Ministry of Agriculture and the Rural Equipment
Société d'aménagement et d'exploitation des terres du delta du fleuve Sénégal et des vallées du fleuve Sénégal et de la falémé (SAED)

Project on Improvement of Rice Productivity for Irrigation Schemes in the Valley of Senegal in Republic of Senegal

Final Report
(Summary Report)

March 2014

Japan International Cooperation Agency (JICA)

Nippon Koei Co., Ltd.

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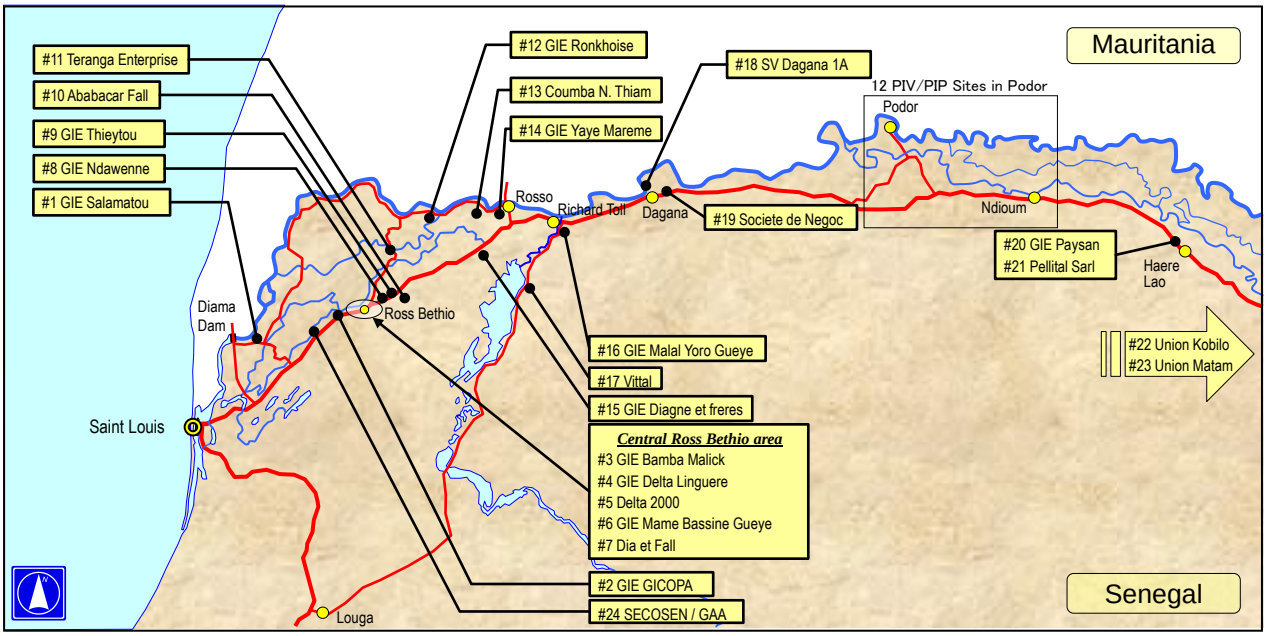
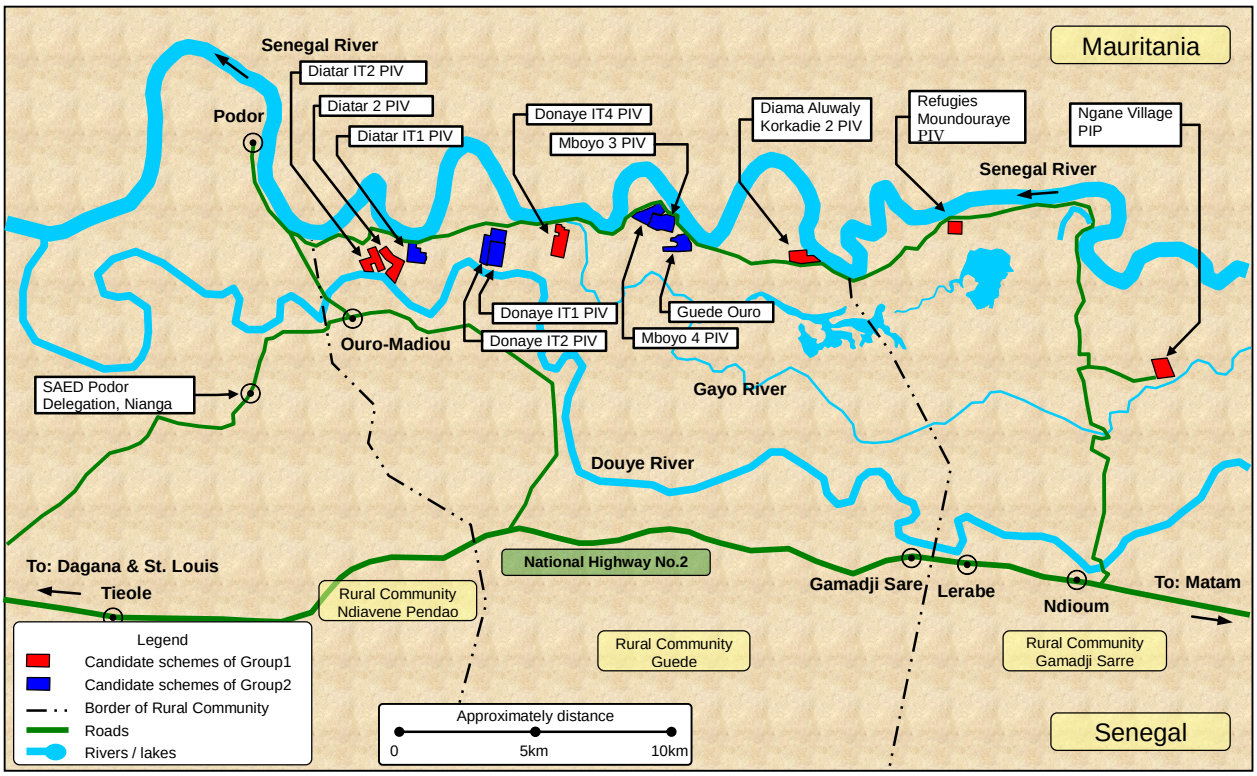
Location Map



Location of 21 Rice Mills where Rice Grading Machines were provided



Location of 12 pilot sites in Podor where Improvement of Irrigation Facilities and Water Management Techniques Program were implemented

Photos （1/3）

Construction work of distribution box completed by farmers' participation.
March, 2012 (Podor, Diatar2 area)

Press tour conducted by JICA. 13 of newspersons (TV, radio and newspaper) attended.
December, 2011 (Podor, Diatar2 area)

Water pumping to the division box.
September, 2011 (Podor, Diatar2 area)

Lining work of main canal.
January, 2013 (Podor, Ngane area)

Repairing work of existing canal done by farmers' participation.
March, 2011 (Podor, Donaye IT4 area)

Repairing work of existing canal done by farmers' participation.
June, 2011 (Podor, Korkadie area)

Installation work of the sign board which indicates the Project area of the repairing work for irrigation facilities by PAPRIZ. November, 2011 (Project area in Podor)

Discussion regarding the farmers' participation. February, 2010
(Podor,Diama Alwaly-Korkadie area)

Photos （2/3）

Introduction of paddy threshing machine. Operation and maintenance training for the machine was carried out. July, 2011 (Podor, Donaye IT4 area)

Introduction of power tiller. Operation and maintenance training for the machine was carried out.
July, 2011 (Podor, Moundouraye area)

Training concerning the herbicide use for farmers was carried out.
April, 2013 （Podor, Diatar 2 area）

Study tour for the farmers in the pilot area of Podor.
November, 2011 (Senegal River valley delta)

Irrigated paddy grows favorably by the technical guidance by PAPRIZ.
March, 2010 （Podor, Diatar 2 area）

Demonstration of the paddy cultivation technology by the group of practical farmers.
November, 2011 (Podor, Guede area)

Length grader installed on the existing rice mill. Operated together with the existing rotary sifter.
February, 2013 (Ross Bethio area)

Rice grading machines provided by PAPRIZ for existing small scale rice mill.
February, 2013 (Ross Bethio area)

Photos （3/3）

PAPRIZ stuff, together with the producer, are measuring the moisture contents of the paddy stacked on the paddy field after harvesting. December, 2011 （Debi-Tiguette area）

Trial training of rice milling, aiming to get value added rice, was carried out for 2 women's group in Podor. September, 2012 (Podor, Taredji area)

Test rice processing was demonstrated by PAPRIZ stuff to the observers from Africa Rice Center.
January, 2011 (PAPRIZ office in St. Louis)

Demonstration of test rice processing machines by PAPRIZ stuff at FIDAK exhibition in Dakar.
January, 2011

Promotion of Senegalese rice by PAPRIZ stuff at SAED booth of FIDAK exhibition in Dakar.
January, 2011

Senegalese rice promotion campaign was carried out at Dakar.
December, 2011 月

Promotion of Senegalese rice by PAPRIZ stuff at SAED booth of FIARA exhibition in Dakar.
February, 2011

For the purpose of promoting and raising awareness of domestic rice, Thiebou Dieune drawing contest was organized. November, 2011 （Kaolack area）

Project for Improvement of Rice Productivity in

Irrigation Schemes in Senegal River Basin (PAPRIZ)

Final Report (Summary Report)

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Chapter 1 Introduction

1.1 Project Background

Rice is the main diet of Senegalese. Its national consumption has sharply increased in recent years and projected to reach 1.0 million ton by 2017. The demand and supply balance of rice in Senegal is characterized by heavy dependency on rice import. Improvement of food security is the central issue of the agricultural policy of Senegal. Ministry of Agriculture and Rural Infrastructure directs all the efforts to the earliest achievement of the self-sufficiency in rice in line with the National Program of Self-Sufficiency in Rice (PNAR).

The Senegal river valley is the leading rice producer in Senegal -supplying some 60% to 70% of domestic rice production. As a result of large public investment in the past, basic infrastructure such as road networks and irrigation facilities are obviously better in the valley than in any other rice production areas. With such circumstances, the Senegal river valley will continue to be the leading rice producer of Senegal for years to come.

The Government of Senegal through Société d'Aménagement et d'Exploitation des Terres du Delta du fleuve Sénégal et des Vallées du fleuve Sénégal et de la Falémé (SAED) and the Government of Japan through the Japan International Cooperation Agency (JICA) concluded the Record of Discussion (R/D) and the Minutes of Meeting (M/M) for the Project on Improvement of Rice Productivity for Irrigation Schemes in the Valley of Senegal (PAPRIZ) in November 2009. In accordance with R/D and M/M, PAPRIZ was officially commenced in February 2010 and completed in March 2014..

1.2 Objectives of the Project

PAPRIZ aims at enhancing productivity and profitability of rice producers through the integrated approach for establishment of a value chain of rice in the Senegal river valley. As shown in its Project Design Matrix (PDM) as Attachment 1, PAPRIZ is designed to achieve the following four (4) outputs;

(1) Establishment of high productivity rice farming techniques,

(2) Establishment of appropriate mechanisms for rehabilitations, management and maintenance of irrigation schemes,

(3) Implementation of measures to improve the financial management of rice producers and rice millers, and

(4) Expansion of appropriate distribution channels for quality milled rice that meets the needs of Senegalese consumers.

It is essential for the rice sector of Senegal to develop more profitable farming system, which will directly motivate rice farmers to produce more rice. Since causes and effects of prevailing problems in the rice sector are complex and multiple, the integrated approaches are required by supporting not

only rice producers but also other stakeholders active in the areas of post-harvest, rice milling and distribution and marketing.

1.3 Project Area

The project area of PAPRIZ administratively falls in both Dagana and Podor Districts of Saint Louis Region. Both districts are basically covered by the project activities especially for market promotion with establishment of value-chain of milled rice from producers to consumers.

The appropriate techniques were introduced in the pilot areas, i.e. the Debi-Tiguette irrigation scheme in Dagana as a model of large-scale irrigation development (GA) and 11 village irrigation schemes (PIV) and one private scheme (PIP) in Podor as models of small-scale irrigation development. In-depth activities of PAPRIZ were carried out in these 13 irrigation schemes.

1.4 Organization

All the activities of PAPRIZ were conducted by joint efforts of the JICA project team (JPT) organized by 10 experts and its Senegalese counterpart (C/P) team consisting of 14 officials. The Steering Committee was organized to monitor the work progress of PAPRIZ and to advise SAED and JPT. The Steering Committee held the meeting on a regular basis under the control of Minister for Agriculture and Rural Infrastructure. JPT submitted a series of the progress reports to the Steering Committee.

1.5 Monitoring and Evaluation

The Joint Study Team was organized by JICA and SAED for the Mid-term Review from 24th June to 18th July 2012 and the Terminal Evaluation from 27th October to 8th November 2013, respectively. The Joint Study Team prepared the Mid-term Review Report and the Terminal Evaluation Report in the respective period, and submitted them to the Ministry of Agriculture and Rural Infrastructure. Both Reports were officially approved.

Chapter 2 Approach to the Project

2.1 Integration of Stakeholders in the Rice Sector

The rice sector is organized by various stakeholders including producers, rice millers, transporters, and wholesalers/retailers as main players, as well as the state agencies supporting the main players. All the stakeholders' activities are directed to be effectively integrated in order to generate more value-added and share the benefit adequately among the players.

Integration of the various players' activities is pursued in PAPRIZ. In the production side, rice producers with farmers' organizations are the main players who are supported by extension agents, irrigation engineers, and service providers of agro-machinery, finance and construction. In order to realize rice productivity enhancement, producers are to be supported with better production system including double cropping of rice through technical guidance on cultivation and water management with improved irrigation system. Introduction of agro-machinery is tried for efficient farming so that the producers could respect cropping calendar. Producers are also expected to provide quality paddy to rice millers through timely harvest and through adequate storage.

As for processing, rice millers were supported through the provision of rice grading equipment with technical guidance to process paddy into various types of rice: whole grain, large broken, fine broken, etc. The rice millers are expected to contribute partly to the provision of equipment, and the contribution will be a seed fund for their credit provision. The rice millers will also be supported with technical guidance on financial management to assure the sustainability of the activity.

In the marketing field, traders bridge the production area with the consumers. They are in a good position to collect market information like the price of rice and the consumers' preference on rice, and the information is expected to be provided to rice millers as well as to producers.

In doing so, the whole rice sector is integrated to form a value-chain. Value-chain will work to maximize the value-added and share the profit among the players.

2.2 Pursuit of the Market-oriented Rice Sector Development

Preference of consumers is the key issue to maintain the value-chain. PAPRIZ pursues the market-oriented rice sector development.

Increased rice production does not necessarily mean that the income of players including producers and rice millers increase, as seen in the past. Local rice must be accepted by the consumers in terms of quality and price. In this sense, rice producers must always make efforts to enhance productivity with low cost as much as possible, and provide quality paddy with adequate moisture content to rice millers. Introduction of aromatic rice varieties would be another option to attract high income urban consumers. On the other hand, rice millers have to make continuous efforts to process better quality rice to meet market demand. Sorting out the milled rice into various categories of size could add value.

Competitiveness of local rice against imported rice must be strengthened. The share of local rice in the market is still small compared with the imported rice. The consumers are aware of advantage of local rice through promotion.

2.3 Assurance of the Project Sustainability

Management and technical capacities of the stakeholders were strengthened through the repeated guidance, training and workshops. Rice producers and farmers organizations were trained to obtain a better rice production system including cultivation technique and water management. Extension agents of SAED were also trained. Rice millers received technical guidance on how to operate the equipment and on financial management.

PAPRIZ promoted awareness creation for project ownership among each of the stakeholders. Having a sense of ownership is always important to continue any activities. As a long history in irrigation development of the Senegal River basin, farmers tend to be dependent upon the government supports. In this regard, PAPRIZ promoted farmers' participation in improvement and maintenance work of their own irrigation facilities to possible extent. Farmers' participation positively affected solidarity and democracy among a community.

Rice in Dagana is produced mainly for cash income of the farmers, while rice in Podor is simply processed at village mills mainly for local consumption. However, although the amount is limited, some of the rice consumed are sold at Podor and/or other local markets. It has become a valuable source of income for farmers. Women play quite an important role in post-harvest activities. PAPRIZ supported rural women by means of technology transfer of rice processing and formation of sales channels from viewpoints of gender perspective.

PAPRIZ assisted establishment of a voluntary lending scheme under Rice Millers Association (ARN) with a seed fund formed by contribution from the rice millers. ARN entrusts the operation of the lending scheme to either CNCAS of other selected financial service provider. A short-term loan is to be provided to the rice millers to supplement their operational budget. At the same time, through the operation of lending, the management capacity and institutional strengthening of ARN can be achieved, over the future.

Chapter 3 Achievement of the Project

3.1 Achievement of the Project Objectives

The achievement of the project objectives of PAPRIZ: "Improvement of productivity and profitability of irrigated rice production in the Senegal river Valley" varied among the pilot areas. The achievement of the project objectives was confirmed at small-scale irrigation scheme (PIV/PIP) in Podor Group 1 (PIV/PIP), as the repair and improvement works of the irrigation facilities were implemented on schedule, and as the guidance on appropriate rice farming techniques was given timely. But it was not in the case in Podor Group 2, where the works started in October 2012. External factors (restricted field activities following the security measures taken by JICA after the terror campaign in Algeria in January 2013, and inundation of the area induced with the raised water level of the Senegal River) retarded the entire work progress there, making farm guidance impossible.

On the other hand in large-scale irrigation scheme of Debi-Tiguette irrigation scheme in the department of Dagana, the farmers' organization (union) of the scheme was dissolved in May 2011 due to the internal conflict, which interrupted the rice farming in the scheme for two consecutive cropping seasons. As PAPRIZ could not work with the farmers in the field for most of its implementation period, the level of the achievement of the project objectives was limited, although the project results were seen.

PAPRIZ provided 21 rice millers (all are members of ARN) in the Senegal River valley with rice grading machines in 2013 with 80% subsidy. The rice millers started using the grading machine after the dry season cropping in 2013. With the production of high quality local rice, marketed volume of local rice by distributors and retail shops at Dakar tended to increase. Therefore, the project objectives in the number of marketing channel and marketed volume were both achieved through the improvement of quality of local milled rice.

Detailed achievement level of the project objectives in terms of verifiable indicators was shown in the following.

(1) Fifteen (15) % increase in the paddy production per hectare in the pilot sites

<u>Small-scale irrigation scheme in Podor</u>

A baseline survey was conducted in July 2010 to grasp the socio-economic and agricultural situation of the pilot areas. The number of farm household interviewed totaled 123, some 20 % of the total households with 600 in the group 1 (six (6) PIV/PIP). The result shows the average grain yield in the dry season in 2009 with 5.4 ton/ha, while that in the rainy season in the same year with 4.5 ton/ha.

Cropping of the dry season in 2011 in the pilot areas in Podor was canceled as the repair and improvement works of the irrigation facilities started in March 2011. The cropping resumed in the rainy season 2011. Among the farmers in the pilot areas who received training on rice cultivation techniques from PAPRIZ, 20 each from seven (7) GIEs in the six (6) small irrigation schemes were

selected to monitor the yield of rice. At mid-term review and terminal evaluation, interview survey on the grain yield in the past cropping seasons was carried out with the selected farmers. The results are summarized in Table 3.1.1.

The number of households in the table shows those who actually planted rice in the season, among 20 farmers selected from each GIE to monitor the yield of rice.

The trend of yield improvement is seen clearly in the 2012 - 2013 after repair and maintenance works as a whole, although variations are seen among schemes.

Table 3.1.1 Average Rice Grain Yield in the Last Four Years in Small Scale Irrigation Schemes in Podor Group 1

GIE	Item	2010		2011		2012		2013	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Diatar IT2	No. of households	14	0	No cropping due to irrigation facility improvement works	18	0	19	19	0
	Average yield (ton/ha)	3.3	-		3.7	-	3.0*3	5.1	-
Diatar 2	No. of households	20	20		16	20	17	19	19
	Average yield (ton/ha)	4.5	3.1		4.5	5.4	5.7	5.9	
Donaye IT4	No. of households	19	20		20	20	0 *4	20	0*4
	Average yield (ton/ha)	5.6	5.4		5.4	5.9	-	5.6	-
Diama-Alwaly	No. of households	18	0		14	14	0	14	0
	Average yield (ton/ha)	5.1	-		3.9	5.3	-	5.6	-
Korkadie	No. of households	20	0		15	8	0	15	0
	Average yield (ton/ha)	4.1	-		3.9	4.3	-	5.5	-
Moundouwaye	No. of households	0	0		20	0*2	20	16	0*5
	Average yield (ton/ha)	-	-		3.6	-	4.	5.3	-
Ngane village	No. of households	0	14		19	20	0*5	8	0*6
	Average yield (ton/ha)	-	4.6		2.9 *1	5.9	-	4.4	-
Total or average	No. of households	91	54		122	82	56	113	
	Average yield (ton/ha)	4.7	4.4		4.2	5.8	4.9	5.4	

Source: arranged based on the survey conducted by PAPRIZ (July 2012, October 2013)
*1: Damaged by drought due to the breakdown on irrigation pump during the cropping season;*2: Not cultivated due to unavailable tractor service;*3: Partly damaged by inundation;*4: Totally damaged by inundation; *5: Not cultivated due to the delayed harvest of the dry season cropping or inundation;*6: Change in the crop cultivated (groundnut)

In the dry season cropping, average grain yields increased from 4.7 ton/ha in 2010 to 5.8 ton/ha (by 23%) in 2012 and to 5.4 ton/ha in 2013 (by 15%). It can be said that the project objective was achieved as far as the dry season cropping is concerned. On the other hand, the average yield increased from 4.4 ton/ha in 2010 to 4.9 ton/ha in the rainy season cropping, and the increase rate of grain yield was 11% between 2010 and 2012. Taking the serious damage on rice production by inundation at Diatar IT2 into consideration, it was likely that the project objective was achieved in the rainy season cropping as well.

It is noteworthy that Diatar 2 continues practicing rice cultivation on schedule except one fallow season when irrigation facility improvement works were carried out, and that the grain yield increased remarkably from 4.5 ton/ha in 2010 to 5.9 ton/ha 2013 (by 31%) in the dry season, and from 3.1 ton/ha to 6.5 ton/ha during the same period (by 110%) in the wet season, respectively.

Large-scale irrigation scheme in Debi-Tiguette

A baseline survey for the farmers of the Debi-Tiguette scheme was conducted in May 2010, and 90 farmers in the scheme were interviewed using a questionnaire. The results show that the average yield of rice in 2009 in the scheme was 5.4 ton/ha in the dry season, and 3.6 ton/ha in the wet season, respectively.

PAPRIZ together with SAED Dagana Delegation gave guidance on water management to the water committee members of the scheme during the three cropping seasons from 2010 dry season through 2011 dry season. In parallel, rice cultivation practice in the scheme was monitored in the dry season of 2011 for the selected nine (9) farmers (one each from nine (9) SV/GIEs). The monitoring results clarified the constraints and problems of farming practices which hampered yield increase. A training session was then held to the farmers of the scheme in October 2011, for enhancing rice productivity through the improvement of farming practices based on the clarified constraints/problems through the monitoring.

The change in yield of the cooperative farmers before and after the project intervention is shown in Table 3.1.2.

Table 3.1.2 Grain Yield of the Cooperative Farmers in Debi-Tiguette Irrigation Scheme

GIE/SV	2010		2011		2012		2013	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
SV Tiguette 1	-	7.0	5.1	-	-	-	7.7	-
SV Tiguette 2	-	-	9.0	-	-	-	5.3	-
SV Tiguette 3	-	6.1	5.6	-	-	-	7.7	-
SV Debi 1	-	4.5	5.5	-	-	-	7.3	-
SV Debi 2	-	6.5	6.7	-	-	-	8.0	-
SV Debi 3	-	4.8	4.8	-	-	-	8.2	-
GIE Debi 1	-	6.5	4.7	-	-	-	6.4	-
GIE Debi 2	-	6.0	5.5	-	-	-	8.4	-
GIE Debi 3	-	6.1	6.8	-	-	-	2.8	-
Average yield (ton/ha)	-	5.9	5.7	-	-	-	6.9	-

Source: Survey by PAPRIZ in 2011 and 2013
Note: Dissolution of the Union of Debi-Tiguette in May 2011 made procurement of crop credit difficult, which interrupted cropping in the scheme for three consecutive seasons from the rainy season 2011 through the rainy season 2012.

Guidance on farming practices was given to the farmers of the scheme putting emphasis on those practices found inappropriate during the monitoring period. As a result, the grain yield of the cooperative farmers increased by 21%, from 5.7 ton/ha in 2011 to 6.9 ton/ha in 2013. Two (2) out of nine (9) farmers decreased in yield due to the damage by rain and inundation after the harvest because of delay in the start of cropping.

(2) Twenty (20) % increase in the incomes of rice farmers of the pilot sites

Small-scale irrigation scheme in Podor

Crop budget of rice in the small irrigation schemes in Podor shows improving tendency as a result of increase in gross benefit with almost unchanged level of production costs. Crop budget analysis was made for total of 25 farmers from five (5) GIEs in which the dry season cropping was practiced in both 2009 and 2013. The results are shown in Table 3.1.3.

Table 3.1.3 Results of the Crop Budget Analysis in the Dry Season Rice in the 25 Farmers of Five (5) GIEs in the Pilot Areas of Podor

	2009	2013
Gross benefit (1000 FCFA/ha)	593	727
Grain yield (kg/ha)	4,740	5,820
Farm gate price of grain (FCFA/kg)	125	125
Total production cost (1000 FCFA/ha)	433	441
1) Land preparation	23	25
2) Farm input (seed, fertilizer, agro-chemicals)	116	87
3) Irrigation	130	159
4) Labors (Transplant and harvest)	52	57
5) Threshing (both manual and machine)	59	66
6) Other costs (materials and transport)	54	48
Net benefit (1,000FCFA/ha)	160	286
Unit production cost (FCFA/kg)	93	76
Unit net benefit (FCFA/kg)	32	49

Source: PAPRIZ (Baseline survey in July 2010; interview survey in October – December, 2013)

As shown in the above table, gross benefit in the dry season rice increased by 23% from 593,000 FCFA/ha in 2009 to 727,000 FCFA/ha in 2013. During the same period, production cost was slightly increased from 433,000 FCFA/ha to 441,000 FCFA/ha. As a result, net benefit increased by 79% from 160,000 FCFA/ha to 286,000 FCFA/ha, which surpassed the project objective of 20% increase.

The great increase in net benefit between before and after the project was largely attributed to the large increase in gross benefit due to yield increase and also to almost the same production cost.

(3) Fifteen (15) % increase in the paddy production in the pilot sites

Small-scale irrigation scheme in Podor

Table 3.1.4 shows cropped area of the pilot area in Podor in the past cropping seasons before and after the irrigation facility improvement works.

All the pilot irrigation schemes except Ngane village stopped cultivation in the dry season 2011 for irrigation facility improvement works. The cropped area in rainy season was greatly expanded compared to that of 2010, although the cropped area varied much from season to season.

Table 3.1.4 Change in the Cropped Area of the Pilot Schemes in Podor Group 1 in the Last Four (4) Years

GIE	Scheme area (ha)	2010		2011		2012		2013	
		Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
Diatar IT2	50.0	20.0	-	-	21.0	-	21.0	26.0	-
Diatar 2	38.0	15.0	14.0	-	10.0	15.0	20.0	15.0	19.0
Donaye IT4	50.0	22.0	21.0	-	21.0	20.2	21.0	20.0	25.0
Diama-Alwaly	44.0	24.0	12.0	-	16.0	7.0	-	13.0	-
Korkadie				-		4.0	-	14.0	-
Moundouwaye	25.0	-	-	-	25.0	-	25.0	12.0	-
Ngane village	45.0	-	13.0-	-	18.0	12.0	-	12.0	0.0
Total area (ha)	252.0	81.0	60.0	-	111.0	58.2	87.0*	112.0	44.0**
Index(2010=100)		100	100	0	185	72	145	138	73

Source: Table 3.3.4 in Progress Report 6 and additional survey by PAPRIZ in October, 2013
Note: *Harvested area was 66ha。 **Harvested area was 21ha。

It should be noted that three GIEs of Diatar IT2, Diatar 2 and Donaye IT4 divide the irrigation area into two, and that they cultivate each area alternately in the dry and rainy seasons. These GIEs cultivate the area near the irrigation pump in the dry season when crop water requirement is high. Two (2) GIEs of Diama Alwaly and Korkadie 2 do not practice double cropping. Many farmers cultivating rice in the above five (5) GIEs have other irrigated farms to produce crops including rice. The other two (2) GIEs of Moundouwaye and Ngane village intend to practice double cropping.

Grain yield sometimes decreases with the damage by flood or break down of irrigation pumps. Rainy season cropping is often canceled due to the delayed harvest of dry season cropping because of the delay in the procurement of fund for starting cropping or in the access to tractor service for land preparation. Even if the irrigation facilities are improved, there are certain factors such as natural conditions or other factors which do not allow the farmers to cultivate rice. Such factors also have to be taken into consideration for improvement. Seasonal crop loan for input procurement and support to the service provider in land preparation are particularly important.

Total grain production is estimated using the average grain yield in each cropping season shown in Table 3.1.1. The result is shown in Table 3.1.5.

Table 3.1.5 Total Rice Production in Each Cropping Season of the Past Four Years in the Six (6) Small Irrigation Schemes of the Pilot Areas in Podor Group 1

Items	2010		2011		2012		2013	
	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
Total cropped area (ha)	81.0	60.0	0.0	111	58.2	86.0	112	44.0
Total harvested area (ha)	81.0	60.0	0.0	111	58.2	66.0	112	19.0
Average yield (ton/ha)	4.7	4.4	-	4.2	5.8	4.9	5.4	6.5
Grain production	381	264	0	466	338	323	605	123
Total annual production	645		466		661		728	
Index	100		72		102		113	

Source: arranged based on the survey conducted by PAPRIZ (July 2012, October 2013)
Note: * Harvested area was 66ha; **Harvested area was 19ha.

Grain production in the rainy season was doubled from 264 ton (100%) in 2010 to 466 ton (176%) in 2011. In the rainy season in 2012, while abnormally high water level of the Senegal River caused inundation in its basin including irrigation schemes, which resulted in the decrease in cropped area, grain production with 323 ton (122%) was achieved. On the other hand, the production in the dry season decreased from 381 ton (100%) in 2010 to 338 ton (89%) in 2012, then increased to 605 ton (158%) in 2013. In terms of annual grain production, despite of the reduction in the total harvested area in 2012 and 2013, due to the inundation of one irrigation scheme induced by the abnormal high water level of the Senegal river, that in 2013 was 728 ton, which is 13% higher than that in 2010 with 645 ton..

(4) The number of distributor and distribution volume of local quality milled rice in the main sales area (20% increase in distribution volumes of sorted local rice milled by beneficiary rice millers)

Rice grading machine was distributed to 21 rice mills under ARN in February 2013. Annual rice processing amount of each of 21 rice mills in the past three years is shown in Table 3.1.6.

Table 3.1.6 Annual Amount of Paddy Processed in the Rice Mills to Which Rice Grading Machine was Provided

Rice Mill	2011	2012	2013	Increase Rate (2011=100)
1	500	500	900	180
2	4,900	5,100	5,400	110
3	4,900	5,100	6,750	138
4	2,900	3,100	3,200	110
5	1,200	1,200	1,600	133
6	600	600	2,400	400
7	4,900	5,100	7,200	147
8	1,000	1,000	2,400	240
9	11,700	12,300	13,750	118
10	2,900	3,100	1,600	55
11	2,000	2,000	2,400	120
12	21,500	22,500	22,000	102
13	2,000	2,000	2,100	105
14	300	300	900	300
15	1,000	1,000	2,000	200
16	1,000	1,000	3,000	300
17	4,900	5,100	6,750	138
18	1,200	1,200	1,200	100
19	400	400	350	88
20	400	400	350	88
21	2,000	2,000	2,400	180
Total	72,200	75,000	88,650	123
Index	100	104	123	

Source: Survey by PAPRIZ in July 2013 and February 2014

Note: Rice processing amount of each year means the sum of dry-season cropping (harvested from mid-June to late July and processed by October) and rainy season cropping (harvested from the end of October to mid-December and processed by March next year.)

The demand for high-quality rice is increased as a result of enhanced willingness to purchase of distributors for high quality rice from the 21 rice mills which were equipped with the rice grading

machine. Those rice mills made efforts to increase the supply amount of milled rice to the market by purchasing a larger amount of paddy and by extending the operating duration of mills.

As a result, total amount of processed paddy in the 21 rice mills increased from 72,200 ton in 2011 to 88,650 ton in 2013. The processing amount (that is to say, the shipping volume of high-quality rice) is expected to increase more in the future, as the replacement of old equipment in rice mills which experience the reduction of processing amount has been progressed.

(5) Quantity of milled rice sold and the number of shops selling quality local milled rice (20% increase in quantity of local milled rice by beneficiary rice millers).

Aiming to raise the awareness on domestic rice, PAPRIZ held the exhibition and sales campaign for domestic rice in Dakar city in December 2011. Prior to the campaign, marketing workshop was held for rice millers and distributors to provide a forum for business matching that allowed them to negotiate with retailers in urban areas.

Distribution and marketing research was carried out in August 2013. In order to grasp the number of rice retailers in the country, thorough enumeration survey is required. Since it was difficult in the framework of PAPRIZ, rice sales volume and sales channels (the number of stores) before and after the introduction of the rice grading machine was confirmed based on shipment data of the rice millers who produce high quality rice.

Many rice millers got more shops to sell quality local milled rice, in comparison with that in 2010. Distribution channels of 11 rice millers are shown in Table 3.1.7, which shows over 2-fold increase from 21 in 2010 to 45 in 2013.

Table 3.1.7 Change in the Sale Destination of Milled Rice from Main Rice Mill

Rice Mill Number	May, 2010		August, 2013	
	Main Sale Destination of Milled Rice	Q'ty	Main Sale Destination of Milled Rice	Q'ty
1	1. Wholesaler in Dakar 2. Retailer in Fatick	2	1. Wholesaler in Kédougou 2. Wholesaler in Dakar 3. Wholesaler in Dakar	3
2	1. Wholesaler in Kaolack 2. Saint Louis	2	1. Wholesaler in Kaolack 2. Saint Louis	2
3	1. Wholesaler in Dakar 2. Wholesaler in Touba 3. Wholesaler in Louga	3	1. Wholesaler in Dakar 2. Wholesaler in Touba 3. Wholesaler in Louga 4. Middleman in Ross Bethio and Saint Louis 5. Middleman in Mbacké	5
4	1. Wholesaler in Dakar	1	1. Wholesaler in Dakar	1

5	1. Large scale sugar factory in Richard Toll 2. Wholesaler in Dakar 3. Wholesaler in Dakar	3	1. Large scale sugar factory in Richard Toll 2. Wholesaler in Dakar 3. Wholesaler in Dakar 4. Wholesaler in Thies 5. Wholesaler in Thies 6. Wholesaler in Dhara 7. Retailer in Richard Toll, Touba, Saint Louis and Louga 8. Wholesaler in Saint Louis 9. Retailer in Fouta and Bakel	9
6	1. Retailer in Ouro Sogui 2. Wholesaler in Dakar 3. Export to Mali through World Food Program (WFP)	3	1. Retailer in Ouro Sogui 2. Wholesaler in Dakar 3. Export to Mali through World Food Program (WFP) 4. Retailer in Louga 5. Women's group in Thies 6. Women's group in Dakar	6
7	1. Retailer in Mery 2. Retailer in M'boumba 3. Retailer in Pete	3	1. Retailer in Mery 2. Retailer in M'boumba 3. Retailer in Pete 4. Retailer in Haere Lao 5. Wholesaler 6. Retailer in M'boumba 7. Retailer in Haere Lao	7
8	1. Neighboring retailer 2. Sold in Matam Region	2	1. Neighboring retailer 2. Sold in Matam Region	2
9	1. Wholesaler in Dakar 2. Wholesaler in Rosso	2	1. Wholesaler in Dakar 2. Wholesaler in Rosso 3. Respective consumers 4. Retailer in Fouta 5. Retailer in Nabadji 6. Retailer in Bokidiawé	6
10	These mills did not exist or not operated at the time of 2010	0	1. Retailer in Fatick 2. Retailer in Ouro Sogui	2
11			1. Wholesaler in Dakar 2. Wholesaler in Saint Louis	2
Total		21		45

Source: Survey by PAPRIZ

Note: Since many factories did not disclose the information regarding above inquiry, above data show only PAPRIZ could acquire from the mills.

PAPRIZ has monitored the volume, quality and price of quality domestic milled rice sold at 14 stores in Dakar and five (5) stores in Saint-Louis before and after the introduction of rice grading machine. Based on the data obtained from the nine (9) stores in Dakar, increase trend in the sales volume of quality domestic milled rice is clearly seen.

Table 3.1.8 Changes in Sales Volume of Domestic Rice in Nine Shops in Dakar

No.	Address	DomesticRice Volume (ton)				Major Supplier	Note
		2010	2011	2012	2013		
1	Tillen Market	109	236	264	306	Large scale rice miller in Rosso	
2	Castol	7	14	9	8	Rice miller around the Senegal River	Having only small amount of stock and being in short supply in many cases.
3	Castol				23	Large scale rice miller in Richard Toll	Starting a retail business from 2013
4	Malyst	260	275	292	254	Large scale rice miller in Rosso	Sales volume was reduced in 2013 because supply from the rice miller was small.
5	Geule-Tapée	64	73	81	96	Large scale rice miller in Rosso	
6	Pikine			72	90	Large scale rice miller in Ross Bethio	Starting a retail business from 2012
7	Police	85	329	336	323		

8	Nelson Mandella City	131	144	112	97	Rice miller around the Senegal River	Sales volume was decreased in 2012 by competing rival store.
9	Ouakam	48	72	176	244	Large scale rice miller in Richard Toll	Domestic rice was rare in the market before 2010
Total		704	1,143	1,342	1,441		

Source: Survey by PAPRIZ

Note: 1) The answer was obtained from10 of 14 shops.
2) Nine of 10shops answered showed the detailed number.
3) Four of nine shops increased clearly the dealing volume of milled rice.
4) Total dealing volume of 9 shops increased.
5) The volume in 2013 is at the timing of September so that the total volume in a year is expected to be much bigger than actual amount.

3.2 Achievement of the Results

3.2.1 Expected Result 1 : Establishment of a High Productivity Rice Farming in the Pilot Sites

(1) Efficiency of quantities of inputs used in the pilot sites (50% of the farmers in the pilot sites)

SAED in cooperation with Africa Rice Center and JICA revised irrigated rice cultivation manual in 2011. SAED distributed the revised manual to all the agricultural advisors of SAED in March 2011 to disseminate unified rice cultivation techniques according to it. PAPRIZ provided a training session on irrigated rice cultivation techniques according to the manual to 25 agricultural advisors of three (3) SAED Delegations for three days in June 2011.

PAPRIZ prepared an extension guide on irrigated rice production focusing on more important farming practices contributing to further grain increase. The guide was prepared based on the experience gained through the project activities including monitoring, farm guidance and training sessions, using many photographs and illustrations. The guide was distributed to all the agricultural advisors of SAED, and is expected to be utilized effectively for realizing further productivity enhancement and income increase of the farmers in the Senegal River basin.

The farmers in the Debi-Tiguette irrigation scheme as the pilot area of large irrigation area have received technical guidance on appropriate farming practices. Almost all farmers have obtained loan from CNCAS through SV/GIE to which they belonged, and used recommended amount of input. However, PAPRIZ found through the monitoring of farming practices of the farmers in the scheme that input has not brought about expected yield increase, and that inappropriate farming practices hampered such enhancement of productivity and benefit. PAPRIZ provided training programs to the farmers to show them how to improve the farming techniques to enhance yield and profit.

As a result of the activities of PAPRIZ, the farmers who received farm guidance and/or training adopted the improved farming techniques and disseminate what they learned to other farmers. The results of the interview survey carried out in November 2013 shows that farmer-to-farmer extension has been in practice, which has contributed to the efficient use of input and yield increase.

In the small irrigation schemes in Podor, many GIE have outstanding debts, which made procurement

of CNCAS loan impossible. The farmers in the area try to procure input by themselves and follow the recommended farming practices. However, it was found through the monitoring that fertilizers and herbicides were often used inappropriately. PAPRIZ tried to rectify the problems through demonstration and training, and most farmers who received training adopted the improved farming techniques to enhance the productivity.

In the pilot areas, it is estimated that more than 60% of the farmers use input efficiently.

(2) The number of agricultural advisors who utilize the revised manual (more than 80% of the agricultural advisors of SAED)

As described in the above, all the agricultural advisors of SAED were given the revised version of irrigated rice cultivation manual to disseminate updated rice cultivation skills to the farmers in the Senegal River valley in February 2011. PAPRIZ gave three-day training to the agricultural advisors of SAED in June 2011 for them to understand the contents of the revised manual on irrigated rice cultivation. PAPRIZ also tried to monitor the farming practices of the farmers in the pilot areas with the agricultural advisors to identify problems hampering further yield increase.

PAPRIZ prepared the extension guide on the irrigated rice farming practices to facilitate dissemination of the revised manual, and provided training on the extension guide to the agricultural advisors of SAED to share more important farming techniques contributing to the yield enhancement and how to disseminate the farming techniques in December 2012. Through the training and monitoring, almost all the agricultural advisors in the Podor and Dagana delegations of SAED are expected to utilize the revised rice cultivation manual.

3.2.2 Expected Result 2 : Establishment of Appropriate Implementation Mechanisms for the Planning of Repair and Improvement, Management and Maintenance of the Irrigation Schemes in the Pilot Sites

(1) Elaboration of the plan and implementation of repair and improvement works in the small scale irrigation schemes (Podor 12 pilot sites)

Repair and improvement works in small scale irrigation scheme in Podor group 1 (six pilot sites) started in March 2011, after the status survey of existing facilities, formulation of facility improvement plan, and achievement of a consensus with the beneficiary farmers on participatory works. The work was completed in January 2013.

The same procedure was applied to Group 2 (six pilot sites), and the work started in October 2012 and completed in December 2013.

In the large-scale irrigation scheme in Debi-Tiguette, the union of Debi-Tiguette has conducted repair and improvement works of the irrigation facilities using the finance of CNCAS, although the work quantity was small. PAPRIZ provided technical guidance on the preparation of urgent repair and improvement plan to the Water Users Committee of the Union.

(2) Cost estimates of the repair and improvement works of small scale irrigation schemes in Podor (12 pilot sites)

PAPRIZ, referring to the unit cost of similar projects financed by the World Bank in Dagana department, implemented urgent repair and improvement works for small scale irrigation schemes in Podor with a maximum cost of 600 000 FCFA/ha. Work items were determined on the basis of the results of field survey and interview to farmers. Cost estimates of 12 pilot sites in Podor (527ha) has been completed. Construction costs of each site based on the performance of construction work are as shown in Table 3.2.1.

Table 3.2.1 Area and Construction Costs of the Repair and Improvement Work in Podor

Group	Scheme	Irrigated area (ha)	Construction cost (1,000FCFA)
1	Diatar IT2	50	12,780
	Diatar 2	38	38,240
	Donaye IT4	50	21,134
	Diama Alwaly Korkadie	44	31,145
	Refugies de Moundouwaye	25	21,583
	Ngane	45	26,686
	Group 1 total	252	151,568
2	Diatar IT1	50	13,362
	Donaye IT2	50	11,946
	Donaye IT1	50	13,005
	Mboyo 4	45	15,528
	Mboyo 3	39	12,209
	Guede Ouro	41	18,803
	Group 2 total	275	84,853
	Total	527	236,421

Source: Survey by PAPRIZ

(3) Preparation of the manual for the repair and improvement of both small and large irrigation schemes, incorporating lessons learned from the project activities including the participatory repair and improvement works of irrigation facilities in the pilot areas, maintenance and management of the facilities, and transfer of technologies

Draft manual of repair and improvement works was completed in October 2013, based on the handouts that have been used in the workshops and field practice. The users of this manual are SAED and farmers. The manual is organized by scale of irrigation schemes and by project implementation procedure such as survey and design, supervision, and management of maintenance.

(4) Expansion of cultivated areas (100% increase in 12 pilot sites) and unit fuel consumption rate of irrigation pumps in the pilot sites (20% decrease 12 pilot sites)

Cultivated area and unit fuel consumption of irrigation pump in each cropping season over the past four years in Group 1 (250 ha) are shown in Table 3.2.2. Cultivated area after the repair and improvement work tended to expand compared to that before the work. The increase of cultivated area in the rainy season from 60 ha in 2010 to 111 ha in 2011 is remarkable. The Cultivated area in

the rainy season decreased from 2012 to 2013. The cultivation area in dry season cropping increased 38% from 81 ha in 2010 to 112 ha in 2013.

Fuel consumption per ha in the dry season cropping in both 2010 and 2013was 164 liter/ha, which is higher than that of the rainy season cropping (80-140 liter/ha). Fuel consumption in the rainy season cropping reduced after the repair and improvement work, although the cultivated area varied year-to-year. Fuel consumption per ha in the rainy season cropping decreased 43% from 2010 to 2013, which is much higher than the targeted figure.

Table 3.2.2 Cultivated Area and Unit Fuel Consumption of Irrigation Pump in Podor

	Unit	2010	2011	2012	2013
Dry season cropping					
Cultivated area	ha	81		0	112
Cost for fuel	liter	13,300		0	18,440
Amount of fuel par ha	liter/ha	164		0	165
Cost for fuel per ha	FCFA/ha	98,400		0	98,400
index (2010=100)		100			100
Rainy season cropping					
Cultivated area	ha	60	111	86*	44**
Cost for fuel	liter	8,395	11,541	6,520	1,520
Amount of fuel par ha	liter/ha	140	104	99	80
Cost for fuel per ha	FCFA/ha	84,000	62,400	59,400	48,000
index (2010=100)		100	74	71	57

Note: Harvested area was decreased into *66 ha and *19 ha by flooding. Paddy yield is calculated with harvested area.
Source: Survey by PAPRIZ

(5) Utilisation of manual for the repair and improvement of irrigation schemes by engineers of SAED and rice farmers (60% of 22 GIEs of the pilot sites)

The handouts that have been used in the workshops and field practice are compiled into the manual of repair and improvement works. This manual is used for the training for SAED and farmers in both large-scale irrigation scheme in Debi-Tiguette and small-scale irrigation schemes in Podor for each process from survey to management of repair and improvement works.

Manual for SAED staff is used by 100% of staffs on Dagana and Podor delegation and all agricultural extension workers in pilot sites. On the other hand, manual for farmer has already been used 80% or more in 12 schemes in Podor (13 GIE), but for Debi-Tiguette, only water management manual has been used (30%).

3.2.3 Expected Result 3 : Implementation of Measures to Improve the Financial Management of Farmers

(1) Cost and benefit of rice farming activities of producers' organisations and their members in the pilot sites (22 GIEs of the pilot sites and 5 farmers for each GIE)

Farm income of rice farmers was improved in the pilot area either by increasing gross benefit or by

saving production cost. On the other hand, in order for the producers' group (GIE) to sustain the proper operation and maintenance of irrigation facilities, it is necessary to collect users' fee from the member farmers.

Currently, each farmer bears the pump fuel costs, maintenance and repair costs, and salary for pump operator and irrigation administrators. Through the repair and improvement of irrigation facilities by PAPRIZ, it is expected that member farmers of GIE understand the importance of maintenance of irrigation facilities and accumulate necessary funds for the purpose. In fact, the GIE of Diama-Alwaly has started collecting facility maintenance costs from the member farmers. It is expected that this activity would replicated in other GIE.

(2) Eligibility and utilisation rates of the credit system by farmers (60% of farmers of the pilot sites)

Provision of production loan by either CNCAS or CMS resumed after the fallow period of two cropping season in Debi-Tiguette, and all the farmers (100%) in the scheme used the loan system. In Podor, two schemes (Donaye IT4 and Moundoway) in Group 1 and four schemes (Donaye IT1, Donaye IT2, Mboyo 3, and Mboyo 4) in Group 2 is to use the finance of CNCAS, the percentage of the users is 44% of all farmers. The total percentage of users in both groups is 60% or more of the entire pilot schemes.

3.2.4 Expected Result 4 : Establishment of Appropriate Distribution Channels for Quality Milled Rice that Meets the Needs of Senegalese Consumers

(1) Number of rice mills properly sorting out rice (100% of beneficiary rice millers)

Rice grading machines were provided to the 21 rice mills that belonged to ARN starting in February 2013. The grading machines were installed to the rice millers who paid 20% of the equipment cost as contribution to the ARN bank account, and all the installation works completed in June, 2013. All the 21 rice millers (100%) started the milling operation using the grading machine for the hot dry season's paddy of 2013.

(2) Number of rice millers using the credit system (available for any of the members of Rice Millers Association.)

As of July, 2013, 28 rice millers are registered as the member of ARN, of which 21 rice mills were provided the rice grading machine. Those 21 rice millers contributed 20% of provisional cost of the grading machine to the bank account of ARN as the seed money of pilot credit system. Total amount of contribution was FCFA 44,000,000. While the seven (7) rice millers who were not provided the grading machines did not need to pay the contribution to the ARN's bank account, they have had no right to access to the pilot credit system.

In the meantime, ARN and CNCAS formulated the draft of operational guideline about credit system, and reached agreement at the end of 2013. The proposal of operational guideline will be approved

formally at the ARN general meeting to be held on early February, 2014. This guideline defines that all 28 rice millers (100%) can use the credit system regardless of the provision of the grading machines. By this operational guideline of ARN, the expected result will be accomplished.

On the other hand, before the official agreement of the operational guideline, small sum of finances for purchasing spare parts necessary for milling operation for the rainy season paddy of 2013 (operation period from December 2013 to March 2014) were requested from the four (4) member rice millers. After the examination, ARN decided to finance those 4 rice millers on a trial basis, and the finance was implemented.

(3) Promotion of local rice

PAPRIZ together with SAED participated in the national exhibitions like FIDAK and FIARA in 2011 and 2012, and made promotion campaign of domestic rice to 2000-3000 general consumers each time.

For the purpose of promoting and raising awareness of domestic rice, *Tiebou Dieune* drawing contest was organized in November 2011 for the target of 2,000 elementary school children in 29 schools in five Regions, where Japan Overseas Cooperation Volunteers worked as teacher.

Domestic rice consumption campaign was also held in December 2011, and major rice millers and traders in Saint-Louis participated in the campaign. There were about 400 visitors and the campaign was reported in TV news, radio, newspaper, etc.

Among those who participated in the campaign, the highly-motivated distributors for rice package improvement were selected, and sample package has been developed until February 2013. Final package was developed based on the result of a questionnaire survey to consumers in an event. PR campaign of local rice with new package was held together with retailers in urban area after June 2013, when domestic rice is in short supply.

(4) Number of distribution channels created between rice millers and middlemen by promotion activities.

Rice marketing workshop was organized in January 2013 for about 12 rice millers and distributors who had participated in the domestic rice campaign. An event for business matching was also held in February 2013 to provide a chance for rice millers and distributors to negotiate with retailers in urban areas. A survey conducted in August 2013 identified that there is a clear increase in the sales channels, as a result of above mentioned activities.

Furthermore, many rice millers have increased sales destination compared to that of 2010. Distribution channels of 11 rice millers are as shown in Table 3.1.7, which shows more than 2-fold increase from 21 in 2010 to 45 in 2013.

Chapter 4 Lesson Learned through the Project

4.1 Necessity of Master Plan

The Government of Senegal conducted the Master Plan Study of the Rice Sector in November 2004 to July 2006 in collaboration with the technical assistance from JICA. The JICA study worked out the Master Plan in which the integrated approaches among paddy production, post-harvest and rice milling, and distribution and marketing were proposed. The Action Plans were also prepared for the rice sector of five representative regions, namely Saint Louis, Matam, Fatick, Kolda and Ziguinchor.

The Master Plan was formulated to set up the necessary measures for (i) provision of better rice production environment which allow paddy farmers to obtain more income and sustain paddy cultivation, (ii) increased production of high quality domestic rice to meet the consumers' needs and (iii) improvement of various conditions to assure the smooth marketing of domestic rice. The Master Plan consists of 11 programs and projects presented in Table 4.1.1.

Table 4.1.1 Master Plan for the Rice Sector Proposed by JICA Study (2006)

Master Plan Program	Proposed Programs and Projects
Senegal river Valley (St. Louis Region and Matam Region)	
1. Rice Productivity Improvement Program	1.1 Adaptive Research and Extension Project for Rice Productivity Enhancement
	1.2 Project for Preventing Salt Accumulation Problem in the Delta Area
2. Mechanized Rice Farming System Improvement Program	2.1 Research and Extension Program for Effective Land Preparation for Rice
	2.2 Rice Reaper Development and Extension Project
3. Irrigation Development Program	3.1 Small-scale Irrigation (PIV and PIP) Rehabilitation and Extension Program
	3.2 Large-scale Irrigation Area (GA) and Middle-scale Irrigation Area (AI) Development Program
4. Rice Quality Improvement Program	4.1 Rice Processing Technology Improvement and Extension Program
	4.2 Rice Quality Standard Extension Program
5. Program for Improvement of Rice Distribution	5.1 Program for support of establishment rice marketing information system
	5.2 Farm Village Access Improvement Program
6. Program of improving credit access for the rice production and marketing	6.1 Program to support the establishment of micro-finance institution for rice producers
	6.2 Financial Support Program for Rice Millers
	6.3 Financial Support Program for Agricultural Machinery leasing business
7. Environment Management Program in Irrigation Development	7.1 Environment Management System Development Project in the Lower and Middle reaches of the Senegal river valley
Traditional Rice Cultivation Area (Kolda Region, Ziguinchor Region, Fatick Region)	
8. Seed production and Distribution Program	8.1 Seed Production and Distribution Support Program in Casamance Region
	8.2 Seed Production and Distribution Support Program in Fatick Region
9. Rainfed Rice Production Support Program	9.1 Rice Production Support Project in Casamance Region
	9.2 Rice Production Support Project in Fatick Region
10. Anambe Irrigation Development Program	10.1 Anambe Irrigation Rice Production Promotion Project
	10.2 Anambe Farmers' Cooperative Support Program
Election of the Organization for Enforcement of Master Plan	
11. Establishment and Management of Promotion Committee for the Reorganization of the Production of Rice in Senegal	

Source：Study on Reorganization of Rice Sector of Senegal (JICA, 2006)

The economic environment surrounding the rice sector of Senegal was significantly changed during last two decades. In particular, the intervention of private sector represented by the service providers for rice milling and farm machinery operation is noticeable. The farm credits were also expanded in terms of loan conditions and service areas. In addition to CNCAS, the crop credits introduced by MEC and the private service providers are prevailing in the Senegal river valley in recent years.

The contributions of international and bi-lateral donor agencies to the rice sector are substantial. They are represented by FAO, who estimated the required investment for the rice sector development, and USAID, who promotes the project for economic growth (PCE). The synergy of their interventions encouraged the growth of the rice sector in recent years. The Master Plan must have provided the basic information and development ideas to further studies and plan formulations by these agencies.

To generate more values in the rice sector, an effective linkage between the public services such as agricultural extension services and seed multiplication and the private services are prerequisite. In order to encourage more investment of the private sector in the rice sector, it is important to update the programs and projects proposed in the Master Plan to meet the current conditions.

4.2 Lesson Learned from Participatory Irrigation Development

4.2.1 Objectives of Irrigation Development in Podor

The irrigation area of Podor is estimated to be 23,556 ha or 26% of 90,000 ha of the total irrigation area in the entire Senegal river valley. Out of 23,556ha, 9,507ha or 40% are used for PIV as seen in Table 4.2.1.

Table 4.2.1 Irrigation Area of Podor by Category

Category	No. of GIE (no.)	Developed Area(ha)	Irrigable Area(ha)
Large-scale Schemes (GA)	46	1,927	1,927
Medium-scale Schemes (UAI)	117	4,197	3,977
Village Irrigation Schemes (PIV)	389	9,507	8,764
Private Irrigation Schemes (PIP)	780	7,925	7,268
Total	1,362	23,556	21,936

Source：SAED/DDAR

Most of PIVs were developed in order to mobilize local farmers of Podor under the famine relief program during 1980s and 1990s. Irrigation pumps and facilities were handed over to the farmers of PIVs in the initial years after the development. PIVs played important roles for the food security in Podor. However, the technical training of irrigation farming was not sufficiently provided to the farmers. Moreover, the farmers tended to be dependent strongly upon the government supports since the facilities were granted under the famine relief program. In general, the farmers of PIVs have less intension to maintain their irrigation facilities by their own efforts even though they are seriously deteriorated.

The total areas of small-scale irrigation schemes, namely PIV and PIP, amount to 17,432 ha combined or 74% of the total irrigation area of Podor. Although the ownership and the legal status are different between PIV and PIP, their development sizes and facilities are quite similar. Taking into consideration their large extents and extreme importance in local livelihood, PAPRIZ focused on improvement of the irrigation techniques especially for efficient water use. Impacts of PAPRIZ were not limited only to the beneficiary farmers in the pilot areas. PAPRIZ drew attentions of other donors to urgent necessity of technical and financial assistance to PIV and PIP in Podor. Referring to the lesson learned through PAPRIZ, more investments will be directed to the small-scale irrigation development in the Senegal river valley as a whole.

4.2.2 Introduction of Participatory Approach

In general, SAED sublet new construction as well as rehabilitation of the irrigation facilities in the Senegal river valley to selected contractors among ones in either Dakar or other urban centers according the official procedures. Qualified contractors are limited in Podor. To select qualified contractors, the contract amounts have to be attractive for them also taking into account work volumes and hardship of local conditions of Podor.

Apart from new facility construction of certain work volume, the farmers of PIV are requested to carry out by their efforts. In this regard, they need basic knowledge and skills for minor but urgent repair of their own facilities such as leakage of irrigation canals.

In association with the SAED engineers, PAPRIZ implemented the training program for skill-up of the farmers in improvement of irrigation facilities. The farmers participatory approach was introduced to six (6) PIV schemes with a total coverage of 252 ha of 600 farm families. Prior to the repair works, PAPRIZ set up the following premises.

1) The main objectives of the program are not to make full rehabilitation of the deteriorated facilities but improve the facilities justified from effective water management point of view.
2) The main works are represented by repair of canal leakages and additional installation of division boxes and check gates.
3) The project cost will be 600,000 FCFA/ha taking into account the conditions of the similar project by the World Bank. The total project cost is estimated to be FCFA 150 million.
4) Awareness creation of the ownership is the key issue for sustainability of the project facilities. Farmers are requested to participate in the construction works by four hours a day for 30 days.

Although the number of farmers participated in the repair works are lower than the plan, it amounted to 19,290 person-days during the construction period from March 2011 to June 2012. It means that each farm family supplied 32 person-days of manpower. Out of the total manpower inputs, 60% to 70% were farmers' participation, while 30% to 40% are farmers who completed their tasks of 30-day work and continued providing the services under the work contract. It is noted that farmers' participatory approach is applicable to this kind of works as far as the premises are mutually agreed in advance.

4.2.3 Cost Analyses

The total cost of the construction works amounted to FCFA 152 million as of June 2013, which is equivalent to 603,000 FCFA/ha.

It is noted that labor cost occupies as low as 10% of the total cost. Out of FCFA 152 million of the total construction cost, FCFA 98 million or 64% were allocated to the construction materials. Furthermore, out of FCFA 98 million of the construction cost, the concrete works occupied 70% consisting of 53% for inlet structures, pump installation floors and discharge structures and 16.5% for canal concrete lining.

It is important to know that the purpose of the participatory approach is not for cost-saving but for capacity building including skill training and awareness creation of the ownership among farmers. PAPRIZ utilized the opportunities to work together with farmers for their training as much as possible.

PAPRIZ excluded the replacement of existing irrigation pumps from this program. However, it was recognized that farmers face frequent stops of irrigation water supply due to mechanical troubles of pumps since most of pumps are old and deteriorated. Replacement of pumps must be considered. Without guarantee for irrigation pumps, farmers will not be motivated in participatory approach for repair of irrigation facilities.

4.3 Lessons Learned and Future Perspectives on Rice Cultivation and Farm Management

4.3.1 Expected Yield

Average grain yield of rice in the Senegal river valley in recent years varied between 5 and 6 ton/ha for the rainy season cropping and between 6.0 and 7.0 ton/ha for the dry season cropping, respectively, both of which are much higher than that obtained in other rice production area in Sub-Sahara Africa region.

Endowed with high solar radiation, abundant water resources, and relatively fertile soils, the Senegal river valley has large potential for crop production, especially rice. In fact, large amount of investment has been put in place for public infrastructure such as irrigation, road, water, etc., which, coupled with the government support for rice development and private sector investment for machinery service and rice processing and marketing, have provided rice farmers with better environment to realize higher yield of rice.

During the implementation period of PAPRIZ, several rice farmers who received technical guidance on rice cultivation increased significantly their yield to more than 10 ton/ha, which indicated that further yield enhancement is possible with the proper crop management practices.

The role of the Senegal river valley in the attainment of the self-sufficiency in rice is more and more important, which should not be underestimated.

4.3.2 Extension System and Capacity of Agricultural Advisors on Rice Cultivation Technique

As described in Chapter 2, SAED assigns 87 agricultural advisors in 68 irrigation zones under four (4) field offices (délégation). Aside from the technical extension works on crop cultivation (not only rice) and water management, and from the support for organizing, the agricultural advisors are mandated to conduct yield survey of rice at harvest time in each cropping season, support the GIEs of rice producers in the irrigation schemes in applying production loan to financial institutes, coordinate the fertilizer distribution by the government at subsidized price, conduct survey on the situation of their responsible irrigation schemes by the order of the headquarters, etc. Obviously human resources for technical dissemination are insufficient to cover vast irrigation area with more than 50,000 ha. Further the agricultural advisors are too busy to concentrate on technical extension activities. In fact, the PAPRIZ team also found difficulty in working closely with the agricultural advisors in the pilot schemes.

As for the technical capacity of the agricultural advisors on rice production, it varies much among them. Not all the agricultural advisors are specialized in rice production. Some are specialized in agricultural engineering, and others are in socio-economy. Under such conditions, uniform technology transfer on rice cultivation is not expected. It means the dissemination level on rice cultivation techniques to the farmers depend greatly on the capacity or experience of the agricultural advisors.

Considering the above, it is difficult for the rice farmers in the Senegal river valley to receive quality technical extension on rice cultivation techniques at present.

How to make the technical extension on rice cultivation to the rice producers more efficient and effective under such circumstances as understaffed agricultural advisors with different capacity poses a serious issue.

As a trial, PAPRIZ established a demonstration plot at selected farmers' field in each irrigation scheme, and provided direct technical guidance on rice cultivation to the owner farmers of the demonstration plots through regular monitoring while provided general group training to other farmers in the schemes. Capacitated owner farmers of demonstration plots could play as extension agents to transfer the technologies to other farmers in the irrigation scheme or even surrounding schemes. In Debi-Tiguette irrigation scheme, one of nine owner farmers transferred his gained experience and knowledge on rice cultivation technique to 30 to 40 surrounding farmers in and around the scheme. Similar case is reported in Podor area. This method is worth considering for future technology transfer, as overall input is smaller although initial input may be larger.

4.3.3 Rice Cultivation Techniques

SAED in collaboration with Africa Rice, under the financial support by JICA, issued the revised version of practical manual on irrigated rice cultivation in February 2011, which was distributed to all

the agricultural advisors of SAED (the agricultural advisors). The manual covers all the information on rice production such as recommended rice farming practice, post-harvest activities including rice milling, and yield survey, all of which are necessary for the agricultural advisors to understand. However, some description on specific farming practices in the manual looks too difficult for the advisors to explain to the farmers.

PAPRIZ, while provided the agricultural advisors with a training on the contents of the revised manual, prepared "the extension guide on irrigated rice cultivation" (the guide) as a supplement to the revised manual in order for the agricultural advisors to be able to disseminate the recommended rice farming techniques to the rice farmers easily. In the preparation of the guide, PAPRIZ extracted more important farming practices which affect the yield, based on the contents of the revised manual, on the results of farmers' field monitoring on rice farming practices, and on the questions raised by the farmers at training sessions, and summarized the identified problems to apply the recommended practices, measures to solve the problems, and dissemination methods in steps. The guide uses many photos and illustrations for easy understanding. Capacity of the agricultural advisors of SAED could be built up with repeated training using the revised manual and the guide. With the use of the same materials, more uniform technical extension is assured.

4.3.4 Conditions that Make Dissemination of Appropriate Rice Farming Technologies Conducive to the Realization of Rice Yield Enhancement and Income Increase

There are several conditions for the disseminated rice farming techniques to contribute to the realization of rice yield enhancement and income increase. They are: (i) proper post-harvest practice of on-farm drying and better storage environment to keep the dry paddy until they are transported to rice mill; (ii) proper distribution system to assure the rice farmers of timely input supply; (iii) proper financing mechanism to assure the rice farmers of enabling environment of doing double cropping; and, (iv) mechanization to meet labor shortage and raise work efficiency.

Even if the rice farming practices are disseminated properly, expected higher yield will not be realized or quality of the products will not be enhanced, which will result in the income decrease, unless they are made according to the cropping calendar. Parallel with the technology dissemination, such environment that enables to realize proper farming practices according to the cropping calendar is necessary.

4.4 Importance of the Establishment of Rice Value Chain

The rice sector in Senegal has issues to overcome at all sub-sectors: production, processing, distribution and marketing. As those issues are mutually related, a holistic approach is necessary to address the issues to improve the situation. It is expected that all the stakeholders involved in the sector understand and share the issues/problems, to find the way to improve the sector as a whole. In the flow from the rice production to its marketing, even if specific stakeholder gains the profit, its economic impact is small, and its contribution to the whole sector is small. PAPRIZ pursued the enhancement of value addition of rice sector as a whole. Starting with the consumers' preference,

favored conditions of local rice in the market shall be shared and pursued by distributors, rice processors and rice producers. It was expected that such a value chain approach would bring about maximum value addition of the whole rice sector.

PAPRIZ tried to realize the establishment of value chain at Debi-Tiguette irrigation scheme. The scheme was selected due to the farmers high skill in rice production, better conditions of the irrigation facilities which would assure stable production with double cropping, high possibility of further technology improvement by saving production cost through the optimum use of input, possibility of quality improvement of milled rice utilizing the existing rice processing facilities, etc., all of which could promote value added rice production with high marketability. During the project implementation period, irrigation facility improvement, introduction of rice grading machine, and construction of a warehouse have been planned. However, none of those plans has been materialized due to the dissolution of the union induced by the internal conflict among the union members.

Although such a value chain connecting specific production and consumption areas was not realized, PAPRIZ accessed to the stakeholders of the rice sector engaged in rice production, rice processing, and distribution, which constitutes the whole rice sector, and transferred the technologies in the respective areas. Through the technical guidance, PAPRIZ tried to raise awareness on rice value chain to realize the importance of the value chain establishment. In synergy with other donor's activities in the sector, the rice value chain was built up.

PAPRIZ assisted the rice millers in the Senegal river valley in procuring the rice grading machine. Total of 21 rice millers were supported to procure the rice grading machine, and total annual processing capacity of 21 rice millers shares some 30% of the total milled rice production with 278,000 ton in the valley. It is expected that some 83,000 ton of quality milled rice with few foreign materials and sorted by grain size will be marketed from the valley.

After PAPRIZ started its activity, it became common that rice millers or middlemen purchase high quality paddy rice at higher price. In particular, local perfumed rice is marketed at higher price. Needless to say, it is the reflection of the consumers' market trend that retailed price of rice varies depending on the quality and variety. This trend is expected to be clearer.

The agricultural advisors should learn, in addition to the techniques on productivity enhancement and production cost saving, adjustment of cropping pattern for grain quality improvement and post-harvest techniques for improving efficiency.

4.5 Countermeasure to the Expansion of Dry Season Paddy Production

Rice cropping in the Senegal river valley is largely practiced in two seasons: the rainy season and the dry season. The rainy season rice cropping usually starts in July until August, and ends in November to December. On the other hand the dry season cropping starts in February to March, and ends in June to July. The rainfall concentrates in August and September in the Senegal river valley. In the past the rainy season cropping was regarded as main season, and its area was more than three times as

large as the dry season. However, in recent years, rice cultivated area in the dry season has increased rapidly to be comparable to the area in the rainy season.

While the grain yield of rice is higher in the dry season cropping than in the rainy season cropping because of the higher solar radiation in the dry season, cost of irrigation is much higher in the dry season due to the longer irrigation pump operation time because of little rainfall and of high evapo-transpiration. Also the dry season cropping needs to pay special attention to the respect of cropping calendar so that the harvesting could be made long before the start of the rainy season, which allows farmers to have enough time to dry harvested paddy in the field and to prepare land for the rainy season cropping.

In 1991 and 1992, Spanish International Development Cooperation Agency (AECID) constructed warehouse for paddy at five locations with the total capacity of 8,520 ton in Dagana along the Senegal River. The largest warehouse located in Mbagam has a total storing capacity of 1,150 ton of paddy. As of December 2013, large quantity of paddy was stored for distributing to a large scale rice miller operating at Richard Toll. The need for warehouse to store dry season paddy after harvest is high to avoid rain, the demand for warehouse will increase with the increased production of paddy in the dry season.

During the implementation period of PAPRIZ, it was planned that a paddy warehouse with the total capacity of 1,800 ton would be constructed at Debi-Tiguette. Although the plan was not realized as it was found difficult to construct such a large facility within the framework of JICA's technical cooperation, and as the union of Debi-Tiguette was dissolved, it is deemed necessary to examine the possibility of constructing the warehouse further because the expectation of Japanese ODA in this field is high.

4.6 Sustainable Lending System of ARN

PAPRIZ supported the establishment of ARN as sole organization of rice millers in the Senegal river valley. The ARN will play an important role for coordination among the member millers resulting. With the initial fund of FCFA 44 million raised through the supply of grading machines, ARN embarked on the lending system to the member millers. In November 2013, the first transaction was made as trial for four (4) millers with a total amount of FCFA 2.0 million, of which repayment was already settled without delay. ARN has entrusted these banking transactions to CNCAS. CNCAS is also willing to allot an additional fund for the loan operation to the ARN member millers. It is highly expected that the lending system will help urgent cash arrangement to meet spare parts procurement, staff salaries, electricity bills, etc.

The experience of ARN reminded us significant advantage to keep close linkage with qualified financial service providers in terms of enhancement of the sustainability of newly established lending system. It is also noted that the advices and witnesses of SAED encouraged the coordination between CNCAS and ARN. Although in-depth study and long-term monitoring will be required, the MEC can be introduced to community-based operations in the rural activities and enhanced its

sustainability.

4.7 Function of the Project Office

During the project implementation period, PAPRIZ employed several local staff with different expertise including project management, irrigation development, rice cultivation, rice processing, and agricultural financing, to augment the capacity of the project activities. They assisted the JICA experts in conducting workshops and/or trainings, in carrying out field works and in communicating with the stakeholders in the rice sector and other donor agencies. They also coordinated with SAED for smooth implementation of the project. Their presence greatly enhanced the efficiency of the activities of PAPRIZ, contributing to the achievement of the project purposes.

On the other hand, the capacity of the local staff in their respective fields has been developed through the daily collaborative works with the JICA experts. After the project, those local staffs are expected to find opportunities to work with other development partners or organizations in the rice sector capitalizing on their developed capacity. In a broad sense, it can be said that PAPRIZ contributed to the development of human resources which are conducive to the rice sector development in Senegal.

Chapter 5 Recommendations

5.1 Necessity of Action Plans for Further Development of the Rice Sector

To achieve the target production of local rice of 100 million ton (160 million tone of paddy) by 2018 of the target year of PNAR, SAED continues directing every effort to further development of the rice sector in the Senegal river valley. On the basis of the experiences through PAPRIZ, it is highly recommended to make an in-depth study on the current positions of the rice sector including verification of prevailing constraints, prioritize the necessary measures and prepare the action plans for seven (7) subjects selected within a framework of CARD. It is important that the proposed PAPRIZ 2 will be formulated and justified in line with the study results.

5.2 Improvement of Methodology of Extension Works

The total number of the SAED extension staff is chronically in short in comparison to the total irrigation areas in the Senegal river valley. It is recommended to introduce more demonstration plots located in several irrigation schemes at appropriate density for efficient extension work. Farmers will easily understand through observation of the farming practices recommended in the manual and their direct results on their farm. PAPRIZ prepared the Extension Guide, which provides supplemental advices and information focusing on effective methodologies of farmers' training.

5.3 More Trials of Farmers Participatory Approaches in Irrigation Development in Podor

PAPRIZ introduced the farmers participatory approaches to the selected PIV/PIP in Podor for improvement and repair of the existing irrigation facilities. It must be too early to conclude that this approach is technical and financially viable although encouraging results were obtained under PAPRIZ. More trials and long-term observation are required to modify them to more practical approach to meet local conditions.

It is rational that the construction works even for small facilities are basically sublet to the professional contractors to ensure quality and schedule control. However, farmers should have basic skills for maintenance of own facilities. It is recommended to organize the farmers training program concerned under the responsibility of SAED.

5.4 Promotion of Farm Mechanization

More efforts are required for timely operation of land preparation and harvesting with aid of farm machinery. Rather large-scale farm machineries have been introduced to Dagana, while the farm mechanization in Podor is still operational to limited extent. Land holding size of average farmers as well as size of farm plots is different in both areas. It is recommended to have more technical discussion for selection of mechanized practices especially in Podor.

Intervention of the private investors is encouraged in the rice sector. Careful discussion will be

required how to utilize their business know-how by keeping close linkage with the private sector to expand their service areas in the Senegal river valley toward Podor and Matam.

5.5 Awareness Raising of New Varieties and Distribution of Quality Seeds

In order for the rice farmers in the small irrigation schemes in Podor to raise awareness on new varieties and certified seeds, demonstration plots for introducing various new varieties are better be established within the irrigation schemes. Regular visit to the demonstration plots will be made, and information on the physiological traits of the varieties will also be disseminated to the farmers.

Farmers are expected to be interested in cultivating quality seed of new varieties. If the demand for certified seeds of specific varieties increases in Podor, seed distributors will be motivated to go there to market certified seeds.

5.6 Promotion of the Rice Mill Business in Podor

The total procession capacity of rice mills in Podor are far below their requirement. The average farmers in Podor sell about 20% of the total harvest according to the baseline survey carried out in 2010. It is estimated that the current rice mill requirement amounts at least to 13 units of 1.0 ton/hr to process 10,000 tons of dry paddy in a crop season. According to rapidly increasing paddy production, more rice mills are required in years to come.

Both technical and financial supports will be required for rice millers in Dagana, who are positive in expansion of their service areas to Podor as well as local women and youth groups in Podor, who are willing to embark on the rice mill business. In this regard, it is expected that they will be able to access the lending scheme of ARN.

5.7 Supports to ARN

ARN started the actual operation in November 2013 when the lending scheme became operational. Their activities are still in initial stages. It is recommended to monitor their performance especially of the lending scheme and provide necessary advices for their proper management.

Attachment 1

PDM

Project Design Matrix (PDMe)

Project Title : Project for the Improvement of Productivity in the Irrigation Schemes
Duration of the Project : 4 years, from January 2010
Target Area : Dagana and Podor Departments in the Saint-Louis Region
Pilot Sites : Debi-Tiguette Irrigation Schemes, 12 PIV/PIPs in Podor
Version: preliminary: November 2009, Revised version 01: October 2012 , Revised version PDMe: November 2013

Summary of the Project	Indicators	Means of verification	Assumptions
Overall Objective Improvement of the rice farming productivity and profitability in the Senegal River Valley	• 15% increase in the paddy production in 2018 compared to 2008, in the Senegal River Valley • 20% increase in the incomes of producers in 2018 compared to 2008, in the Senegal River Valley	• The statistical documents of SAED	• The Japanese inputs and activities are carried out as planned within the framework of the Food Security Programme: development of small scale irrigation schemes, dispatch of JOCVs, etc. • The inputs and activities of other donors and Government of Senegal are carried out as planned in the Senegal River Valley • The extension of the Projects' results are carried out
Specific Objective Improvement of rice farming productivity and profitability in the Dagana and Podor Departments	• 15% increase in the paddy production per hectare in the pilot sites • 20% increase in the incomes of rice farmers of the pilot sites • 15% increase in the paddy production in the pilot sites • The number of distributor and distribution volume of local quality milled rice in the main sales area (20% increase in distribution volumes of sorted local rice milled by beneficiary rice millers.) • Quantity of milled rice sold and number of shops selling local quality milled rice (20% increase in quantity of local rice milled by beneficiary rice millers).	• The statistical documents of SAED • Results of the sampled rice farmers follow-up survey	The Rice Self-Sufficiency Policy as part of the Food Security Programme is a priority

Expected results			
1. Establishment of a high productivity rice farming in the pilot sites	• Efficiency of quantities of inputs used in the pilot sites (50% of the farmers in pilot sites) • The number of agricultural advisers using the proposed practical manuals (80% of agricultural advisors trained)	• Reports by the Japanese Experts and counterparts • The statistical documents of SAED	• The stability of the rice production cost with the stability of the price of agricultural inputs. • Security of the pilot area won't be deteriorated. • The Union of Framers' Organisations works well. Twenty two (22) GIE are operational, i.e. 9 GIE of Debi-Tiguette Scheme and 13 GIE of 12 pilot sites in Podor
2. Establishment of appropriate mechanisms for the planning of rehabilitations, management and maintenance in the pilot sites	• Elaboration of the design plans and small-scale irrigation scheme repair and improvement works (Podor 12 pilot sites) • Estimation of the repair and improvement works of small-scale irrigation schemes in Podor (12 pilot sites) • Maintenance and management has been continued after the participatory irrigation repair and improvement works in Pilot areas, and repair and improvement manual for small and large scale irrigation area is prepared based on the contents of the technical transfer. • Evolution of sown areas (100% increase in 12 pilot sites) and fuel utilisation rate of power driven pumps in the pilot sites (20% decrease in fuel consumption per ha in 12 pilot sites) • Utilisation of scheme repair and improvement manuals by engineers of SAED and rice farmers (60% of 22 GIE of the pilot sites)	• Reports by the Japanese Experts and counterparts • The new development plans compared to the formers ones • Record of the pumping station service in the pilot schemes	
3. Implementation of measures to improve the financial management of farmers	• Balance sheets of rice farming activities of producers' organisations and their members in the pilot sites(22 GIE of the pilot sites and 5 farmers for each GIE) • Eligibility and utilisation rates of the credit system by farmers (60% of farmers of the pilot sites)	• Reports by the Japanese Experts and counterparts • The statistical documents of SAED • Service records of the farmers' new micro credit system	
4. Establishment of appropriate distribution channels for quality milled rice that meets the needs of Senegalese consumers	• Number of rice mills sorting rice (100% of beneficiary rice millers) • Number of rice millers using the credit system (available for any of the members of Rice Millers Association.) • Promotion of local rice. • Number of distribution channels created between rice millers and middlemen by promotion activities.	• Reports by the Japanese Experts and counterparts • The statistical documents of ARM	

Activities	Inputs	
1-1. Establishing a rice farming improvement and supervision plan based on the rice farming practical manual elaborated by the Africa Rice Centre (former WARDA) and SAED (National Company for the Development and Exploitation of the Senegal River Delta, Senegal River and Faleme Valley Lands) 1-2. Elaborating an appropriate model for each scheme, which implements a rice farming improvement plan in the following areas with agricultural advisers of SAED: a) Optimising investments in inputs (fertilizers, pesticides, etc.) b) Studying and implementing measures to reduce cultivation and harvest losses 1-3. Building the farm management capacities of producers' organisations in collaboration with agricultural advisers of SAED. 1-4. Building the training capacities of SAED in order to improve farm advisory in the fields mentioned in 1-3. 1-5. Dissemination of the rice farming model in the areas around the pilot schemes by the SAED agricultural advisers. 2-1. Choosing small-scale irrigation schemes as a result of a basic data collection study on the situation of schemes. 2-2. Supporting the planning of the design and execution of rehabilitation works in the former schemes by studying the possibilities of providing profitable and low-cost equipments and making a quantitative assessment 2-3. Carrying out the rehabilitation works of small-scale schemes targeted by SAED in collaboration with JICA based plans mentioned in 2-2 2-4. Carrying out and supporting the elaboration of plans for water management in the Valley irrigation schemes 2-5. Supervising and training the staff members or paid employees of the groupings in charge of the management of pilot schemes in the following fields: a) Water management b) Maintenance of equipments c) Organisational capacity building of groupings 2-6. Monitoring-evaluation of the rehabilitated pilot schemes and water management 2-7. Establishing appropriate models of management and maintenance of equipments in the pilot large-scale and small-scale irrigation schemes. 2-8. Putting in place an extension system for this model and proposing manuals and other extension materials 2-9. Disseminating the management and maintenance model of irrigation schemes located around the pilot schemes based on extension methods and materials mentioned in 2-8.	**Senegalese Side** ➢ Senegalese counterparts 1) Project Coordination (Project Team Leader)/Irrigated Agriculture 2) Rice farming/Improvement of farm management 3) Water management/Rehabilitation works 4) Farmers' Organisation/ Microfinance 5) Milling/post-harvest operations 6) Distribution and marketing 7) Others if necessary ➢ Offices in SAED, DAGANA and PODOR delegations ➢ Participation of agricultural advisers in training sessions ➢ Budget allocation for the project implementation and extension of the results	

Activities	Inputs	
3-1. Carrying out a socio-economic survey on the current situation of the financial management of farms in the pilot sites. 3-2. Supervising and training producers' groupings and their members in the following areas: a) Improvement of the financial management through the market information promotion b) Financial management improvement through the production of financial statements and balance sheets by the Management and Rural Economy Centres of the Valley (known as CGERs) c) Profitability improvement through the production cost rationalization d) Improvement of the access to credit capacity e) Improvement of the input supply and marketing of productions 3-3. Building the capacities of agricultural advisers in the fields specified in 3-2. 3-7. Carrying out the monitoring-evaluation of producers' financial management and credit system 3-9. Taking measures to improve the financial management and credit system and disseminating them in the areas around the pilot schemes 4-1. Supervising and training rice millers in the following areas: a) Improvement of the financial management: The financial statements and balance sheets of the production through the CGERs (Management and Rural Economy Centres) b) Use and maintenance of equipments c) Increase in the annual utilisation rate of machines d) Rice sorting and labelling e) Quality monitoring system 4-2. Providing rice millers, through SAED, with complementary equipments that are suitable for their processing units 4-3. Agreeing with the rice millers' association and SAED about the terms and conditions of the equipment transfer mentioned in 4-2. 4-4. Establishing and starting the pilot credit system meant for rice millers with the counterpart funds mobilized for the allocation of equipments mentioned in 4-2, in collaboration with the existing local financial institutions 4-5. Promoting the local rice sale through: a) Advertisement (awareness-raising campaigns, fairs, etc.), b) Improvement of the packaging and local rice image, c) Building the capacities of organisations in charge of the local rice marketing 4-6. Improving the local rice collection and distribution by carrying out the following actions: a) A study on milled rice financing and marketing channels and role of the different stakeholders: producers and traders b) Improvement of the rice collection and marketing system thanks to an efficient use of information on the rice market. c) Review of rice market system through the rice distribution improvement	**Japanese Side** ➢ Dispatch of Japanese experts 1) Direction/Irrigated Agriculture / 2) Rice farming/Improvement of farm management 3) Water management/Rehabilitation works 4) Farmers' Organisation/ Microfinance 5) Milling/post-harvest operations 6) Distribution and marketing 7) Coordination ➢ Training of the Senegalese staff in Japan ➢ Provision of equipment ➢ Budget allocation to implement the Project	