Final Report
for
The Project on Development of Participatory Multiplication and Distribution System for Quality Rice Seed
(F.Y.2011-F.Y.2016)

－Collaboration between the Republic of Union of Myanmar and
Japan International Cooperation Agency (JICA)－

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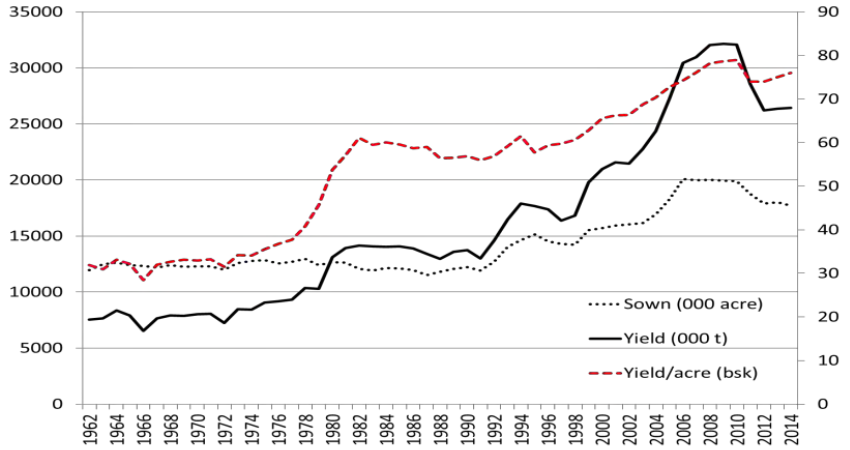
I . Introduction

Rice is the most important crop in Myanmar for both a staple crop and an export item. In FY 2015, rice is sown 17.7milacre and harvested acre. The yield is 3.9 t/ha and total amount of paddy production is 26.4milt. However, growth of the yield as well as total production of rice is stagnated since FY 2009 (Fig.1).



(1)Varietal Information on Rice Production of Burma 1988, Ministry of Agriculture and Forests, (2) Agricultural Statistics (1985/86 to 1995/96), (1989/90 to 1999/00) and (1997/98 to 2009/2010) Central Statistical Organization, Ministry of National Planning and Economic Development, (3) Myanmar Statistical Yearbook 2015, Central Statistical Organization, Ministry of National Planning and Economic Development

Fig.1 Rice production in Myanmar

The government of Myanmar (MOALI: Ministry of Agriculture Livestock and Irrigation) recognized that the deterioration of seed quality had been one of the major cause of the rice yield stagnant, then requested the government of Japan to provide technical support for seed sector improvement in 2009. The preliminary survey was conducted in 2010 and the government of Myanmar and the government of Japan agreed upon implementation of the technical cooperation project on "Development of Participatory Multiplication and Distribution System of Quality Rice Seed" so as to strengthen seed multiplication and distribution system in Ayeyarwady Region through enhancing capacity development of human resources of MOALI. The Record of Discussions (R/D) outlines agreements of both parties concerning to the project (Annex 1). It is important to note that definition of the quality seed in this project is genetically pure seed that meets the seed standard in Myanmar.

The project covers entire seed flow from Breeder Seed (BS), Foundation Seed (FS) and Registered Seed (RS) to Certified Seed (CS) (Fig.2). Therefore, the project activities have been conducted in close collaboration with Department of Agricultural

Research (DAR), and Seed Division & Extension Division of Department of Agriculture (DOA). Among these offices under the MOALI, Director of Seed Div. is appointed as the project director and is responsible for taking initiative to lead the project. The location of the project sites are scattered in wide area from north, Nay Pyi Taw to south, Yangon and to west, Ayeyarwady (Fig.3).In addition to the activities mentioned above, the project has also conducted marketing activities to promote a CS sale which has been deemed as a bottle neck of the seed flow.

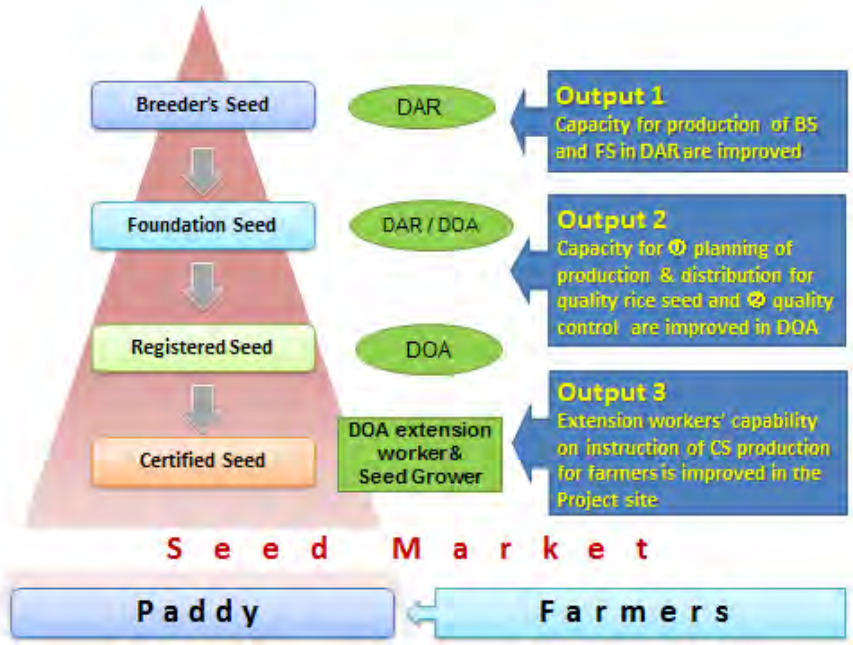


Fig.2 The Project outline and Seed Follow

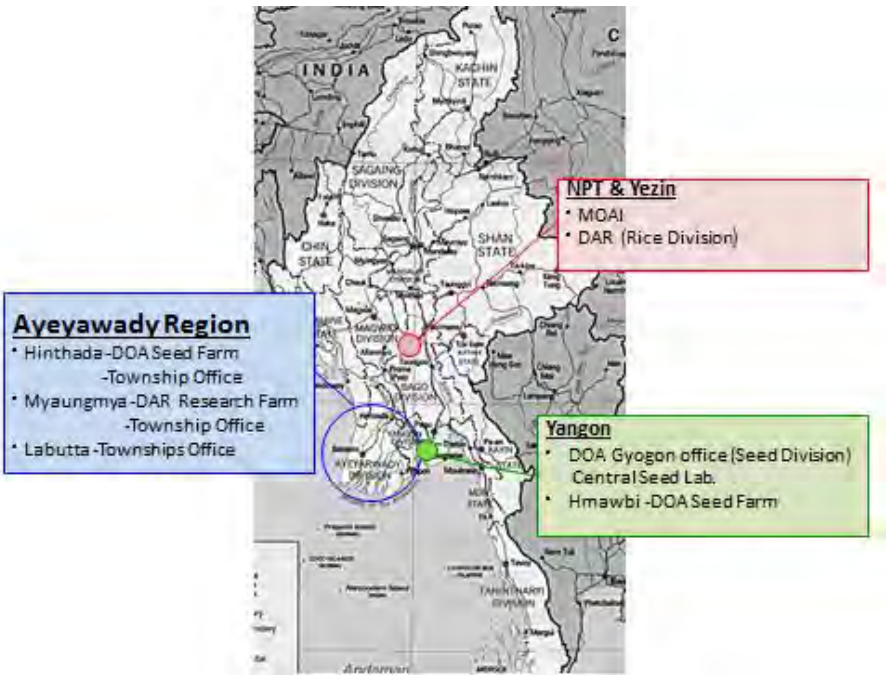


Fig.3 The Location of the Project Sites

Ⅱ. Activities and Outcomes of the Project

The purpose of the project is to establish participatory multiplication and distribution system of quality rice seed is established in Ayeyarwady delta area. The Joint Terminal Evaluation was conducted in February 2016 and the evaluation team concluded that the purpose of the project was moderately achieved based on the investigation into the project activities, input, output and achievements. The result of the evaluation was reported for approval at the Joint Coordination Committee held in Nay Pyi Taw on February 2016 (Annex 9-7). This report, therefore, focuses on not only the major achievement reported by the Joint Terminal Evaluation Team but also highlight other important achievement made till the very end of the project.

1. Base Line Survey (BLS)

In order to discuss project activities in detail, the Project conducted BLS in the project site; Labutta, Myaungmya and Hinthada townships in Ayeyarwady Region in December 2011 (Table 1). Total of six hundred (600) farmers including seed growers were interviewed in corporation with planning Div., DOA. The survey revealed that more than 80 % of farmers use self-saved seed for paddy production and approximately 90 % of farmers replaced seeds within three years (Table 2 & 3) through purchasing good seeds from neighbor. However, CS was not available in these three townships. With due analysis of the BLS survey result, top nine (9) common yet popular varieties among farmers in three townships were selected as the targeted varieties of the project (Table 4). These varieties are also common in the nationwide and share more than 50 % of total sowing area in Myanmar at present.

Table 1. Outline of three townships surveyed

Item / Township	Labutta	Myaungmya	Hinthada	**Myanmar (381 T/S)**(1)
Cultivated area (acre)	263,223	163,585	129,073	33,500,500
No. of farmer house hold	15,561	18,921	18,374	5,761,800
Ave. cultivated area (acre)	16.9	8.6	7.0	5.8
No. of Extension Worker (2)	18	25	15	10,437

(1) Natioanl Ave. : 2008/2009 Ministry of National Planning & Economic Developemnt (2) As of Jun. 2014

Table 2. Seed Sources (No. of person)

Seed Souces / Township	Labutta (200)	Myaungmya (204)	Hinthada (202)
Seed Grower	4	2	5
Self-Saved Seed	183	162	162
Neighbor	17	30	33
MAS /DAR	35	45	47
NGO	5	7	12
Others	4	5	6

※ Plural answer

Table 3. Renewal of Seed (%)

Frequency / Township	Labutta(1)	Myaungmya	Hinthada	Average
Every Year	12.5	8.7	6.4	9.2
2 year	17.5	30.7	28.2	25.5
3 year	65.5	50.0	64.4	59.9
More than 3 year	3.0	10.6	1.0	4.9

(1) 1.5% no answers

Table 4. Targeted varieties of the project

Variety	Release	Background	Feature	Origin	Maturity
Hnangar	1934	B 34-1	Deep water	Local	152-158
Pawsanyin			Flagrance	Local	152-158
Shwewartun	1974	γ ray mutant of IR5	HYV	DAR	145
Ayeyarmin	1977	Machando	HYV	Malaysia	140
Manawthukha	1978	Mashuru-M	HYV, Short culm	Malaysia	135
Kyawzeya	1980	X 70-18-32 (IR5/Aungzeya)	HYV	DAR	140
Theedatyin	1991	IR 13240-108-2-2-3	HYV, Short culm	Philippines	110
Sinthwelatt	2005	IR 53936-60-3-2-3-1	HYV	Philippines	135
Sinthukha	2007	IRYN 1068-7-1 (Mashuri-M/IR BB-21)	HYV, Short culm	DAR	140

2. Capacity Development of MOALI Staff

The most significant outcome of the project is the improved capacity of MOALI staff concerning to the seed multiplication. The fulltime Japanese experts stationed in Myanmar have provided continuous technical guidance and conducted the series of the technical training to MOALI staff for the purpose of improving knowledge and skills in seed multiplication of BS, FS, RS and CS in the project sites.

(1) DAR-Yezin for BS multiplication

Intensive technical guidance has been provided to the staffs of BS unit of rice section in DAR-Yezin since January 2012. The most significant outcome is the introduction of "Line selection method (Pedigree method)" to BS multiplication in order to make genetically pure varieties of BS (Fig.4 & 5).

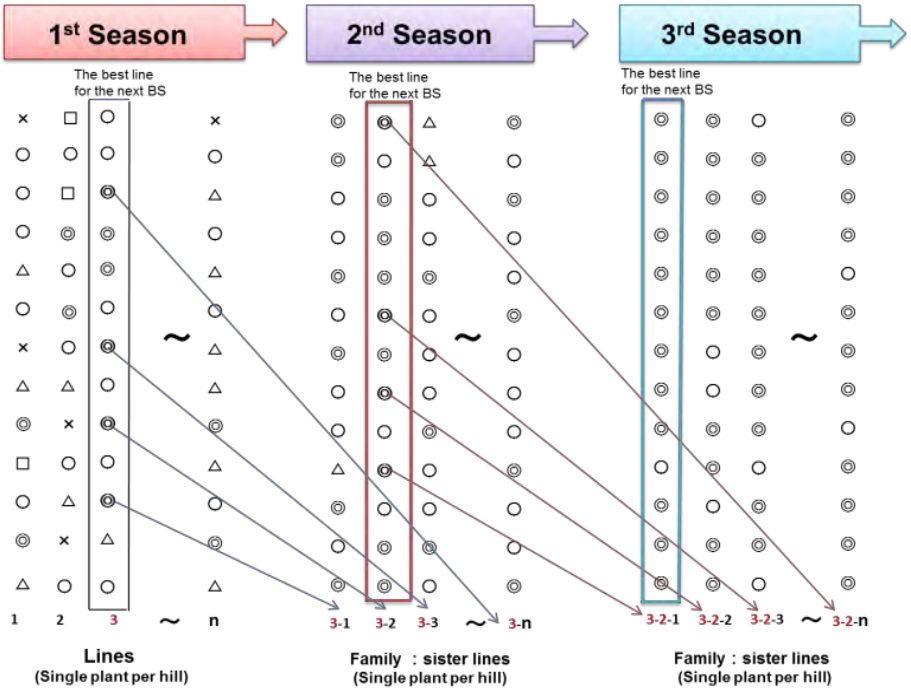


Fig.4 Line (pedigree) selection method of BS


Fig.5 Evaluation of BS lines in DAR-Yezin

The line selection method is common in cross breeding of self-pollinated plant. The method was applied to BS multiplication in DAR-Yezin for nine (9) succeeding seasons from FY 2012 to FY 2016 in order to reselect pure genetic lines which carry original morphological characters of the variety. As the result of these operations for several generations, DAR has obtained genetically pure BS of 9 varieties which have short heading duration and uniform morphological characters, e.g. culm length and panicle length (Table.5& 6).

In addition, Bacterial Leaf Blight (BLB) resistant lines of Sinthukha var. were selected since some pedigree lines of this variety were found to be susceptible to BLB by inoculation test.

Table.5 Heading duration of BS from 2012 to 2016 in DAR-Yezin

Variety	2012 WS	2013 WS	2013 DS	2014 WS	2014 DS	2015 WS	2015 DS	2016 WS
Manawthukha	6.0(2)	4.4 (9)(1)	—	4.5 (8)	3.6 (6)	3.5 (7)	—	2.8 (4)
Shinthukha	6.0	3.8 (9)		4.3 (6)	3.5 (7)	3.9 (6)	—	4.0 (7)
Sinthwelatt	9.0	4.3 (8)	—	3.7 (8)	—	3.7 (7)	—	3.6 (6)
Theedatyin	5.0	3.9 (9)	—	2.6 (7)	—	3.9 (6)	—	
Kyawzeya	—	4.0 (7)	—	4.3 (6)	3.9 (9)	4.5 (6)	—	3.5 (4)
Shwewartun	6.0	5.1 (8)	—	4.5 (7)	—	4.7 (6)	—	3.0 (4)
Ayeyarmin	—	3.9 (8)		4.7 (8)	5.5 (9)	Lodging	4.1 (6)	4.1 (6)
Powsanyin	6.0	6.8 (8)	—	4.4 (8)	—	6.1 (9)	—	3.6 (6)
Hnankar	—	5.0 (6)	—	4.0 (-)	—	Lodging	—	

(1)Heading days from10 to 90% heading rate in entire line of the variety. (2) Average heading days from 10 to 90% heading rate at each line of the variety

Table 6. Transition of Coefficiency of Variation by the line selection of BS from 2013 to 2016

Variety	Item	2013 Monsoon		2014 Monsoon		2014 Dry		2015 Monsoon		2016 Monsoon	
		Av. (cm)	CV (%)	Av. (cm)	CV (%)	Av. (cm)	CV (%)	Av. (cm)	CV (%)	Av. (cm)	CV (%)
MTK	Culm Length	86.9～ 98.2	**3.3～ 5.7**	95.1～100.7	**2.6～ 4.0**	60.6～ 64.8	**3.0～ 4.2**	93.4～ 95.9	**2.5～ 3.5**	89.5～97.6	**2.5～3.4**
	Panicle Length	25.2～26.35	**4.5～ 7.1**	25.1～ 25.8	**2.8～ 4.5**	21.7～ 22.2	**4.8～ 7.2**	24.3～ 25.2	**3.9～ 5.0**	23.5～24.6	**4.2～7.3**
	Panicle No.	15.2～ 20.5	**28.2～40.7**	15.7～ 16.6	**16.2～20.1**	14.4～ 16.2	**15.6～22.7**	16.2～ 19.8	**16.8～19.2**	17.0～22.0	**13.9～21.7**
STK	Culm Length	104.6～108.0	**11.7～13.4**	104.5～108.4	**2.3～ 4.1**	75.0～ 82.2	**2.6～ 5.0**	92.1～ 94.4	**2.0～ 2.9**	98.0～99.4	**2.2～4.1**
	Panicle Length	25.3～ 25.9	**4.2～10.0**	26.4～ 27.5	**2.8～ 5.1**	23.4～ 24.4	**3.6～ 7.9**	25.5～ 26.1	**4.8～ 5.6**	25.1～25.7	**4.8～6.6**
	Panicle No.	15.3～ 19.5	**23.0～31.0**	13.2～ 15.5	**18.0～30.0**	12.1～ 13.6	**16.3～22.4**	15.8～ 17.7	**14.8～24.0**	18.3～19.7	**13.1～27.9**
STL	Culm Length	105.4～111.7	**3.2～ 5.4**	113.3～117.0	**2.1～ 3.2**			109.8～111.0	**2.2～ 2.3**	111.0～118.8	**2.9～6.0**
	Panicle Length	32.2～ 33.2	**4.6～ 7.6**	32.0～ 32.5	**3.9～ 5.2**			33.3～ 34.9	**3.8～ 4.4**	31.5～34.0	**5.3～7.5**
	Panicle No.	13.0～ 15.9	**21.1～38.2**	13.7～ 15.4	**15.8～25.0**			14.2～ 14.8	**15.0～17.0**	13.1～15.2	**15.3～24.3**
TDY	Culm Length	72.7～ 81.6	**2.9～ 8.1**	86.5～ 87.7	**3.5～ 4.1**			71.9～ 75.8	**2.6～ 4.1**	68.9～76.7	**3.3～3.9**
	Panicle Length	25.2～ 26.7	**4.8～ 8.2**	26.1～ 26.6	**5.7～ 6.8**			26.4～ 28.7	**4.2～ 5.2**	25.6～26.0	**3.7～6.0**
	Panicle No.	17.2～ 20.1	**11.4～34.0**	17.0～ 18.5	**20.4～24.3**			15.3～ 17.7	**13.8～19.9**	14.8～16.8	**14.5～20.2**
KZY	Culm Length	107.9～118.3	**3.3～ 5.8**	116.3～120.0	**2.5～3.2**	80.0～ 84.4	**3.7～ 5.2**	124.3～131.2	**1.6～ 3.7**	111.8～116.9	**3.2～5.0**
	Panicle Length	26.9～ 30.9	**8.7～19.0**	32.8～ 33.1	**4.1～4.4**	29.0～ 29.7	**3.7～ 7.2**	29.1～ 30.8	**3.8～ 5.5**	29.3～30.3	**4.0～4.9**
	Panicle No.	11.4～ 14.1	**20.8～32.6**	13.4～ 14.4	**19.9～25.8**	11.3～ 12.5	**16.3～21.5**	14.3～ 19.3	**15.1～22.0**	12.9～14.5	**15.2～20.5**
SWT	Culm Length	118.9～124.8	**3.3～ 7.1**	120.6～132.1	**3.4～ 4.4**			129.2～135.1	**3.1～ 4.8**	128.4～129.8	**2.5～3.3**
	Panicle Length	29.1～ 31.0	**4.6～ 9.0**	31.7～ 32.8	**5.8～ 6.7**			28.25	**4.7～ 6.5**	30.0～30.8	**3.6～4.9**
	Panicle No.	10.9～ 12.3	**14.2～27.6**	12.1～ 13.9	**19.9～25.0**			14.3～ 15.6	**22.0～31.8**	13.5～14.7	**18.0～25.0**
AYM	Culm Length	131.2～144.5	**5.2～ 5.9**	137.2～160.6	**3.3～ 4.9**	100.5～109.3	**3.6～ 5.8**	144.3～160.6	**1.9～ 4.2**	158.0～162.8	**1.8～4.2**
	Panicle Length	23.9～ 26.3	**5.2～10.0**	26.8～ 27.8	**4.8～ 6.9**	26.4～ 27.8	**7.1～ 7.5**	25.5～26.3	**3.8～ 6.6**	26.6～27.8	**2.7～5.7**
	Panicle No.	13.9～ 14.6	**19.1～32.1**	14.9～ 17.0	**23.8～27.4**	12.0～ 14.7	**16.8～23.0**	16.5～19.9	**16.0～27.0**	16.2～17.7	**12.7～21.6**
PSY	Culm Length	135.5～139.1	**5.2～ 6.0**	156.2～163.2	**1.9**			120.3～134.2	**2.3～ 4.0**	116.4～120.4	**2.5～3.2**
	Panicle Length	23.4～ 25.5	**7.3～10.0**	26.6～ 27.4	**4.3～ 8.8**			26.0～26.7	**3.8～ 5.1**	26.7～27.0	**3.6～6.0**
	Panicle No.	14.8～ 16.4	**23.7～36.0**	14.5～ 16.6	**15.1～19.8**			13.1～15.0	**15.0～24.7**	13.0 ～13.7	**16.9～22.2**
HNK	Culm Length	136.2～157.9	**3.7～10.9**	143.8～156.4	**2.8～ 4.9**			137.1～139.8	**2.3～ 3.1**	142.4～149.6	**2.7～3.7**
	Panicle Length	28.8～ 29.6	**6.1～10.8**	29.4～ 29.5	**3.4～ 6.7**			28.6～29.4	**4.8～ 6.0**	28.9～30.8	**4.7～5.9**
	Panicle No.	16.4～ 21.4	**24.6～30.4**	15.2～ 17.3	**15.1～19.8**			13.1～16.9	**18.2～24.9**	18.6～22.4	**17.4～20.0**

Furthermore, DAR researchers have gained proper knowledge and skills of line selection method and quality control measures of BS lines in the field practice. The researchers of DAR have applied the line selection method to other BS varieties. The method of BS multiplication and quality control instructed by the JICA experts are summarized in a publication "BS, FS & RS Multiplication Manual," and delivered to all concerned researchers and staff of both DAR and DOA.

(2) DOA Seed Farm for FS and RS multiplication

Staff of MRRC: Myanmar Rice Research Center (Hmawbi), DOA seed farm in Taguntaing (Hinthada) and DAR research farm in Myaungmya were provided continuous technical guidance and seminars on the quality control measures of FS and RS multiplication. Contrary to limited resources and capacity, sowing acreage of these farms were too large to manage seed quality. Therefore, priority was given to FS quality control so as to improve RS quality to some extent as long as the same RS variety was grown in the same plot every year. Amount of BS, FS and RS multiplied in those farms are shown in Table.7.

Table 7. BS,FS & RS multiplication from FY 2011 to FY 2015

	2011			2012			2013			2014			2015		
	BS	FS	RS	BS	FS	RS	BS	FS	RS	BS	FS	RS	BS	FS	RS
DAR-Y	159.0	–	–	197.0	–	–	105.5	–	–	136.5	–	–	92.0		
MRRC	–	1,250	10,925	–	1,040	10,655	–	1,823	10,207	–	596	11,832	–		
HTD	–	372	2,477	–	361	1,842	–	329	2,573	–	234	3,461	–		
MM	–	68	1,539	–	105	1,911	–	99	3,045	–	96	2,964	–	73	2,092
Total	159.0	1690	14,941	197.0	1,506	14,408	105.5	2,251	15,825	136.5	926	18,257	92.0		

DAR-Y: DAR-Yezin, MRRC: Myanmar Rice Research Center (Hmawbi), HTD: Taguntaing Seed Farm, MM: DAR-Myaungmya

Genotype and environmental interaction (G×E) experiments targeting nine (9) varieties were also conducted in DAR-Yezin, DAR-Myaungmya and Hmawbi Seed Farm from four succeeding seasons to observe growth under the different environment. As the result of these experiments, some environmental interactions were found in heading time and culm length under different year, summer & monsoon season and different location. Therefore, adaptability of nine (9) varieties needs to be reviewed by season and location in terms of heading time and maturity period.

Fig.6. Technical Instruction by the JICA experts and G×E Experiment

(3) DOA Extension staffs for CS multiplication

Training for Extension Staffs: Series of practical training was conducted to extension staffs to gain proper knowledge and practical skill in CS multiplication since most of the extension workers of three townships; Hinthada, Myaungmya and Labutta, as they had neither an experience of CS multiplication nor providing technical support of CS multiplication to seed growers. The training program was designed in accordance with the growth stage of rice and held five (5) times from sowing seeds to harvesting in a season (Table.8, Fig.7 & Annex 12).

Table 8. Contents of Extension Worker Training on Seed Multiplication

Training	1st	2nd	3rd	4th	5th
Day After Sowing	0 Sowing time	21 3 weeks after sowing	49 4 weeks after transplanting	115 Heading time	145-150 Harvesting time
Practice	Seed selection / **Seed disinfection** Land preparation / Land leveling Nursery making **Seed sowing**	Land preparation / Land **leveling** Uprooting seedling **Transplanting** Fertilizer application Water management Research of practice field	**Weeding & Roguing** Pest & Diseases control Water management Field Inspection Field visit on farmers field Research of practice field	**Weeding & roguing** **Field Inspection** Visit to Gyogone Labo & Plant Protection Field visit on farmers field	**Weeding & roguing** **Field Inspection** **Harvesting** Post harvest technology Seed processing Seed sampling Seed testing
Lecture, Presentation & Discussion	Activities plan **Seed selection / Seed disinfection** Land preparation / **Land leveling** Nursery making Seed sowing	Land preparation / **Land leveling** Uprooting seedling **Transplanting** Fertilizer application Water management	**Weeding & Roguing** Fertilizer application Pest & Diseases control **Field inspection** **Morphological Characteristics**	**Weeding & roguing** Weedy rice **Field Inspection** **Labo. Test** **Pest & Diseases control** Post harvest technology Seed processing	**Field Inspection** Harvesting **Post harvest technology** Seed processing Seed sampling Seed testing **Examination**

This series of training was conducted for four (4) years from 2012 to 2015. PLA & RRA trainings were also held for better communication among farmers and extension staffs (Table.9). As the result of these training, the extension staffs have gained their capacity to provide appropriate extension services to CS growers and organized training for seed growers using their original extension materials.

Fig.7. Practical Training for Extension Staffs

Table 9. Extension Worker Training, Workshop and Seminar from 2011 to 2016

Year	Name of Training / Workshop / Seminar	Month	No. of Training	No. of Participant	Target
2011	Quality Control, Plant Protection	8,3	10	398	DAR, DOA, YAU
2012	Extension Staff Training	5,8,9,10	4	237	DOA
	PLA & RRA Training	8,9	3	121	DOA
	Post Harvest Training	11,12	3	33	DAR, DOA, YAU
	Quality Control, Plant Protection	6,8,12,1,2,3,	13	377	DAR, DOA, YAU
2013	Extension Staff Training	5,7,8,9,10	5	284	DOA
	PLA & RRA Training	6,8	4	102	DOA
	Post Harvest Training	10,11	5	101	DAR, DOA, YAU
	Weedy Rice, Plant Protection	7,8	6	130	DAR, DOA, YAU
2014	Extension Staff Training	5,6,7,9,10	5	393	DOA
	Field Inspection, Quality Control,	9,10,12	7	275	DAR,DOA
2015	Seed Growers Training	6,7,9,10,11	8	1596	DOA
	Quality Control, Field Inspection,	4,5,8,9,10	10	533	DAR,DOA
2016	Extension Staff Training	6,7,9,11	5	368	DOA
	Field Inspection Training	8,9,10	8	413	DOA
	Seed Growers/Farmers Training	6,7,8,9,10,11	24	1074	DOA
	Pathein, BS/FS/RS Seminar	3,5	3	166	DAR,DOA
Total			123	6,601	

Trial CS multiplication by farmers: Fifty (50) farmers were selected in each township and CS was multiplied in one acre farm plot by each farmer under the intensive supervision by the well trained extension staffs from FY 2012 to FY 2016. Extension staffs also organized CS multiplication training for farmers in accordance with the growth stage of the rice (Fig.8). Consequently, the farmer could learn proper CS multiplication method and succeeded in CS multiplication which meets the seed standard. The result of field inspection and laboratory test are shown in Table.10. Till now, many are continuing CS multiplication in the right way under a technical instruction provided by extension staffs.

Table 10. Result of Field Inspection & Laboratory Test

Township	2012 Monsoon			2013 Monsoon			2014 Monsoon			2015 Monsoon			2016 Monsoon		
	F.I.	Labo.	CS	F.I.	Labo.	CS	F.I.	Labo.	CS	F.I.	Labo.	CS	F.I.	Labo.	CS
Labutta	90	47	42	96	69	66	94	72	68	86	77	66	70		
Myaungmya	88	61	54	90	11	10	100	82	82	86	70	60	76		
Hinthada	90	36	32	92	91	84	98	69	68	84	62	52	92		
Average	45	48	43	93	57	53	97	75	73	85	69	59	79		

Fig. 8. CS growers and Awarding Ceremony of the Best Seed Growers

3. Strengthening of Seed Quality Control System

(1) Field Inspection System

The field inspection is extremely important to distinguish whether they are off-type plants, weed or disease infected plant contaminate CS field or not. The project restored field inspection system that had almost abandoned for long time through practical training to the extension staffs of three townships in close

collaboration with Central Seed Laboratory in Gyogon, Yangon. The field inspection trainings were held every season from FY 2012 to FY 2016 (Fig 9 & Annex 12). At present, field inspection is regularly conducted in three targeted townships. However, the field inspection requires sufficient skilled manpower and means of transportation, therefore, continuous support for capacity building of inspectors and finance are essential to maintain proper execution of this system so as to improve seed quality steadily.

Fig.9. Field Inspector Training

(2) Laboratory Test

The laboratory test has been conducted in a proper manner because of well trained laboratory staff of Seed Div., DOA. However, number of seed sample send to the laboratory was not as many as expected, rather it was very few. This was because of the malfunctioned field inspection system. As the result of the field inspector training mentioned above, number of the sample has been increasing year after year (Table. 11).

Table 11. Number of seed sample sent to Gyogon Central Seed Laboratory and their passing rate (%)

Seed	2011/12		2012/13		2013/14		2014/15		2015/16	
Class	Sample	Pass	Sample	Pass	Sample	Pass	Sample	Pass	Sample	Pass
BS	55	78.2	31	87.1	43	100	13	84.6	15	100
FS	27	92.6	42	69.0	40	82.5	48	91.7	52	80.8
RS	49	75.5	90	63.3	73	76.7	97	75.3	109	88.1
CS	95	45.3	231	55.4	556	46.6	551	60.4	543	64.1
F1	21	90.0	94	39.4	53	50.9	18	55.6	11	55.6
Total	247		488		765		727		730	

The project also provided laboratory equipment to the central seed laboratory in Gyogon for improvement of test efficiency (Annex 6).

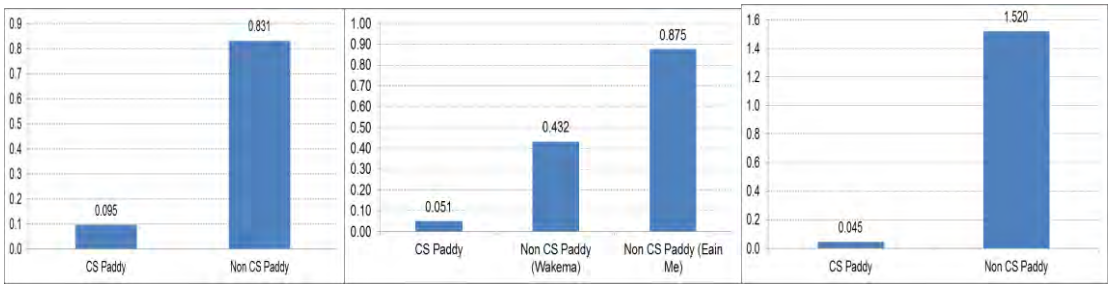
As regard to both field inspection and laboratory test, the authorities tend to argue only the passing rate of them. It will, however, influence proper execution of

the field inspection and laboratory test and the result might be distorted for fear of offending authorities. The proper practice and process of the field inspection and also laboratory test are both important rather than focusing on mere result.


Fig.10.Seminar for Seed Laboratory Staff andSeed Lab. Test Training for Extension staffs

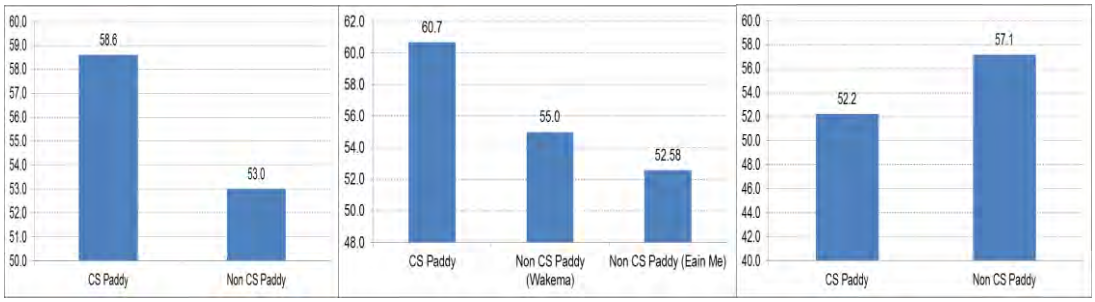
4. Rising Awareness of the stakeholders

Since the sale of quality seeds was sluggish and advantages of CS use were not well recognized among stakeholders such as paddy production farmers, traders and rice millers, the project decided to conduct milling demonstration for the stakeholders in FY2015 and FY2016 in order to gain awareness of CS use for paddy production. In the demonstration, testing sample of both CS origin paddy and none CS origin paddy were collected from Labutta, Myaungmya and Hinthada townships respectively, and preliminary test millings were conducted in collaboration with Myanmar Rice Research Center (Hmawbi). Samples from all township showed that red rice ratio of CS origin paddy was significantly lower than that of none CS paddy. Similarly the head rice ratio of CS origin paddy was significantly higher than that of none CS paddy (Fig.11 & 12). During a Field Day program, these test results was verified by the milling demonstration of 1,000 kg CS origin paddy. The demonstrations were held in the middle class of miller (capacity of approx. 30t/day) of in Labutta, Myaungmya and Hinthada townships respectively (Fig.13). The stakeholders invited to the demonstrations realized, almost for the first time, several advantages of the paddy grown form CS such as higher head ratio and lower contamination of red rice compared with the paddy produced from self-saved seeds of which they usually deal. It is expected that rice millers and traders would be a distributer of CS to paddy production farmers and buy back the paddy produced from CS in a premium price so as to establish the real supply chain of rice seed.



① Hinthada (Sinthukha) ②Myaungmya (Sinthukha) ③Labutta (Powsanyin)

Fig.11. Ratio of Red Rice in a sample (500g) from Hinthada, Myaungmya and Labutta townships in FY 2016



① Hinthada (Sinthukha) ②Myaungmya (Sinthukha) ③Labutta (Powsanyin)

Fig.12. Head rice ratio (milled rice) sampled from Hinthada, Myaungmya and Labutta townships in FY 2016

Fig.13. Milling Demonstration in Labutta Township in 2016

5. The dissemination of the project outcome to entire Ayeyaerwady Region

(1) Regional extension staffs training

In order to disseminate the outcomes of the project in all over Ayeyarwady Region, regional training was held for the district seed officer-in-charge of six (6) districts and twenty six (26) townships as well as township extension staffs. There were two types of practical trainings, the one was for CS multiplication technique and another was field inspection training (Table.11& Fig.14). Both of them were held in the same manner as the training held in the three targeted townships mention above. In consequence of these trainings, extension activities for CS growers came to be lively and the field inspections also came to be regularized in many townships with rising awareness among extension staffs toward improving quality control in CS multiplication.

Table 11. Regional Extension Worker Training on CS multiplication in FY 2016

Training	**1st**	**2nd**	**3rd**	**4th**	**5th**
Date	7-8 June	28-29 June	26-27 July	28-29 Sep	1-2 Nov
Day After Sowing	0 Sowing time	21 3 weeks after sowing	49 4 weeks after transplanting	115 Heading time	145-150 Harvesting time
Venue	Pathein	Pathein	Pathein	Yangon / Hmawbi	DAR-MM
No. of participants	67	66	73	85	77

Fig.14. Regional Extension Staff Training in FY 2016

(2) Seed Action Plan of Ayeyarwady Region

Considering the sustainability of CS multiplication in Ayeyarwady Region, DOA regional office in Ayeyarwady and six district offices formulated “Action Plan” in FY 2017. The Action Plan consisted of three parts; part one is extension staff training, part two is seed growers training and part three is budget to implement the Action Plan. The Action Plan covers three succeeding years till FY 2019 to improve capacity of extension workers in twenty six (26) townships so as to multiply true CS in Ayeyarwady Region and achieve the overall goal of the project (Annex 14).

6. Production of manual, technical document and DVD

For efficient and effective operation of the several training programs in proper CS multiplication, manuals, movies and technical documents were produced and delivered to the project counterpart personnel, training participants and official concerned to rice seed (Fig.15 & Annex 13). These material are expected to be used for further expansion of the project out-come to all over Myanmar. Movies recorded and delivered in a DVD are supporting tool for sharing project experiences and for better understanding on selected yet important topics to visually explain how-to. These movie clips are publicized on You Tube[1] so that all interested people can watch and learn from it whenever and wherever mobile network available, even at farmers field.

Fig. 15. Use Manual in the Training programs and DVD making

7. Collaboration of the other JICA projects and NGOs

The project invited counterpart personnel of the "Project for Profitable Irrigated Agriculture in Western Bago Region (PROFIA)"to the Ayeyarwady regional training program held in FY 2016for dissemination of the project outcome to other region. The one day technical seminar on seed multiplication was also held by the project in Pyay for the counterpart personnel of PROFIA. The participants from PROFIA would make use of the knowledge and experiences gained in the training to their project activities in Western Bago Region.

The out-put of the project also apply to the "Project for Integrated Regional Development Plan to Support Ethnic Minorities in the South-East". It is anticipated that extension workers and seed growers in that area will make use of the manuals and DVD for multiplication of CS.

The project also invited several NGOs to the extension staff training programs held during the project period to share the knowledge and experiences of proper CS multiplication.

[1]https://www.youtube.com/channel/UC1Rr9mk2TkJejnfTLpFHqFg

Ⅲ. Result of End Line Survey (ELS)

1. Outline of ELS

The ELS is conducted to measure how much has changed since the beginning of project intervention. The survey was held in December 2016 in close collaboration with Planning Division, DOA, and extension staff of three townships. The survey was conducted by intensive interview using structured questionnaire for different category of respondents. The target and respondent in ELS were township extension staffs, regional/district officer in charge of seed, seed growers, CS user (ordinary paddy farmers) and market stakeholders such as local millers and traders. Total number of respondents amounted for more than two hundred.

Basic concept in designing questionnaire was to obtain perceptions on situations and/or to forecast a scenario while requesting to respondents to compare before and after joining project activities or project intervention. The following section highlights some of the key findings.

2. CS Production and Sales

First of all, demand of CS is increased by the end of the project according to extension staffs in three townships and the reason is summarized in Fig 16. Accordingly, more than one third of extension staffs think CS production has increased in terms of both area and number of variety.

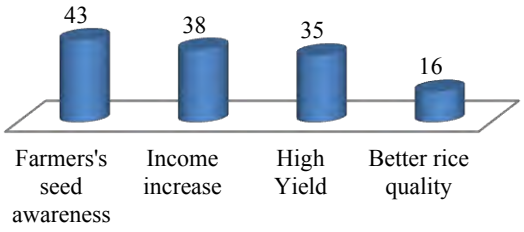


Fig 16. Reason of increased CS demand (multiple answers in %)

As stated in the previous Chapter, one of the highlight of project achievements is restoration of the field inspection and laboratory test. Seed growers tended to sell so called “seed” before obtaining the result of laboratory test. However, after project intervention, seed growers now try to sell their products as “CS” after they get the result from laboratory, which indicates increased awareness on seed quality control system among growers and extension staffs (Fig 17 and 18).

However, 26% of seed growers still sell their products before laboratory test result comes out. Among such seed growers, 92% answers they sell their products as "seed" and the reasons of selling are summarized in Fig. 19. As it says, most of them sell

"seed" to neighbors. The answer itself doesn't give a real reason for the early sale, however other answers such as urgent need of money or luck of storage might be the real reasons behind it. Moreover, it might imply either demand from such farmers are too high to sell after lab test result or time consumed for getting result of laboratory test is too long for them and cannot wait for some reasons.

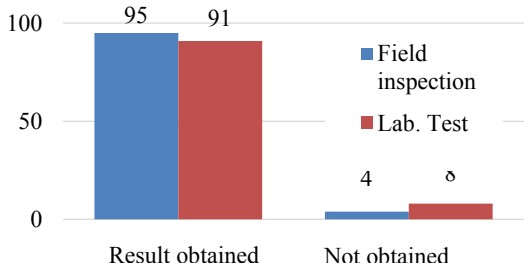


Fig. 17. Answer to field inspection and lab test result (in %)

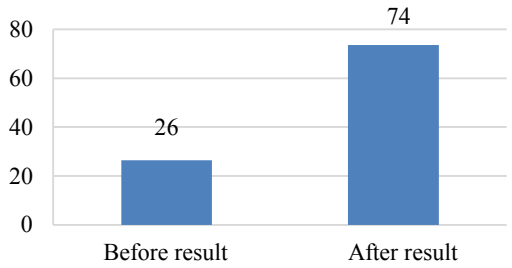


Fig. 18. Percentage of selling before and after lab test result (in %)

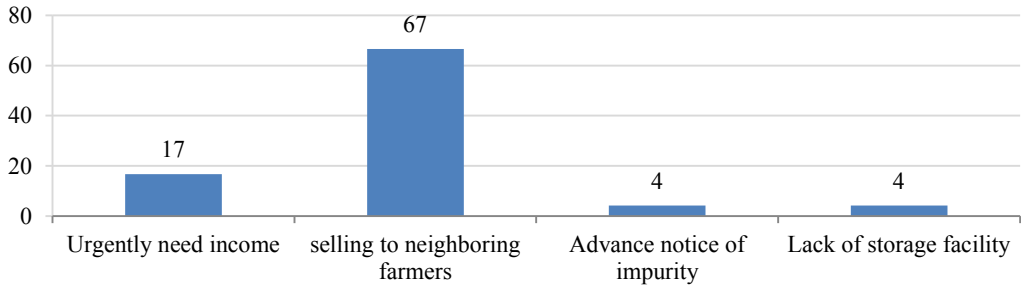


Fig. 19. Reason of sales without waiting lab test result (in %)

Such observation is also supported by seed growers' answers toward a market of CS (Fig. 20). As mentioned above, demand of CS is increased during project period and so is the unit price of CS. Majority (84%) of seed growers are satisfied with CS unit price as they sell at higher rate than expected. However, as CS supply in three townships has not drastically increased during project period, increment of CS supply triggered by the increased awareness on advantage of CS in paddy production, may have pressured some seed growers to sell seed sooner while they are available in their stock.

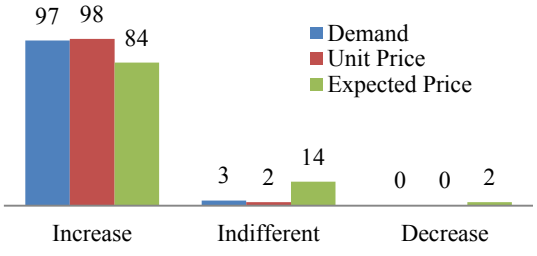


Fig. 20. Seed market conditions for seed growers (answers in %)

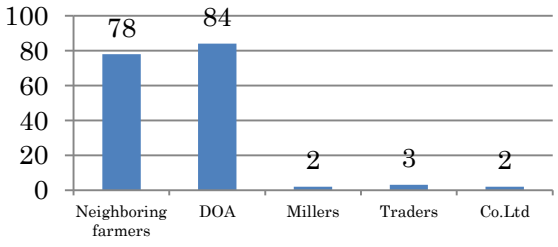


Fig. 21. Major seed buyers (multiple answers in number)

3. Awareness in CS use among ordinary farmers

According to the interview with CS users, majority answers CS price is affordable or cheap. To date, purchasing price of CS (Kyat 8,500-9,000/basket in average, varies from varieties) remains reasonable in general for its quality even though 87% answer that the unit price has been increased during the past five years.

The question is also made to identify what difference they noticed after using CS. Fig. 22 summarizes answers obtained from paddy farmers and millers/traders. The biggest difference they noticed is uniformity of growth, higher yield and higher milling turn-out. As for the yield, the project compared yield difference in FY2015 between CS paddy and Non-CS paddy and it was found that nearly 10% more yield could be obtained over Non-CS paddy.

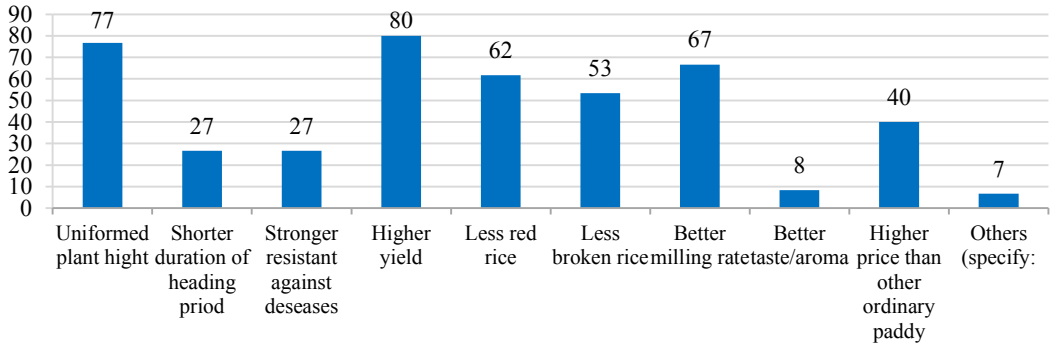


Fig. 22. Perception of advantage of CS among ordinary paddy farmer (CS users) (multiple answer in number)

4. Marketability and distribution of CS

As reviewed in Fig. 21, most of the CS was purchased by neighbor or DOA township office but purchase case by millers/traders was relatively less.

However, millers/traders occasionally purchase a "seed" from seed growers for further distribution to produce quality paddy. Fig. 23 shows their experience in the past to purchase any kind of paddy seed. Nearly a half answers they have experience but purchase and distribution of CS is limited to 14% whereas "farmer good seed" amounts for 86%. Almost all millers/traders show their high willingness to purchase CS in the future after participation in a series of Field Dayprograms (Fig. 24).

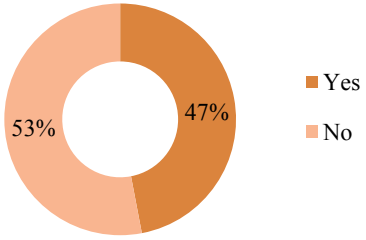


Fig. 23. Experience of paddy seed purchase and distribution among millers/traders (answer in %)

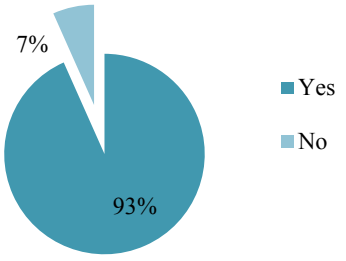


Fig. 24 Willingness among millers/traders to purchase and distribute CS (answer in %)

5. Change of attitude toward seed multiplication and quality control

Fig. 25 and 26 represent for how interest of seed growers and extension staffs on seed production have changed after project activities. Before they joined in the project, their interest on seed production remained rather mixed and 28% answered they had less or no interest. However, after joining in project activities, their attitude has positively changed and none of them has less/no interest any longer and those having high interest has drastically increased from 30% to 97%.

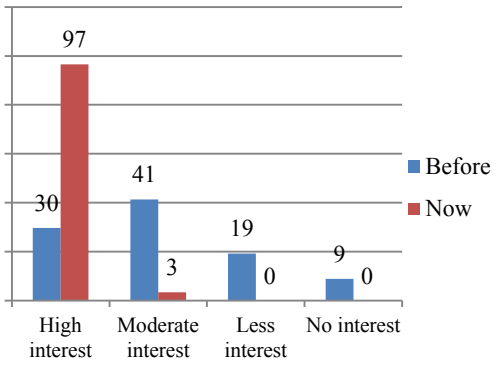


Fig. 25. Interest on CS production (answers in %)

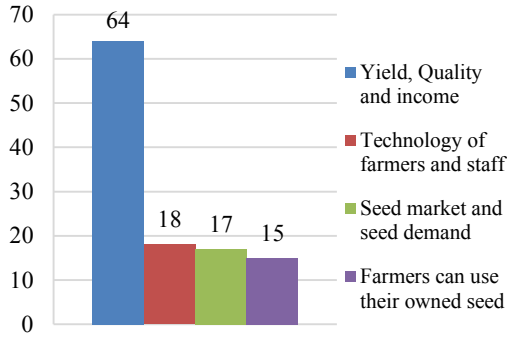


Fig. 26. Reason behind higher interest (multiple answers in number)

The ELS was concluded with question on impression of CS and suggestions for the future CS distribution (Fig.27 and 28). As they show, many of them opine increased income from CS multiplication or use of CS in paddy production.

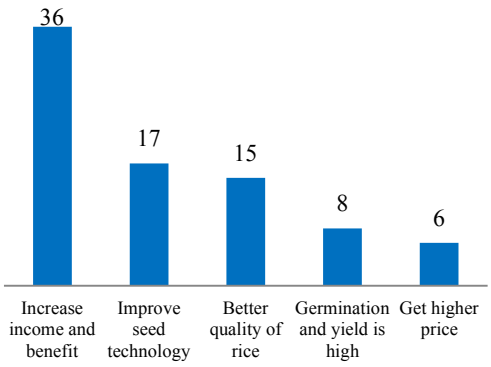


Fig. 27. Impression of CS (number of answers)

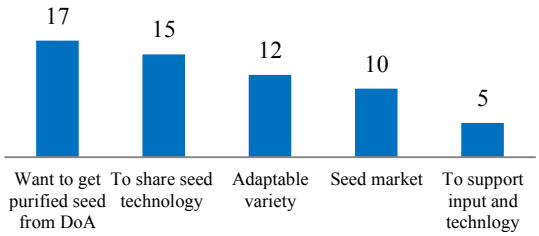


Fig. 28. Future suggestions on CS distribution (number of answers)

Ⅳ. Achievement of the Project Purpose and Overall Goal

1. The Project Purpose

The project purpose is completely attained owing to the seven months activities of the project extension period from August 2016, while the terminal evaluation team reported as moderately achieved as of February 2016.The extended activities enable to ensure the achievements mentioned in Chapter Ⅱ. Those achievements fulfill all requirements of verifiable indicators for the project purpose in the PDM (Table 12& Annex 2-6).

Table 12. Achievement of the Project Purpose

	Verifiable Indicators	Actual Figure as of 2016/17 monsoon
1	More than **150 farmers** continue to multiply CS every year in the project site.	**150 farmers** continue to multiply CS every year in the project site since 2012/13 monsoon.
2	Passing rate of CS inspection become more than **50 %** in the project site.	Passing rate of CS is more than **60 %** in the project site (2015/16 monsoon).
3	More than **70%** of CS, which is excluded for own-use of the seed growers, produced in the Project site will be sold by 150 seed growers.	More than **79%**of CS is sold as seeds.
4	**Action Plan** on expansion of quality rice seed is formulated.	**Action Plan** was formulated in October, 2016 and submitted to the Minister of Ayeyarwady Region.

Further, the results of end line survey (ELS) imply that the achievement of the project purpose is conclusive, e.g., ①the most encouraging and positive result is shown in answers about intension or interest in CS production, especially among seed growers and extension staffs. After joining in project activities, their attitude has positively changed and those having high interest have drastically increased from 30% to 97% (Fig. 26 and 27), ②seed growers now try to sell their products as "CS" after they get the result from laboratory, which indicates increased awareness on seed quality control system among growers and extension staffs (Fig 18 and 19), ③as rising demand of CS,unit price of CS also increase. 97% of seed growers replied that CS demand is increase and 84% of them are satisfied with the unit price of CS as they expect, and ④major CS buyers were DOA township office and neighboring farmers and limited millers/traders could also purchase CS in 2016/17 (Fig.22). However, demand of millers/traders for CS is high enough for selling more CS (Fig. 25).

2. Overall Goal of The Project

Verifiable Indicators for evaluation of the Overall Goal of the Project and their present situations are shown in Table 13. Ayeyarwady regional extension workers trainings were conducted to disseminate the project output beyond the project sites (Chapter Ⅱ- 5 (1)). Through these trainings, extension workers gained proper knowledge and skills which enable them

to provide technical guidance as well as to practice field inspection in CS multiplication for seed growers in their townships. In the 2016/2017 monsoon, seed growers multiplied CS in proper manner and field inspections were conducted in some selected CS farms.

The action plan formulated by DOA regional office is expected to push further improvement of extension workers' skill in CS multiplication and the plan will lead attainment of overall goal of the project until 2019/20.

Table 13. Achievement of Overall Goal of the Project

	Verifiable Indicators (In the favorable area for rice cultivation in Ayeyawady Region;)	Situation as of 2016/17 monsoon
1	Number of CS producing farmers(*)increase from 150 to 663.	Extension workers of 26 townships gained proper knowledge and skill in CS multiplication through regional training by the project. Intensive extension services have been conducted for CS multiplication in entire Ayeyarwady Region. In addition, Action Plan was formulated, then submitted to the Minister of Ayeyarwady Region.
2	Acreage of CS producing farms(*)increase up to 2,601.5acre.	
3	Field inspection is conducted for 40% of CS producing farms and all seeds that have passed field inspection are sent to laboratory test.	
4	Genetic purity of BS is maintained.	**Action Plan** was formulated in October, 2016 and submitted to Minister of Ayeyarwady Region.

*CS producing farmers/farms are those adopt "CS quality control measures" with technical guidance of DOA extension workers which have been practiced in the project.

Expansions of stakeholders' awareness as well as CS market are also keys to achieve the overall goal of the project. Higher appreciation toward better milling turn-out is important issue achieved through a demonstration activity (Chapter Ⅱ-4). Paddy produced from CS is now getting wider and better reputation among market stakeholders. Such scenery per se potentially prompts and fosters quality CS market and is a remarkable achievement of the project when we recall seed market was hardly observed during BLS in 2011.

One of the scenario of which Dr. Akio Takahashi, the short-term experts of agriculture economy (Dec. 2013) envisaged as a business model, e.g., establishing a linkage among CS growers, millers/traders and paddy production farmers in a township/district, so CS would be purchased and distributed by millers/traders to other many paddy farmers in their circle.

During the project implementation period, strong and stable linkage between seed growers and millers/traders is remained at incubation stage but ELS result affirms seed market in three townships is developed and shifting toward next phase in the near future. And this movement will support not only the attainment of the overall goal of the project but also sustainable development of quality cum high yielding paddy production in Myanmar.

Ⅴ. Summary of Project Outline and Monitoring History

1. Project Design Matrix (PDM)

JICA technical cooperation project is operated based on the PDM originated in logical frame work. PDM of this project has reviewed several times in accordance with the progress of the project operation and revised by Joint Coordination Committee for smooth and successful implementation of the project. There were two serious discussions on the PDM revisions. First was definition of targeted area in project design. Second was the alteration of mind from quantity into quality during five-year-project period. These matters were finally settled that the project targets on the area of the project sites and is operated with quality oriented activities.

The outline of the PDM revision is as follows;

(1) **Version zero** agreed on 24th March, 2010 (Annex 2-1)

This version was formulated by preliminary survey team, however, the verifiable indicators were not identified. The Master Plan attached to the Record of Discussion of this project was drawn based on this version.

(2) **Version 1** revised on 24thMay, 2012 (Annex 2-2)

This was a temporary version formulated by PIC.

(3) **Version 2** revised on 27th June, 2012 (Annex 2-3)

In addition to Labutta township, Myaungmya and Hinthada townships were incorporated into the project sites. Verifiable indicators were identified, however, there were several unsettled discussions about targeted area, volume & acreage of CS multiplication for project goal & overall goal. Consequently, the area of the project purpose was defined as the project sites and the area of overall goal was defined as the Ayeyarwady region in the verifiable indicators.

(4) **Version 3** revised on 25th February, 2014 (Annex 2-4)

As a result of Joint Mid-term Review conducted in February, 2014, the projected decided to incorporate marketing and advocacy activities in townships by involving different types of stakeholders in a seed market. Some verifiable indicators were also modified to realistic figures to pursue.

(5) **Version 4** revised on 4th August, 2015 (Annex 2-5)

Considering the actual capacity of all 26 township offices in Ayeyarwady Region for extension service of CS multiplication, verifiable indicators of overall goal were set in realistic figures so as to ensure the quality of CS. It is quite essential to seriously consider available yet capable human resources, budget and other available resources when target is set by the authorities.

(6) **Version 5** revised on 18th February, 2016 (Annex 2-6)

Formulation of the Action Plan in Ayeyarwady Region came to a new project

activity since the new indicator was added to verify an achievement of Overall Goal formulation of Seed Action Plan: "Action plan on expansion of quality rice seed is formulated." This modification was quite important for sustainable development of the project outcomes. Ultimate goal of the project is the real CS multiplication in Myanmar.

2. Plan of Operation (PO)

Actual project activities were conducted in line with the PO. PO outlines annual activities of the project including input such as dispatching JICA experts, procurement of equipment, facilities construction and etc., and it was reviewed and revised annual bases in accordance with the project activities (Annex 3).

3. Input to the Project

Based on the Record of discussions (R/D), several kinds of resources were mobilized in the project operation for efficient and effective implementation as follows.

(1) Japanese Expert dispatched (Annex 4)

Total four long-term experts in three posts were dispatched and stationed in Myanmar full-time bases for five (5) years and seven (7) months, in addition, short-term experts were dispatched to supervise some specific subject.

(2) Counterpart training in Japan (Annex 5)

Because of difficulties of counterpart nomination, only few counterparts could participated in the training.

(3) Provision of machineries, equipment and facilities (Annex 6)

Several kinds of machineries, equipment, vehicles and building facilities were provided for efficient and effective implementation of the project.

(4) Local running cost bore by JICA (Annex 7)

Much expenditure goes to OJT and other training activities in township and farm that associated with construction works, travel allowance of both JICA experts & project staff.

(5) Administrative and counterpart personnel of MOALI (Annex 8)

Both administrative and counterpart personnel were assigned from Seed Div., & Extension Div. of DOA and DAR. Although staffs of Planning Div., DOA are not listed in the table-○, they provided tremendous support for smooth implementation of the project.

(6) Land, office space and other facilities provided by MOALI (Annex 9)

The project office and car parking space located in DOA Seed Division compound in Gyogone, Yangon was provided. The project renovated the office and constructed garage for the parking space of two Prado and one Hi-ace.

4. Joint Coordination Committee (JCC)

JCC is the apex body of the project administration. Major functions are i) to deliberate and approve annual operation plan of the project and ii) to review and control overall progress of the project based on the Record of Discussions (R/D). The committee chaired by Director General of DOP, DOA or DAR was held seven (7) times during entire project period for determination of the project direction to achieve the goal as well as overall goal of the project (Annex 11).

5. Project Implementation Committee (PIC)

PIC chaired by the Project Director was held on quarterly basis to monitor the project activities and to find the way for smooth implementation of the project (Annex 10).

VI. For Sustainability of the Project

1. Ownership& Leadership

Ownership as well as leadership is the most important for sustainable development of rice seed sector while taking advantage of external assistance such as JICA project. It is strongly recommended to keep reviewing how the authorities make use of the project outcome to improve rice seed sector in terms of the attempt made by Rice Sec. of DAR, Seed & Extension Div. of DOA and their budget allocation. It is appreciated that DOA Ayeyarwady Regional Office formulated "Seed Action Plan" to disseminate the project outcome for CS multiplication in entire Ayeyarwady Region. DAR-Yezin also realized the importance of BS, then strengthen BS multiplication unit through increasing number of researcher and budget allocation from FY 2016. Such kinds of movements are expected to realize sustainable development of rice seed sector in Myanmar.

In addition, close collaboration among DAR, DOA Seed Div. & Extension Div. is essential in order to multiply quality seed. It is recommended that representatives of these offices have regular meeting to exchange idea of seed technology of BS, FS and RS multiplication in constructive manner so as to improve seed quality.

2. Importance of the Process and Its Review

Authorities tend to see only a result of things and to jump to conclusions. But if process is ignored, the goal cannot be attained in proper manner or fail. Although a project success in some place, it is not sure that the same project will also success in other place where conditions such as climate, people, custom and many other things are different form original place. It is, therefore extremely important to review the process to achieve a goal in an efficient manner.

Let's review the process of field inspection, quality control measures or entire process of seed multiplication when unexpected result comes. Where a process is ignored, development and improvement are not expected.

3. Seed Quality vs Quantity

Regarding rice production, MOALI has given top priority to the quantity such as acreage and the yield rather than the quality. The idea of such material supremacy doesn't meet quality seed multiplication. However, the one tends to show a tangible resultsuch as volume, whereas the quality is intangible and difficult to figure out in visual unlike acreage and the yield. Therefore, seed multiplication and paddy production must be clearly distinguished by the authorities concerned.

Furthermore, seed multiplication of BS, FS and RS must be undertaken by the

government so as to apply strict quality control measures. It is essential that quality of upper class seeds is completely guaranteed by the government because it would affect quality of CS and the paddy yield. And finally, it influence Myanmar economy.

4. Private Sector Participation

(1) CS multiplication: MOALI, so far, has been taking charge of CS multiplication through extension services for contact farmers and model seed villages. On the other hand, some private companies have already initiated CS multiplication business.

It is important to recognize that CS multiplication by individual farmer improves not only their own livelihood but also rural economy of Myanmar. Moreover, private companies tend to show their interest to the marketable rice variety because they must seek for a profit from seed sale. However, such a variety sometime doesn't satisfy farmer's preference in terms of local consumption and environmental adaptability for paddy production.

Therefore, the balance between farmers' benefit and private companies' profit must be taken into consideration when the MOALI promote participation of the private sector into rice seed business.

(2) CS distribution: According to the result of ELS, rice millers/traders are keen interested in purchasing CS from seed growers and distribute them to paddy production farmers because of the advantages brought by CS use. A potential of expansion of CS market is explained in Chapter Ⅳ-2. Such a CS market cycle may enhance entire seed industry as well as Myanmar economy.

5. Price Incentive& Motivation

Recognizing the importance of CS marketing for its stable supply and distribution, the marketing activity was added as the project activities in order to stimulate stakeholder's awareness in advantages of CS use for paddy production. There is, however a double structure in marketing mechanism of rice seed; the former is paddy market and the latter is CS market. If paddy quality is not reflected on the paddy price, farmers may not have an intention to buy CS for quality paddy production. Consequently, CS demand as well as its price comes lower, and then seed growers could not enjoy price incentive in CS sale. At last, their motivation in CS multiplication and its quality control might be lost. Such a negative cycle could be observed anywhere in Myanmar.

Seed as well as food value chain would not be linked without fair distribution of a profit among the members consists of such a chain.

6. Economic Impact of Seed Quality

Rice is the most important staple crops in Myanmar. It is grown approximately 17,720,000 acre and produced 26,423,000 t of paddy in 2015/16. Assuming that the yield of paddy will increase 5 % in 2015/16, the paddy yield will increase 1,321,150 t. It is equivalent to US$ 243 million (Milling out-turns: 60%, Milled rice price to Africa in 2014: 335/t).

Table 14 shows the yield contrast between paddies produced from CS and that of none CS. The survey was conducted by townships of the project sites in 2015. The yield of paddy grown form CS is 3.9 to 13.9 % higher than the paddy grown from none CS.

It can be said that CS use for paddy production will contribute to the growth of Myanmar economy in a certain manner.

Table 14. The Yield Contrast Between the paddy produced from CS and none CS (basket)

	Hinthada T/S (Sinthukha)	Myaungmya T/S (Sinthukha)	Labutta T/S (Pawsanyin)
CS	74.4	95.9	54.7
None CS	71.6	84.2	48.8
Increasing Rate (%)	3.9	13.9	12.1

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