Gazipur. Farmers were able to obtain much higher profit using healthy rice seed instead of farmers own preserved seed in Boro season.

CONCLUSION

1. The following socio-economic characters were found in Gazipur district.
   - Duration of working of male farmers was affected by household education, family size, number of male workers and non-farm occupation.
   - The regression results indicated that the higher education of the household head, less work was done by the household head.
2. The farm specific variability in farmers knowledge, attitude, perceptions particularly in use of quality seeds and seed management practices which are highly technical to farmers were identified as the most important factors contributing more to the variation in yield, insect and past pressure. Any effort in improving farmers' knowledge on rice production through farmers training and farmers participatory experiment and arrangement of cross site visit, field visit and demonstration could help in minimizing yield gap in between farmers own seed and healthy seed.
3. Per hectare yield was higher in healthy seed plot compared to farmers' saved seed plot.
4. Seed management is one of the major ways of maintaining its quality. Farmers practice different manual seed management methods. Very few farmers practice chemical treatment methods.
5. About 10% to 15% yield was increased by use of healthy rice seed in different seasons.
6. Input cost share in rice production showed that labor was most important in terms of cost share.
7. Higher benefit cost ratio was observed for healthy seed in Boro season.
8. Partial budget analysis showed that healthy seed users get higher profit TK 1653/ha in the Boro season.

RECOMMENDATION AND POLICY ACTION

Based on the findings of this study, the following recommendations would help policy makers to implement the technology:

1. The importance of quality rice seeds in increasing yield has been widely recognized. Generally, farmer-to-farmer exchange is a major source of seed in Bangladesh. It has been documented that the use of healthy clean seed by farmers can raise yield. A strong policy support would be required to achieve the target of using healthy seed in Bangladesh.To promote a technology that offers great potential for increasing agricultural output, the government should closely follow an effective extension strategy in the targets areas. Extension agents should be capable of making recommended technology known to all farmers, and exercising efficient supervision.

2. Farmers saved seeds should be stored properly. They should measure the moisture level of their seeds. Farmers should add different additives like neem leaves and naphthalene to save their seeds from insect damage. Government and different NGO's who are working with the farmers in the field level should inform the farmers to use additives in their seeds.
3. About 50% of farmers are using their saved seed for their rice cultivation. Government or NGO should motivate farmers that their saved seed should be replaced by healthy seed.
4. Awareness should be developed among rice farmers about seed-borne disease so as to save their seeds from seed borne diseases.
5. Training programmes should be conducted among male and female farmers for seed grading, seed production and preservation. This type of training will develop farmers develop farmers' knowledge about spotted seed, deformed seeds, varietal mixture unfilled seed, germinated seed, weed seed and inert materials etc.
6. From the findings it was observed that female farmers are fully involved in seed cleaning, sorting and preservation. So all types of training on seed preservation should be given to the female farmers.

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