3.4.6 Evaluation in Basement Rock Areas

Generally, it is important to comprehend the following items for groundwater development in basement rock areas.

- Hydrogeological structure (fault, fracture zone, etc.)
- Deep weathered zone
- Distribution of dikes and veins

Regarding basement rock areas, the groundwater potential division as shown in Table 3-4-6 is analyzed from the relation between geology and the geological structure, and the discharges of existing wells.
Moreover, the region along large and medium size rivers where the sedimentary deposit (Q aquifer) is thickly distributed and has a hydrogeological condition similar to Zone-5 in Table 3-4-5.

Table 3-4-6 Geology and groundwater potential in basement rock areas

Surface geology	Groundwater Potential	
	High	Possible
Cambrian sedimentary rocks	• Distribution of basaltic rocks with faults and fractures • Distribution of pelitic rocks with dense fractures • (Distribution of quartz veins)	• Distribution of faults and fractures • Distribution of quartz veins • The underlying metamorphic rock is the main aquifer around Kidira-Bakel area.
Cambrian volcanic rocks (Andesite)		• Distribution of faults and fractures
Cambrian metamorphic rock (Schist, Quartzite)	• Distribution of basaltic rocks with faults and fractures • (Distribution of quartz veins)	• Distribution of faults and fractures • Distribution of quartz veins
Dolerite	• Distribution of faults and fractures	• Distribution of small faults and fractures
Birrimien（Schist, Quartzite, Greywacke, Conglomerate）	• Distribution of basaltic rocks with faults and fractures • (Distribution of quartz veins）	• Distribution of faults and fractures • Distribution of quartz veins
Cipolins		• Distribution of faults and fractures
Basaltic rocks	• Distribution of faults and fractures	• Distribution of small faults and fractures
Andesitic rocks		• Distribution of faults and fractures
Amphibolite		• Distribution of faults and fractures
Granitic Rocks (excluding the syntectogenic)		• Distribution of faults and fractures • Distribution of quartz veins • Distribution of pegmatite veins
Granitic Rocks (Syntectogenic)	• Deep weathering in coarse granite • Distribution of dikes in coarse granite • Distribution of basic rocks with faults and fractures	• Distribution of faults and fractures • Distribution of quartz veins • Distribution of pegmatite veins

*****

Chapter 4 Basic Policies of Master Plan

This Master Plan establishes a plan for contributing to the improvement of access to safe water supply and sanitation facilities as a countermeasure for addressing the water and sanitation issues in the project area within the framework of the Millennium Drinking Water and Sanitation Program (PEPAM) established to achieve the Millennium Development Goals (OMD) in Senegal. The basic policies of the Master Plan shall be to contribute to improving the rural living environment and fostering human resources by handling water and sanitation as one package in accordance with the policies of PEPAM.

Water Supply

4.1 Outline of Water Supply Master Plan

4.1.1 Scope of Water Supply Master Plan

(1) Target year

PEPAM, an upper-level plan for the water and sanitation sector in Senegal, has a target year of 2015 with no specific target after this year. This Master Plan has a final target year of 2027 and consists of three phases: short term (2011-2015), medium term (2016-2021) and long term (2022-2027). The target year of the short term has been set in view of consistency with PEPAM.

(2) Target water supply facilities

Since the point-source facilities such as shallow wells are mostly secured in the project area, the installation of AE(M)V piped water supply facilities is required as the next step. This Master Plan gives the construction of AE(M)V piped water supply facilities as its main theme.

4.1.2 Content of Water Supply Master Plan

The countermeasures for constructing new water supply facilities aim at improvement of the water supply coverage rate with piped water supply facilities as a priority item. Furthermore, the countermeasures for expanding and repairing the existing water supply facilities position re-digging of deep wells and renovation of the pumping equipment as priority items. (Details are planned for shaded items)

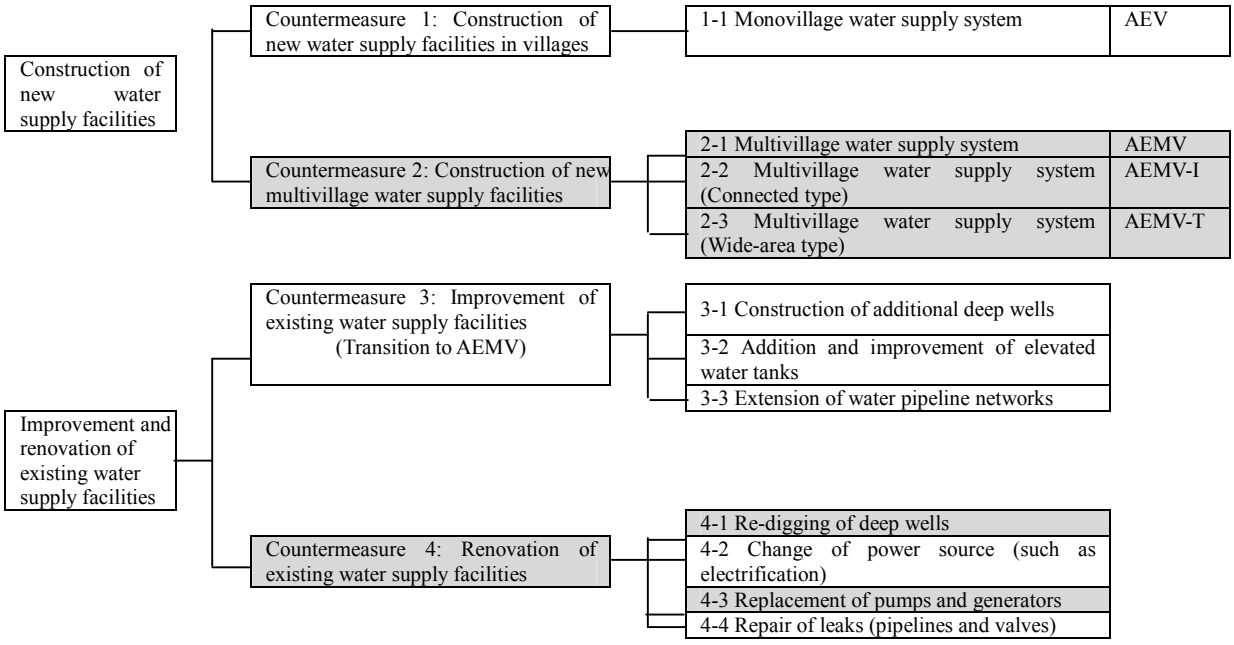


Figure 4-1-1 Structure of countermeasures proposed in the Water Supply Master Plan

4.1.3 Short-term, Medium-term, and Long-term Water Supply Framework

(1) The Short-term Master Plan (2011-2015) aims at increasing the coverage rate of piped water supply facilities, which falls far short of the national average. The villages with top priority are mostly those with a population of 1,000 or less or centers of local economy and administration.
(2) The Medium-term Master Plan (2016-2021) promotes the upgrading of point-source water supply systems using shallow wells to piped water supply facilities using deep wells. The target villages are medium-priority villages currently with an approximate population of 700 to 1000 (which will increase to more than 1,000 at the time of implementation).
(3) The Long-term Master Plan (2022-2027) mainly aims at water supply improvement in low-priority villages with small populations by continuing to construct new facilities, as well as an increase in water consumption and hygiene improvement.
Although the use of water is indispensable for maintenance of public and household sanitary facilities, few are equipped with faucets. Therefore, installation of faucets for hand-washing at sanitary facilities shall be promoted. Furthermore, installation of iron removal equipment for water with high iron content and improvement of water supply services shall also be pursued.

Table 4-1-1 Objective at the Short/Medium/Long/ term

Phase	Up to 2015	2016-2021	2022-2027
Definition	Short term	Medium term	Long term
Major goal	Achieve 82% water supply coverage rate of OMD goals (including concrete lined shallow wells)	・ Transition from shallow wells to piped water supply facilities	・ Improvement of water supply (consumption) amount
Principal theme	・ Raising coverage rate of piped water supply facilities to the national average Tambacounda 48% Kédougou 40% Matam 78%	・ Raising coverage rate of piped water supply facilities to the national average (Continued) Tambacounda 65% Kédougou 55% Matam 86%	・ Improvement of coverage rate of piped water supply facilities Tambacounda 80% Kédougou 65% Matam 90%
Secondary theme	・ Conversion of motorized water supply facilities with limited supply rates to appropriate facilities ・ Improvement of maintenance systems	・ Improvement of maintenance systems (Continued)	・ Increase of water supply rates in bedrock areas ・ Improvement of maintenance systems (Continued) ・ Improvement of water quality
Major plans	・ Construction of new water supply facilities for high beneficiary populations ・ Refunctioning of stopped facilities ・ Changeover to commercial power source	・ Construction of new piped water supply facilities for beneficiary populations of around 1,000 ・ Conversion to use of commercial power source ・ Management transfer of large-scale water supply facilities ・ Private consignment of facility repairs	・ Construction of new piped water supply facilities for beneficiary populations below 1,000 ・ Improvement of sanitary conditions through promotion of water supply projects ・ Installation of iron removal equipment

A water supply facility plan shall be proposed for each region because they have different natural and social conditions, village forms, hydrogeologic conditions, and water supply conditions.

4.2 Basic Policies of Water Supply Plans

As described below, the basic policies of the water supply plans shall conform to the methods adopted by DHR, the implementing agency, and the policies defined by PEPAM.

1) Water supply to households

Population	:	The survey results of RGPH2002*, the census conducted in Senegal, shall be adopted. RGPH: Recensement Général de la Population et de l'Habitat * However, some of the populations in the census are different from the actual figures, and some existing villages are missing from the list. Therefore, the validity of the population data should be verified by field identification before the project implementation.
Population growth rate	:	3.0% * Various national plans and PEPAM have adopted 3.0%. However, it would be more accurate to set the rate for each project and each project area.
Unit water supply ratet	:	35 L per person per day * The unit water supply rate is the WHO recommended value. However, the actual water consumption is 28 L per person per day according to the PEPAM survey results and 21.6 L per person per day according to the survey results in this project. These results show the limitations of the use of public faucets, indicating that the transition to a water supply to each household is required to achieve the recommended value.

2) Water supply for domestic animals (livestock)

Number of domestic animals	:	The population multiplied by 2.57 * Pursuant to the Ministry of Agriculture standard
Growth rate of number of domestic animals	:	2.0% * A growth rate of 2.0% has been conventionally adopted by PEPAM and other donors.
Unit water consumption	:	40L per UBT per day * One UBT (Unité de Bétail Tropical/Unit of Tropical Livestock) means one domestic animal weighing 250 kg.

4.3 Basic Policies of New Installation Plan

4.3.1 Water Supply System

1) Countermeasure 1: AEV monovillage water supply system

AEV refers to piped water supply facilities that supply water to only one village.

2) Countermeasure 2-1: AEMV multivillage water supply system (Adduction d'Eau Multi Villageoise)

AEMV refers to piped water supply facilities that supply water to a central village and surrounding satellite villages. With this system, the greater the population served, the lower the operation and maintenance costs to be borne by the residents.

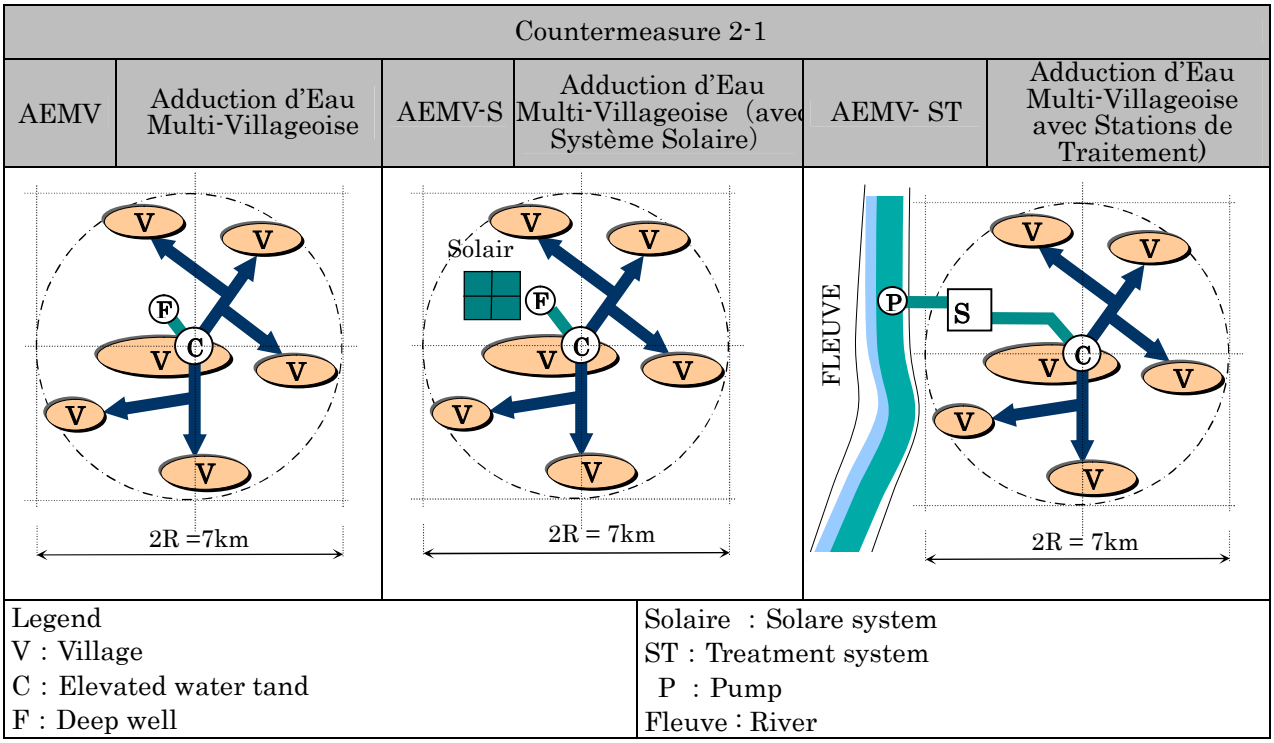


Figure4-3-1 Concept drawing of AEMV

3) Countermeasure 2-2: AEMV-I multivillage water supply system (Connected type)

One of the reasons for the low water supply rate in the project area is that small-scale villages are often dispersed over a wide area. These villages have conventionally been considered to be low priority when constructing water supply facilities. To further improve the water supply rate after the completion of water supply improvements in the large villages, it is necessary to solve the problem of coverage of these small-scale villages with low investment effect.

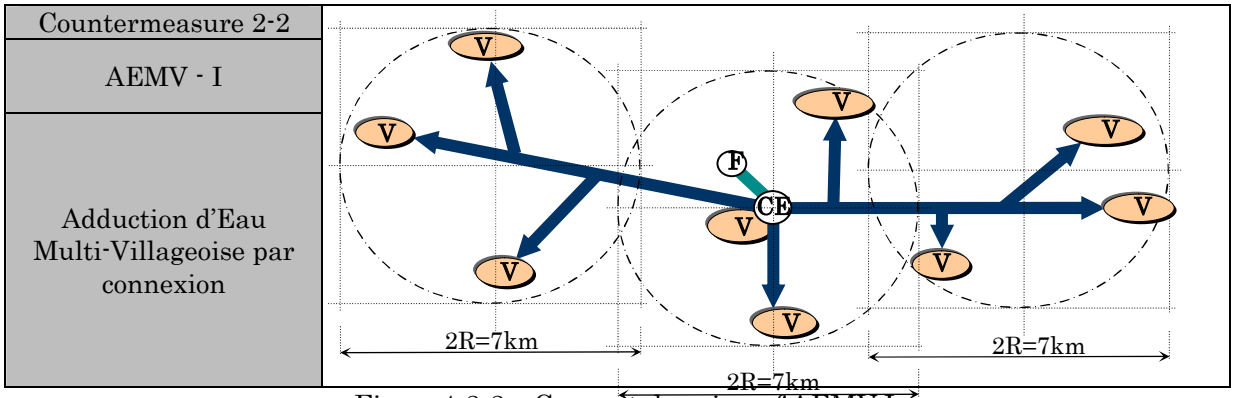


Figure4-3-3 Concept drawing of AEMV-I

4) Countermeasure 2-3: AEMV-T multivillage water supply system (Wide-area type)

AEMV-T is a wide-area water supply system intended to meet the water demands of villages located in bedrock areas with low groundwater storage potential by transferring and distributing water from water sources in areas where abundant water is available. The difference between AEMV-T and AEMV-I is the distance between the water source (F) and elevated water tank (CE). In AEMV-I, the water source and the elevated water tank are close to each other, and the distribution pipe is longer than a conventional AEMV. In AEMV-T, the distance from the water source to the elevated water tank is 15 to 20 km, and a booster pump needs to be installed along the way.

As for the topographical conditions, the border area between the bedrock area and the sedimentary layer area has a higher altitude than the surrounding area. If a distribution reservoir is built in this border area, water from a water source in the sedimentary layer area can be transported to the water tank and then distributed by gravity flow to the bedrock area. The sedimentary layer area with the water source is 10 to 15 km from a suitable site for the distribution reservoir.

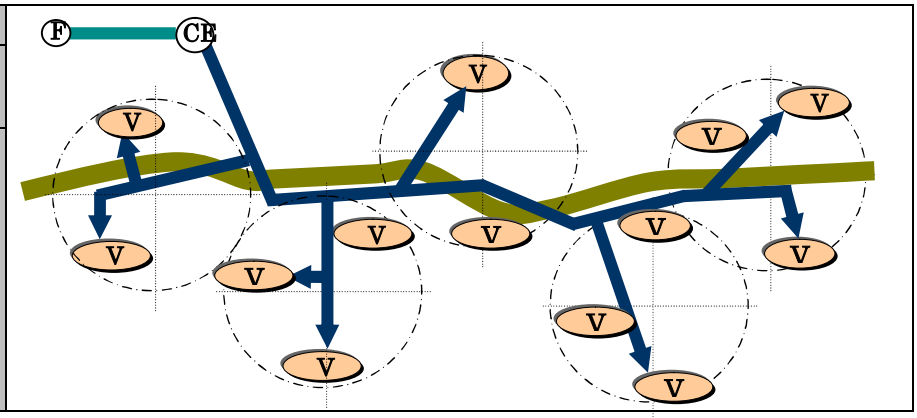
Countermeasure 2-3	
AEMV-T	
L'Adduction d'Eau Multi-Villageoise sur des zones de grande étendue	

Figure4-3-4 Concept draing of AEMV-T

4.3.2 Technical Option for Piped Water Supply Facilities to Address Individual Issues concerning Water Supply in Project Area

A common system used to supply water to villages in Senegal uses groundwater as the water source and pumps up water by a motorized pump power by a generator. However, since some villages in the project area have low groundwater potential, surface water needs to be used as the water source or, if located in a remote region, they have difficulty procuring fuel and must pay a large sum for operation of the water supply system using a diesel generator. The alternatives for these villages are water-purification facilities using surface water (AEMV-ST) and solar-powered facilities (AEMV-Solaire). In an area where the iron content of groundwater is 2 to 4 mg per liter, iron removal equipment may be installed in managed water supply facilities in order to improve the water quality.

Although the use of iron removal equipment can improve water quality, operation and maintenance of the equipment requires time and effort so first it needs to be used on a trial basis. Therefore, it shall be considered as a long-term goal, and only the construction costs of the facilities shall be examined in the Feasibility Study.

4.4 Basic Policies of Renovation Plan

The existing facilities that are currently stopped, as seen by their early construction dates, are located in villages that are local centers with high priority for water supply improvement. Since their importance is unchanged, prompt renovation of the facilities is required. To improve the rate of access to safe water with limited investment, it is more effective to renovate and/or expand the existing facilities than to rebuild all the constituting facilities as long as there is no problem with durability.

A piped water supply facility consists of a deep well, pumping equipment, machinery room, water tank, buried piping, public faucets, livestock watering troughs, and vehicle watering stations. The main aims of this Master Plan are re-digging of deep wells which is the main cause for stoppage of facility operations, and renovation of pumping equipment.

4.5 Outline of Region-by-Region Water Supply Frameworks

4.5.1 Tambacounda Region

Tambacounda Region, extending 400 km east-west and 200 km north-south, has different hydrogeologic and social conditions in the north and south and in the east and west, for which different points must be noted in the water supply plans. The Operations and Maintenance Bureau, which is in charge of a large area, has two branch offices in Tambacounda and Goudiry.

In this region, AE(M)V has not been installed even in villages where village community office buildings are located or in large-scale villages. The construction of AE(M)V is required in the entire region.

(1) Framework

1) Construction

The construction of new facilities with single boreholes shall be promoted to increase the beneficiary population. Although the sedimentary rock area has no restrictions on water sources, a bedrock area imposes the prerequisite that more than one well must be used. Therefore, test drillings of additional water sources shall be conducted at the implementation stage to secure water sources. Regarding the water conveyance facilities from outside to the bedrock area, water conveyance between Goudiry and Kidira and to Bema with its high concentration of villages shall be examined.

2) Renovation

Many facilities have stopped supplying water. Renovation shall be conducted as a short-term goal in order to match the substantial water supply rate with the nominal rate and in consideration of the private consignment of repairs scheduled for the future. An urgent response is required particularly for stoppage of the water supply due to damage of the superannuated wells themselves, which is seen in local-center villages.

Table 4-6-1 Master Plan Framework for Tambacounda Region

	Cadre temporel	Plan à court terme (2011-2015)					Plan à moyen terme (2016-2021)						Plan à long terme (2022-2027)					
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6
	Mesures pour atteindre les objectifs	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	Objectifs du PEPAM	atteindre un taux de desserte en eau potable de 82% .					Non fixé						Non fixé					
	Objectifs proposés - nouvelles constructions	Remonter le niveau national du taux d approvisionnement en eau par la pose de conduites					Passage d'un puits peu profond a un ouvrage AE(M)V						Améliorer la quantité d'eau desservie (consommée)					
	Objectifs proposés Réhabilitations	Alignement des taux de fonctionnement réel et nominal					Vers des ouvrages ou le transfert de l'exploitation, et la délégation des réparations au secteur prive est possible						Vers une alimentation par branchements particuliers					
Plan de nouvelles constructions																		
1-1	Ttaux de diffusion des AE(M)V à 48 %	Construction de 47 ouvrages																
Dito	Station de traitement des eaux de surface	Koungany, Golmi,Yafera 3ouvrages																
1-2	Taux de diffusion des AE(M)V à 65%						Construction de 62 ouvrages hydrauliques											
Dito	Plan d'alimentation en zone étendue par transport d' eau sur longue distance						Goudiry-NE		Bakel SE									
1-3	Taux de diffusion des AE(M)V à 75%												Construction de 82 ouvrages hydrauliques					
Plan de réhabilitation																		
2-1	Reconstruction des forages à l'arrêt	4ouv.	4ouv.	4ouv.	4ouv.	2ouv.												
2-2	Remise en marche des ouvrages à l'arrêt (problèmes hors forage)	4ouv.	2ouv.	2ouv.														
2-3	Transfert de l'opération des ouvrages grande envergure						Kidira, Koumpentoum,Goudiry,Koussanar 4 ouvrages											
2-4	Paquet de soutien pour la concession de la gestion et maintenance au secteur privé																	
2-5	Soutien au transfert aux ASUFOR																	
2-6	Promotion de l'utilisation du réseau électrique	15ouv.																
2-7	Promotion des robinets de branchements particuliers																	
2-8	Mise en place d'un dispositif de déferrisation																	
Coopération technique																		
3-1	Appui l'établissement de la système de la maintenance PMH		en cours par UEMOA															
3-2	Evaluation de la maintenance PMH et projet pour soutien system																	
3-3	Ouverture du boutique pour le pièce de PMH		A Kidira, Bakel, Sadatou (3 villages) distance est moins de 100km de toutes villages															
Situation du soutien des bailleurs																		
Décidé	PEPAM-BAD																	
Décidé	PEPAM-IDA																	
Décidé	UEMOA 2																	
Décidé	PAISD																	

4.5.2 Matam Region

(1) Local characteristics of the region

The social conditions vary greatly between 1) the area from the national road to the Senegal River and 2) the Ferlo area in the western part of the region, with significant disparities in the infrastructures.

Although the coverage rate of piped water supply facilities is at the national average, the western part has a lower coverage rate and is an area where the construction of new facilities needs to be given priority. Although medium- and large-scale villages are concentrated along the national road, groundwater cannot be secured due to bedrock areas in some of the villages, for which one possible solution is water conveyance from sedimentary layer areas. Since there are five large-scale villages with populations of 3000 to 4000, transfer to operation by SDE is required.

(2) Framework

1) Construction

The construction of new facilities using single boreholes shall be promoted to increase the beneficiary population. However, appropriate facilities shall be examined for villages with large populations such as those along the national road. Although a sedimentary rock area has no restrictions on water sources, a bedrock area imposes the prerequisite that more than one well must be used. Regarding the water conveyance facilities from outside to the bedrock area, the southern part of Bonji with its high concentration of villages shall be examined. One facility at this site will solve the water supply in the bedrock area of Matam Region.

Implementation along the national road can be mostly completed in the first half of the short-term plan, and the focal area for project implementation can be moved to Ferlo.

2) Renovation

The demand for renovation is potentially high because all the existing facilities except a few are superannuated. Due to the small number of facilities, each facility has a large beneficiary range, and the failure of a facility has significant impact. Being located in the most remote area from the operation and management headquarters, this area will significantly benefit from the private consignment of operation and management scheduled for the future. Due to the current small number of facilities, the need for renovation has not been aggravated but will constitute a major issue in the medium-term plan or later when the construction of facilities progresses in Ferlo which is located inland.

Many of the facilities along the national road were constructed a long time ago. For superannuated facilities, it is necessary to renovate the deep wells, elevated water tanks, machinery rooms, and buried piping in stages. In this case, an effective means of cutting the operation and management costs will be to move the elevated tanks to higher places and thus include the inland villages in the beneficiary area.

In the south-western part of Matam Region is an area called Ferlo where nomads practice transhumance for their living. Whereas the villages in this area have small populations and the concentration of villages is low due to their scattered locations, the number of domestic animals is larger than in any other area. Since this area has a relatively low water supply coverage rate in the project area, domestic animals and people are concentrated at a few water supply facilities, resulting in an insufficient number of watering places for domestic animals and water supply points. Therefore, the basic policy of renovation of the existing facilities shall be to increase livestock watering troughs and vehicle watering stations.

Table 4-6-2 Master Plan Framework for Matam Region

	Cadre temporel	Plan à court terme (2011-2015)					Plan à moyen terme (2016-2021)						Plan à long terme (2022-2027)					
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6
	Mesures pour atteindre les objectifs	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	Objectifs du PEPAM	atteindre un taux de desserte en eau potable de 82% .					Non fixé						Non fixé					
	Objectifs proposés - nouvelles constructions	Remonter le niveau national du taux d approvisionnement en eau par la pose de conduites					Passage d'un puits peu profond a un ouvrage AE(M)V						Améliorer la quantité d'eau desservie (consommée)					
	Objectifs proposés Réhabilitations	Alignement des taux de fonctionnement réel et nominal					Vers des ouvrages ou le transfert de l'exploitation, et la délégation des réparations au secteur prive est possible						Vers une alimentation par branchements particuliers					
Plan de nouvelles constructions																		
1-1	Amélioration du taux de diffusion des AE(M)V à 78%	Construction de 25 ouvrages (groupe de 30 villages ciblés)																
1-1	AEMV-T						Bakel SO											
1-2	Amélioration du taux de diffusion des AE(M)V à 86%						Construction de 26 ouvrages hydrauliques											
1-3	Amélioration du taux de diffusion des AE(M)V à 90%												Construction de 28 ouvrages hydrauliques					
	Station de traitement des eaux de surface	Koungany, Golmi,Yafera																
Plan de réhabilitation et soutien technique																		
2-1	Reconstruction des forages des ouvrages à l'arrêt		1 ouv.															
2-2	Remise en marche des ouvrages à l'arrêt (problèmes hors forage)	3 ouv.	3 ouv.	1 ouv.														
2-3	Transfert de l'opérations des ouvrages grande envergure						Ourosougui,Kanel,Boki Diave.Orkadiere.Orefonde.Dembankane											
2-4	Paquet de soutien pour la concession de la gestion et maintenance au secteur privé																	
2-5	Soutien pour le transfert aux ASUFOR																	
2-6	Promotion de l'utilisation du réseau électrique commercial	17 ouv.																
2-7	Promotion des robinets de branchements particuliers						Ouvrage long de la route nationale											
2-8	Mise en place d'un dispositif de désertisation												Dans CR Sinthou Bamanbe 、CR AOURE					
Coopération technique																		
3-1	Appui l'établissement de la système de la maintenance PMH	en cours par UEMOA																
3-2	Evaluation de la maintenance PMH et projet pour soutien system																	
Situation du soutien des bailleurs																		
Décidé	PEPAM-IDA																	

4.5.3 Kédougou Region

(1) Local characteristics of the region

Being in a bedrock area, the wells generally have low pumping discharges of 1 to 3 m^3/h. Therefore, PMH plays a central role in the water supply facilities. Since many of the handpumps are left unrepaired, PEPTAC2 fostered pump menders and invited companies to open spare parts shops to improve the situation. Until this system becomes fully operational, continued support will be necessary.

Although motorized pumps have been installed in major villages, the majority of the water tanks are ground tanks constructed in the 1980s. Even where there is an elevated water tank, the network of distribution pipes is poor and the water supply system itself needs to be radically reviewed. There are three or four villages in each CR for which piped water supply facilities are appropriate in terms of the village scale, but there is no construction plan at present. Therefore, this project aims towards construction and renovation of pipeline-based facilities. Due to limitations in pumping discharges of wells, the water supply systems must be examined at the detailed design phase in consideration of the fact that there will be villages that need to be installed with PMHs. Since there are large undulations in the topographic features, accurate measurements through surveys and hydrologic accountings will be required for pipe routings.

Moreover, in Medina Baffe and other village communities, water with high iron concentration is found and therefore must be improved using iron removal equipment.

(2) Framework

1) Construction

In this region, population concentration is progressing in local-center villages, making it appropriate to construct piped facilities. The construction of new facilities using single deep wells is promoted to increase the beneficiary population. At the time of construction, it is essential to check the relationship between the water sources, topographic features, and ethnic groups in the target village groups. In the target villages for the medium term and thereafter, the project promotion will take into consideration the findings of the short-term facilities plan and ASUFOR diffusion. Furthermore, it is considered a prerequisite to increase the number of facilities in the region for the introduction of private consignment, and a coverage rate that keeps pace with Tambacounda Region has been set as the goal.

2) Renovation

There are a few facilities, most of which are point-source facilities, that were built more than 20 years ago. In the case of renovation of the existing water supply facilities in areas with sufficient pumping discharges and a populations over 500, the basic policy shall be to examine upgrading to piped water supply facilities and construction of elevated water tanks with pillars 20 m or taller to expand the water supply area. Since the water supply quantity is small, the use of solar-powered water supply facilities shall be examined.

Since the operation and maintenance system of handpumps is far from being established, continued support for enhancing management/operation and maintenance is required.

Table 4-6-3 Master Plan Framework for Kedougou Region

	Cadre temporel	Plan à court terme (2011-2015)					Plan à moyen terme (2016-2021)						Plan à long terme (2022-2027)					
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6
	Mesures pour atteindre les objectifs	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	Objectifs du PEPAM	atteindre un taux de desserte en eau potable de 82% .					Non fixé						Non fixé					
	Objectifs proposés - nouvelles constructions	Remonter le niveau national du taux d approvisionnement en eau par la pose de conduites					Passage d'un puits peu profond a un ouvrage AE(M)V						Améliorer la quantité d'eau desservie (consommée)					
	Objectifs proposés Réhabilitations	Alignement des taux de fonctionnement réel et nominal					Vers des ouvrages ou le transfert de l'exploitation, et la délégation des réparations au secteur prive est possible						Vers une alimentation par branchements particuliers					
Plan de nouvelles constructions																		
1-1	Amélioration du taux de diffusion des AE(M)V à 40%	Construction de13 ouvrages																
1-2	Amélioration du taux de diffusion des AE(M)V à 55%						Construction de 10 ouvrages hydrauliques											
1-3	Amélioration du taux de diffusion des AE(M)V à 65%												Construction de 11 ouvrages hydrauliques					
	Projet de construction avec PMH																	
	Station de traitement des eaux de surface										En cas de croissance démographique							
Plan de réhabilitation																		
2-1	Reconstruction des forages à l'arrêt	Pas d'ouvrage correspondant																
2-2	Remise en marche des ouvrages à l'arrêt (problèmes hors forage)		3 ouv.	2 ouv.														
2-3	Transfert de l'exploitation des ouvrages grande envergure	Pas d'ouvrage correspondant																
2-4	Paquet de soutien pour la délégation de la gestion et maintenance au secteur privé																	
2-5	Soutien pour le transfert aux ASUFOR																	
2-6	Promotion de l'utilisation du réseau électrique commercial		4 ouv.															
2-7	Promotion des branchements particuliers	Pas d'ouvrage correspondant																
2-8	Mise en place de dispositif de déferrisation (CR Medina Baffe)																	
Coopération technique																		
3-1	Appui l'établissement de la système de la maintenance PMH		en cours par UEMOA															
3-2	Evaluation de la maintenance PMH et projet pour soutien system																	
3-3	Ouverture du boutique pour le pièce de PMH		Slemata, Saraya (une boutique par département)															

4.6 Basic Policies for Operation and Maintenance

Currently, water supply facilities are operated and maintained by water comity or ASUFORs, the associations for water facility users. Water comities are being transformed to the ASUFORs. In general, the piped water supply facilities have the structure shown in Figure 4-6-1 below.

In this M/P, it should be determined that the above ASUFORs will continue to take responsibility for operation as the basis of the operation and maintenance system for water supply facilities and it should be the policy to support the establishment of ASUFOR associations and enhancement of their operational capabilities.

Meanwhile, water-related facilities such as AEMV-T, AEMV-ST and iron removal equipment proposed in this M/P have not often been introduced in rural water supply facilities projects in Senegal and although ASUFORs will be the primary body responsible for operation and maintenance, when the required level of technology and efficient operation of the water supply systems are taken into account, it is desirable to use outside resources with adequate expertise to operate and maintain such facilities. In Senegal, a policy has been drawn up to promote contracting of water facility operation and maintenance to the private sector and, therefore, in accordance with this policy, in the following section, an operation and maintenance model for AEMV-T and AEMV-ST proposed in this M/P is reviewed.

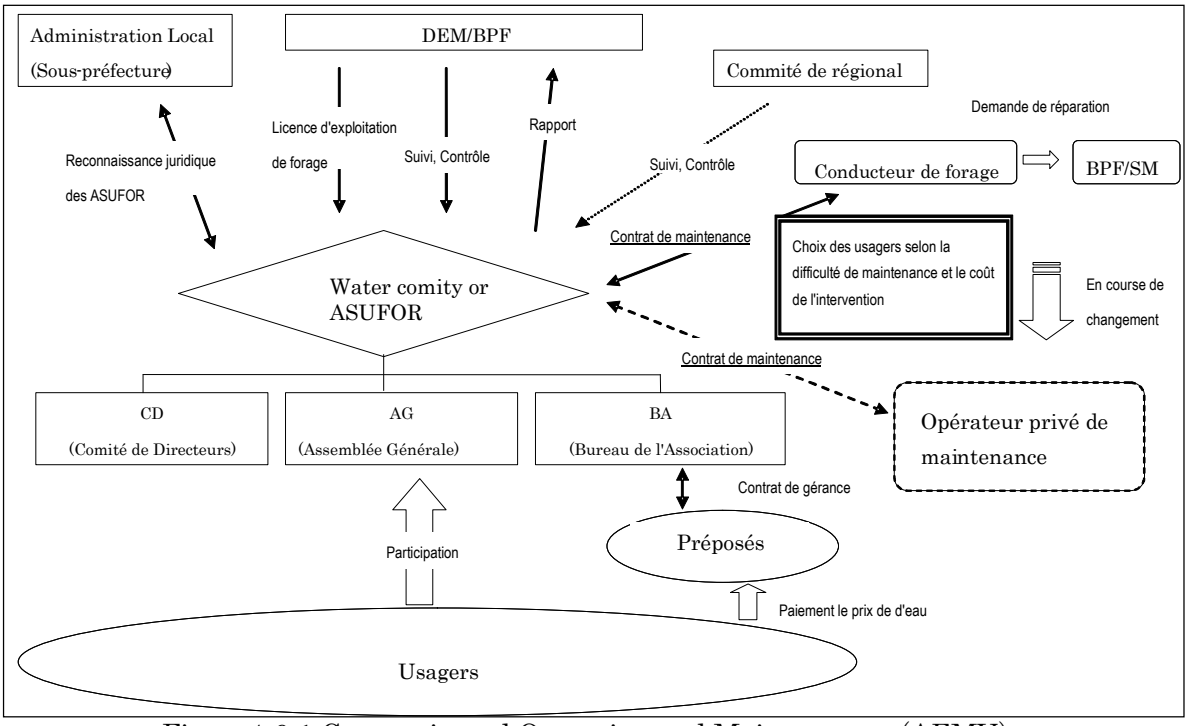


Figure4-6-1 Conventionnal Operation and Maintenance（AEMV）

For operation and maintenance of the water supply facilities, the following two options are possible: An individual from the village can be selected by Water comity or ASUFOR as the operator of the facilities, or a private company can be contracted to do the work. It will be reasonable to hold discussions with the water users in a comprehensive manner concerning expected technical difficulties in the operation and maintenance of the facilities, the knowledge level of the villagers and the payment to be made to the selected private company, before making a decision.

4.6.1 Factors to be Reviewed concerning the Option to Utilize the Private Sector for Operation and Maintenance

The following three factors were reviewed:

(1) Local resources to which operation and maintenance can be contracted

1) Employment of the services of large companies
Since there are concerns about employing local private companies that are not stable in terms of financial means or facility operation, the services of large companies should be employed for operation and maintenance of the water supply facilities as the principal contractor and the actual work should be subcontracted to private companies in rural areas. In this case, it is expected that a certain level of quality can be ensured in their services, while it is also expected that the water comity and the ASUFORs will offer resistance to this arrangement because the indirect costs will be higher than adopting other measures.

2) Local private companies
At present, minor repair works and construction works for a door-to-door water supply are conducted by local private companies in each region. If local administrative bodies introduce a certification system in order to maintain the quality at a certain level and local residents are able to confirm the private companies' reliability, the above-mentioned arrangement will be possible. If operation of the entire water supply system is contracted out, the contractors will be required to have management capabilities in addition to capabilities to conduct repair works. It will also be possible for companies with adequate management capabilities to undertake the work jointly with other companies who are capable of doing repair works.

(2) Establishment of the required maintenance level for water supply facilities

As shown in the table below, works related to maintenance of the water supply facilities were classified broadly into three levels and a comparison was made between the current status and a desirable framework for the future: 1) operation and daily maintenance and inspection of facilities; 2) regular inspection and small to medium-scale repair works; and 3) large-scale repair works requiring demounting of pumps.

Table 4-7-1 Maintenance levels for water supply facilities

Maintenance level	Current status	Body that will conduct the work	Conditions for the plan to be realized
Operation of facilities (pumping operation, examination, water fee collection, accounting, etc.) and daily maintenance and inspection	Conducted by Water comity or ASUFOR	Facilities operators, water fee collectors and accountants appointed by Water comity or ASUFOR or dispatched from private company	Possible
Regular inspection and small to medium-scale repair works	Conducted by BPF and small local companies	Local small or medium-size private companies	Currently some works are contracted to small or medium-size private companies but there are problems with their work quality. Therefore, it is necessary to introduce a certification system to confirm the quality of contractors' performance.
Large-scale repair works	Conducted by SM	Rural or urban private companies. However, the works also need to be conducted by BPF and SM before the transition is completed.	A policy will be established when private companies' capabilities to perform the works are confirmed based on the results of contracted works implemented earlier in central Senegal.

(3) Breakdown of operation and maintenance costs

The fixed costs for operation and maintenance of the facilities were estimated based on the calculations obtained in PEPTAC1. If the daily water supply is assumed to be 300m^3/day and the water fee is 400FCFA/m^3, water fee revenues will be 3.6 million FCFA/month maximum. Since the payment for the operation contract is estimated to be 3.33 million FCFA/month, it will almost balance with the above estimated revenues. However, in addition to the above, there will be costs for maintenance and renewal and payment to the water faucet operators, which will result in a negative balance, and it can be said that it will be difficult in terms of cost to contract out operation of the water supply facilities to private companies in this rural water supply project.

4.6.2 Proposition on Operation and Maintenance of Water Supply Facilities

(1) Multivillage water supply system (wide-area type)

ASUFORs should be responsible for operation; operators dispatched from private companies should be responsible for maintenance and inspection of the facilities; and private companies, under contract, should be responsible for repair works.

The water supply service will cover an area approximately 40km x 40km and each of the water supply facilities will typically have a deep well, an elevated water tank with a height of 20-25m, multiple public water faucets and an underground pipeline network. Since there will be about 8,000 beneficiaries, each of the facilities will have a scale several times that of a typical multivillage water supply system (AEMV). In addition, as the facilities will have a number of public water faucets and a far-reaching pipeline network, the target area should be divided into subareas in actual operation.

Although the system operation should be the responsibility of ASUFORs, works related to operation

of the pumping equipment and repair works should be contracted to private companies in order to operate such a large-scale water supply system appropriately.

(2) Surface water purification facilities (Since iron removal equipment have similar features, they should be operated in a similar manner.)
In the proposed system, ASUFORs should be responsible for general and daily operation of the facilities and maintenance and inspection works, and private companies should, under contract, be responsible for repair works.

In Gorom Lampsar, located in the lower reaches of the Senegal River, surface water purification facilities are used to supply water to local rural areas. Currently, 10 years after its construction, the facilities are still operated by ASUFOR, while repair works are outsourced. Because this area has similar features to those assumed to be found in the target area of this project in terms of facility conformation and village environment, a similar arrangement for operating the water supply facilities can be applied.

(3) Solar-powered pumping facilities
ASUFORs should be responsible for operation; operators dispatched from private companies should be responsible for daily maintenance and inspection; and private companies, under contract, should be responsible for repair works.

In another project related to solar-powered pumping facilities in the target area, PRS, a maintenance agreement on solar-powered pumping equipment has been concluded between a private company and 80 ASUFORs. To date, there has been no problem arising from the arrangement, such as nonpayment by the ASUFORs.
Currently, there are not many solar-powered pumping facilities in Tambacounda and Kédougou Regions, except for Bakel Department, and, therefore, no maintenance agreement has been concluded with any private company, and as a result, broken-down facilities have not been repaired near the city of Tambacounda. Few maintenance problems will occur if a system similar to that employed in PRS is applied in this project so that works can be contracted to private companies.

4.6.3 Scenario for Introduction of Highly Feasible Private Sector Contracting Process

It is possible to use dispatched operators or to contract small and medium-scale repair works to local private companies by promoting the introduction of a certification system. Meanwhile, since it will be difficult to immediately find appropriate local private companies capable of performing large-scale repair works, the operation and management headquarters should continue to perform the works and a review should be made in order to draw up an appropriate policy by monitoring developments in the central area where the project has been implemented earlier. In addition, in PEPTAC-1 and REGEFOR, it was indicated that, in order to ensure profits for private companies, works for 45-60 target facilities should be consolidated into one contract to a private company so that the company exclusively performs the works. In the target area of this project, the number of wide-area water supply facilities or surface water use facilities, to which the contracting process will be employed prior to other facilities, will not be large enough to allow private companies to achieve the merits of performing the works exclusively. Therefore, it will be reasonable to contract the works to local companies that already have ensured profits from their regular business.

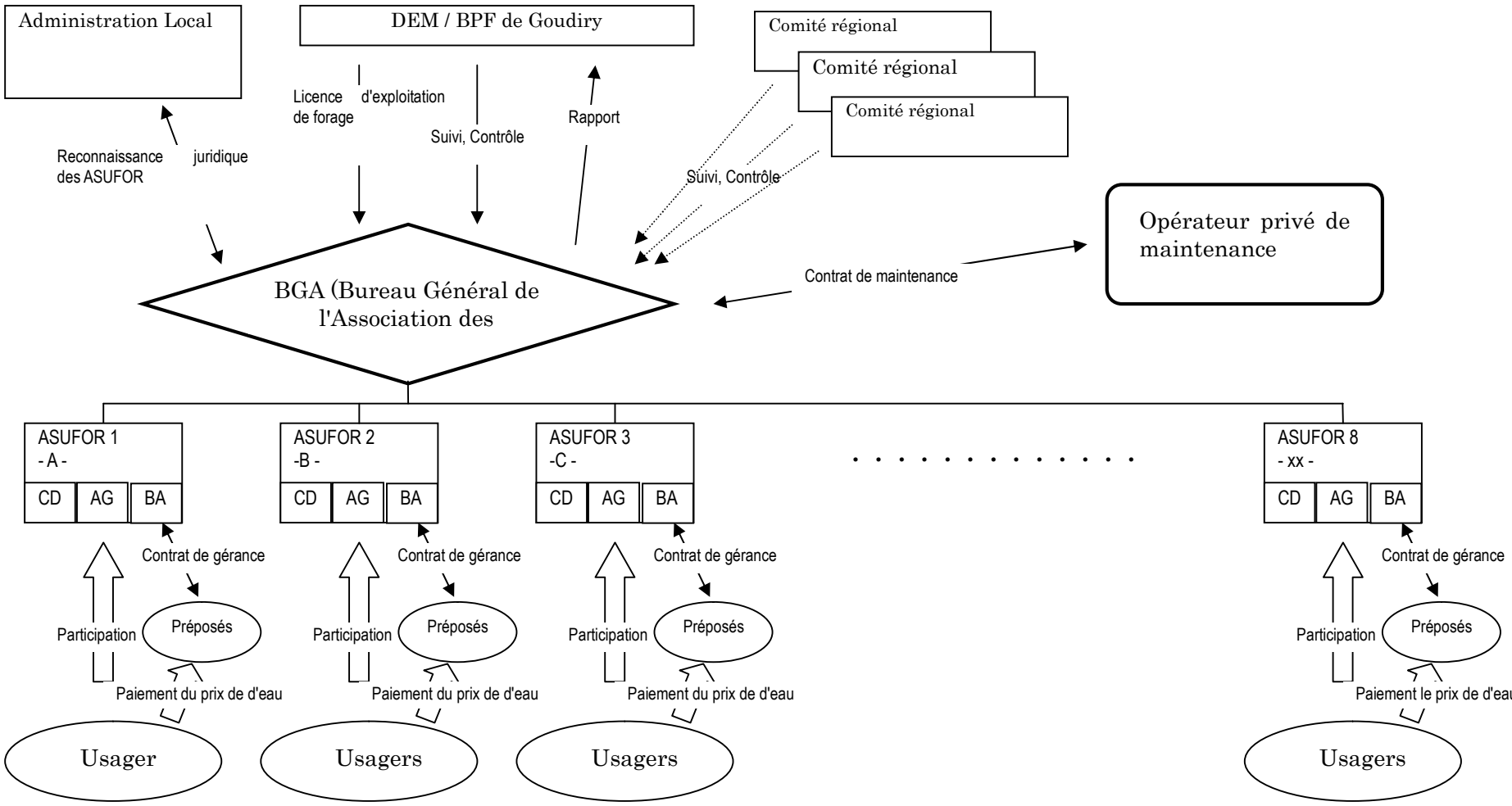


Figure4-6-2 Operation and Maintenance for Private Contract Type (Multivillage water supply system of wide-area type AEMV-T)

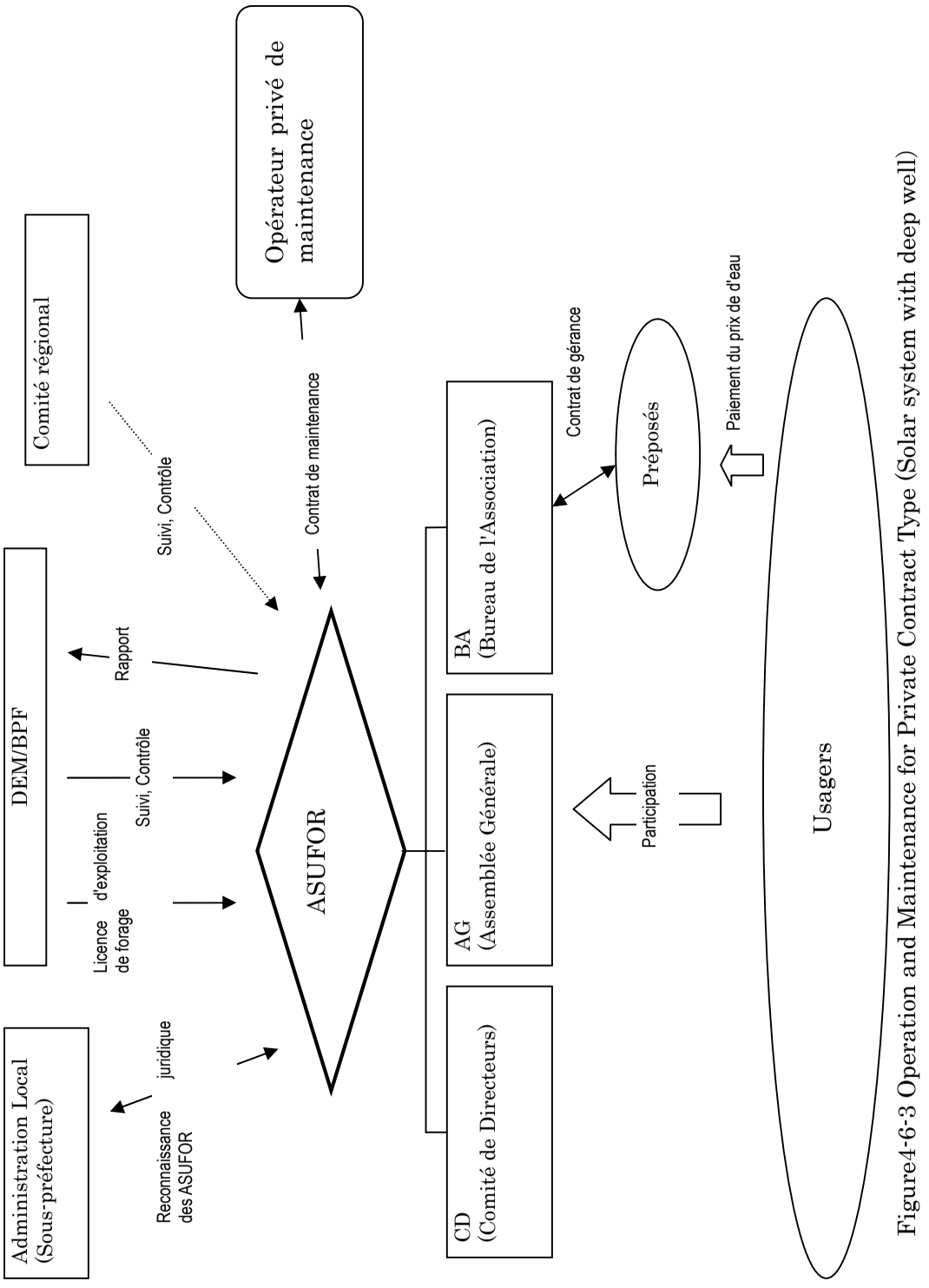


Figure4-6-3 Operation and Maintenance for Private Contract Type (Solar system with deep well)

Sanitation

4.7 Summary of Sanitation Master Plan

4.7.1 Scope of Sanitation Master Plan

In this Master Plan, it was decided to establish a policy to improve the access rate to improved individual sanitation facilities as part of the sanitation project package for rural areas as recommended in the PEPAM framework.

In PEPAM, the technical options for improved water supply facilities and sanitation facilities were categorized as shown below. The rate of access to sanitation facilities was defined using the number of residents who will have access to "improved sanitation facilities" shown in Table 4-7-1 below.

Table 4-7-1 Classification of improved and unimproved water supply facilities and sanitation facilities[1]

	Improved facilities	Unimproved facilities
Water supply system	・ Water supply to individual households through house connections ・ Public water faucets ・ Deep wells with handpumps ・ Protected (improved) shallow wells ・ Protected springs ・ Rainwater harvesters	・ Unprotected shallow wells ・ Unprotected springs ・ Purchase from water vendors ・ Bottled water (unprotected and unprocessed)* ・ Unprocessed water supplied directly from water tankers
	Improved facilities	Unimproved facilities
Sanitation facilities	・ Sewerage pipelines connected to public sewerage lines ・ Wastewater treatment facilities connected to septic tanks ・ Flush toilets ・ Dry system toilets ・ VIP toilets with ventilation	・ Human waste tub toilets** ・ Unprotected open pit toilets ・ Public lavatories using the above systems

* Categorized as unimproved facilities because of poor quality and insufficient quantity.

** Human waste is collected in tubs or buckets and thrown away by manual labor.

In addition, in this project, the specifications of the improved sanitation facilities were categorized as shown in Table 4-7-2 below.[2]

Table 4-7-2 Specifications of sanitation facilities in PEPAM

1. Urban public sanitation facilities (Assainissement Collectif) Sewerage pipeline is connected to each household. Composed of a pipeline to dispose wastewater, removal facilities and water purification facilities.
2. Individual sanitation facilities (Assainissement autonom/sur site) i. Household sanitation facilities (Assainissement Individual) Household toilets and rainwater/wastewater treatment facilities • Desirable facilities for urban household sanitation: Combination-type septic tanks, toilets with ventilated decomposition tanks or flush toilets, wastewater treatment facilities connected to septic tanks, combined wastewater treatment facilities connected to decomposition tanks

[1]Source: "Elaboration d'un document de stratégie pour la réalisation à l'horizon 2015 des objectifs du millénaire pour le développement, Volume 1: ETAT DES LIEUX Rapport définitive," p46; Translated into Japanesethen into English by the survey team.
Obtained in October 2008 and used as a source for the Progress Report 2. In the new version, translation was performed again in order to make changes in word usage. (In the previous version, "traditionnelle (traditional)" was used but the word was changed to "non-amélioré (unimproved)" or "Non protégé (unprotected)" and also notes were added.)
[2]Source: "Elaboration d'un document de stratégie pour la réalisation à l'horizon 2015 des objectifs du millénaire pour le développement, Volume 1: ETAT DES LIEUX Rapport définitive"

• Desirable facilities for rural household sanitation: Improved ventilated toilets or flush toilets, or promotion of wastewater treatment facilities (decomposition tanks/septic tanks) ii. Public sanitation facilities (Assainissement des zones publiques) Toilets in public areas where there is a large volume of human traffic (markets, hospitals, schools, religious institutions, roadside stations, etc.) and rainwater/wastewater treatment facilities
3. Autonomous public sanitation facilities (Assainissement Semi-Collectif) These are facilities to collect both human waste and domestic wastewater for treatment using small-scale treatment facilities such as a small-diameter underground pipelines and decomposition tanks or septic tanks. These facilities are conditional on autonomous operation by their owners (community or village).

4.7.2 Targeted Goals

This rural sanitation master plan applies the study's basic policy so that consideration on rural sanitation programme implementation always accompanies with water supply project. And this principle makes contents of the project established in this Master Plan are divided in to three phase as short term (2010-2015), middle term(2016-2021), and long term (2022-2027) as well as the goals are defined uniformly for the 3 phases as shown in Table 4-7-3 below. In this sanitation development component of Master Plan, those three regions treated as the same condition and applied 3.7% of annual increase rate in whole target area.

Table 4-7-3 Goals for sanitary environment improvement in target areas

Period Region	Target year 2015 Short term	Target year 2021 Middle term	Target year 2027 Long term
National revel	63%	81%	91%
Tambacounda	60%	80%	90%
Kédougou	55%	77%	88%
Matam	56%	78%	89%

source : PEPAM-UC/DAR/JICA

4.7.3 Contents of Sanitation Master Plan

The proposed sanitation master plan is composed of three elements: 1) construction of sanitation facilities; 2) proper application of the sanitation concept and health and sanitation knowledge; and 3) establishment of a sustainable operation system in the village. The entire system will be called the rural sanitation system and plans will be made combining the following components.
The minimum unit applied in this planning process is the village.

Table 4-7-4 Components of rural sanitation system

Component 1	Construction of household/public sanitation facilities
Component 2	Activities to identify local resources (human, budget, existing approach, natural resource…)
Component 3	Activities to improve capabilities of human resources Development (training) of rural sanitation education staff (mainly women[3]) Development (training) of technician and staff of ASUFOR or CBO related to amelioration of sanitation condition in villages
Component 4	Implementation of activities to improve sanitation concept within village
Component 5	Establishment of sustainable implementation system (including monitoring and evaluation)
Component 6	Other activities (to prevent open-air defecation)

[3] In the target area, they are called Relais féminin.

4.8 Approach to Diffusion of the Sanitation System

4.8.1 Construction of Sanitation Facilities

A review of the specifications of both the sanitation facilities that satisfy PEPAM standards and the toilets being constructed in the target area was conducted in addition to a review of the possibility of introducing other facilities. As a result, the sanitation facilities to be developed under the Master Plan were defined as shown in Table 4-8-1below.

Table 4-8-1 Sanitation facilities to be developed and diffused in the sanitation master plan

No	Facility type	Details
1	Household sanitation facilities	2-tank VIP toilet (2 decomposition-tank toilet) Simple Hand-wash stand Washbasin with drainage ditch
2	Public sanitation facilities	Installation of 2-tank VIP toilet with Hand-wash stand (2 decomposition-tank toilet) Village washbasin with drainage ditch to be shared by villagers

If no financial support can be obtained from the government for sanitation facilities construction, a review will be conducted as to whether support can be obtained from CLTS based on the recognition that the target area is at the lowest level of sanitary conditions. In that case, it is important to proceed with the project with a view to implementing future plans to further improve the sanitary conditions and after presenting such possible plans to the villages.

4.8.2 Selection of Areas where the Sanitation System will be Introduced

(1) Priorities when introducing the sanitation system

When introducing the sanitation system, the target villages will be selected based on whether any water supply facilities development is planned, underway or completed. Further those areas where the village people fetch and utilize water from shallow well (puits) and from river shall be covered by sanitation development program. The flow of target village selection is shown in Table 4-8-2 below.

Table 4-8-2 Flow of target village selection

[Selection Basis 1 (one of the following must be satisfied)]

1-1	There are already public water supply facilities in place.
1-2	There are plans to construct public water supply facilities.
1-3	Although there are no public water supply facilities, water can be drawn on a daily basis, for example, from a shallow well.

↓ *If any of the above is satisfied, proceed to Selection Basis 2.*

[Selection Basis 2 (all of the following must be satisfied)]

2	A majority of the villagers who do not have sanitation facilities have requested that such facilities be constructed.
3	Residents are willing to provide labor or bear the cost of the construction materials, etc. required to construct the sanitation facilities.
4	The responsible CR is willing to provide cooperation and perform the administrative duties for the village.

↓ *Introduction of Sanitation System*

(2) Priorities when installing public sanitation facilities

In the villages selected to be the target for sanitation facilities development in accordance with the above process, the priorities when installing the public sanitation facilities will be determined based on the results of discussions held with the counterpart organization, DAS, throughout the survey period, as follows:

Table 4-8-3 Priorities when installing public sanitation facilities

Priority	1st/ 2nd (same priority)	1st/ 2nd (same priority)	3rd	4th
Location	Schools	Schools	Religious institutions	Public spaces
Specifications for installation	2 facilities per location, 1 each for men and women		1 per location	Villages with more than 500 villagers 1 each for men and women per village

In previous projects that have been implemented under the PEPAM framework so far, it was recommended to construct public toilets at markets and roadside stations for use by the general public coming from outside the village. It is reported, however, that in many cases the constructed toilets are left unattended, poorly cleaned and carelessly used and the maintenance issue remains unsolved. In this Master Plan, however, it is planned to develop sanitation facilities at important public institutions in the village where the users can be identified to a certain extent in order to improve the effectiveness of the project. Also, in setting the priorities, the policy will be to select the target institutions by confirming that there are both users and maintenance staff on a daily basis. When it is determined to proceed with this project, if there are any poor households in the village that are unable to install a household toilet, a review will be conducted on installation of toilets in public space in the village as shown in the above column for the 4th priority.

4.8.3 Sanitation Project to be Implemented Independently

If any sanitation facilities development project is implemented independently (in which all or part of the construction costs are provided), the target villages will be selected according to the above flow so that sanitary habits can be established in the villages and sustainable operation of the facilities can be ensured comparable to the input.

Although the project will be implemented village by village, it should be the policy to review the project over a wider scope to obtain synergy between villages, for example, by combining neighboring villages that belong to the same CR or villages with the same social and cultural backgrounds as well as aggregating areas under the charge of one ASUFOR for the water supply into one greater area. Also, it should be the policy to establish a monitoring system so that the local administrative bodies and DAR can see how the access rate is improved.

***

Chapter 5 Water Supply Facilities Planning

5.1 Selection of Sites to be Prioritized

5.1.1 Procedure of Selecting Sites

The procedures of selecting sites are as follows.

2) Reviewing the water supply group
In order to review the priority order for construction, which assumes installation of AEMV, villages are grouped together into areas within around 3,5km

3) Classification of data in the list of villages
The village list data is classified into two groups, one is the villages whose population is more than 500 and the other is less than 500. The population does not include the beneficiaries who have already been provided with water.

4) Prioritization
Concerning the water supply village group, for which new constructions and enhancements of piped water supply facilities are planned, prioritization was conducted based on the following three criteria: 1) population, 2) needs for safe water and 3) expandability. Criteria and points for evaluation are shown in the following table.

Table 5-1-1 Criteria and points for prioritization (for piped water supply system)

Item			Criteria		Point
1	Advantage of scale (Population)	To consider the number of beneficiaries, which directly affect the achievement of target water supply coverage rate	a	Target population for water supply is more than 1500	12
			b	Target population for water supply is more than 1000	10
			c	Target population for water supply is more than 800	7
			d	Target population for water supply is more than 600	5
			e	Population in the village is less than 600	3
2	Urgency and Water need	To evaluate needs for safe water and existence of water supply facilities	a	Areas where people secure drinking water from hand-dug shallow wells or untreated surface waters Areas where water level in hand-dug well is deeper than 50m	12
			b	Although traditional shallow wells exist, PEPAM does not consider them to be safe water sources	10
			c	There are improved shallow wells.	7
			d	Although water supply systems (AEP) exist, they have use time limitations and some areas are not provided with enough water.	5
			e	Although water supply systems (AEP) exist, extensions of distribution pipes are needed.	3
3	Impact (Expandability)	To possess proper conditions to maintain facilities and be expected to socially develop through improvement of infrastructures	a	The groups are located along main roads and act as important interregional centers for traffic and distribution. There is a village whose population is more than 1000. There are district (arrondissement) and CR offices	12
			b	The groups are located along main regional roads and are regional bases of traffic. There is a village whose population is more than 600.	10
			c	It is expected to socially develop because improvements in infrastructures are in progress .	7
			d	There is a possibility to socially develop if infrastructures are developed in the future.	5
			e	There is a low possibility to socially develop because the groups are located in remote areas	3

In the same way, the priority setting was conducted for the groups where point source type water supply facilities are targeted to be installed.

Table 5-1-2 Example of the evaluation sheet

SHOURT LIST																		
Arrondissement	C/R	PEPAM Code	Village Group		Evaluation				Priority		Village	Village Pop.	Existing Facility				
			No.	G. Pop	Catego.1	Catego.2	Catego.3	Total	No.	Rank			Facility	F+P	PM	PT	Note
KOUMPENTOUM	BAMBA NDIAYENE	5311005	KBO-1	837	7	7	5	19	92	D	ELIHINA	698	PM		1	ND	
		5311019									MEDINA DEDI KA	139	PM		1	ND	
		5311020	KBO-2	659	5	7	7	19	92	D	MEDINA THIALENE	266	PM		1	ND	
		5311033									SARE DEMBA EGUE BA	150	PM		1	ND	
		5311038									VELINGARA DIAM-DIAM	243	PM		1	ND	
		5311003									DAROU NDIAWENE	886	AEP	1		ND	AEP supply water sufficiently.
		5311027									NDIAYENE BAMBA	1947	AEP	1		ND	AEP supply water sufficiently.
		5311031									SAME NGUEYENE	457	AEP	3		ND	AEP supply water sufficiently.
		5311017	KBO-3	2 092	12	7	12	31	3	A	MEDINA BISSI	402	PM		1	ND	
		5311018									MASSEMBE	1160	PM		1	ND	
		5311036									TAOFEKHE	530	PM		1	ND	

An example of the evaluation sheet is shown in the table 5-1-2. The item of G.Pop indicates population of the group. If AEP has already been constructed, the beneficiaries of the AEP is excluded from the population in G.Pop. The Note describes the situation of existing water supply facilities and so on.

5）Development of List of Priorities

Priority rankings were set into five levels as shown in Table 5-1-3, according to the previously-mentioned procedure. The villages prioritized as A or B has large beneficiary populations or are political and economical centers of the area.

Table 5-1-3 Priority ranking based on evaluation score

Priority ranking	Score	Adoption (Desirable time frame to implement project)
A	More than 30	Short term project to be implemented by 2015
B	26～30	Short or mid term project to be implemented by 2021
C	21～25	Mid term project to be implemented by 2021
D	16～20	Mid or long term project to be implemented by 2027
E	Less than 16	Long term project to be implemented by 2027

5.1.2 Results of the Selection

Highly prioritized groups which are desirable to be implemented as short term projects are shown in Tables 5-1-4 to 5-1-7. The distribution of the groups is shown in Figure 5-1-1. The others are attached to supporting data A-1 in Main Report.

Table 5-1-4 List of projects of priority ranking A
Target: Tambacounda Department, Tambacounda Region

Priority		Point	Arrondissement	C/R	Village Group		Village			
Rank	No.				Group No.	Group Pop	Village Name	PEPAM Code	Village Pop	Facility
A	1	34	MISSIRAH	MISSIRAH	MMS-6	1,792	5342005	BOULACOUNDA BOLOL	121	NEANT
							5342029	MADINA BALANCOUNDA	884	NEANT
							5342037	MISSIRAH TABADIAN(BOU)	609	NEANT
							5342051	SAME OUMAR LY	215	AEP
							5342017	KELECOUNDA	107	NEANT
							5342010	GADAPARA	71	NEANT
A	1	34	MISSIRAH	MISSIRAH	MMS-5	1,924	5342004	BIRA (TABA)	944	NEANT
							5342033	MADINA DIAKHA	311	NEANT
							5342062	SITAOULE ISSAC	415	NEANT
							5342073	VELINGARA YAYA (SITAOU)	254	NEANT
A	3	31	MISSIRAH	MISSIRAH	MMS-3	2,832	5342021	KOUAR I	522	F+P,PM
							5342022	KOUAR II	215	NEANT
							5342023	KOUAR III	1565	NEANT
							5342035	MISSIRAH TOUNGOUNDE	530	NEANT
A	3	31	KUMPENTOM	BAMBA NDIAYENE	KBO-3	2,092	5311017	MEDINA BISSI	402	PM
							5311018	MASSEMBE	1160	PM
							5311036	TAOFEKHE	530	PM
A	3	31	MISSIRAH	NETEBOULOU	MNE-7	1,977	5343010	DJINKORE MANDINGUE	68	NEANT
							5343011	DJINKORE PEULH	636	PM
							5343019	KENIEBA	440	PM
							5343046	SARE NGABA	166	PM
							5343051	SINTHIOU DIEKA	79	NEANT
							5343023	KOUNTOUNDIOMBO	202	PM
							5343042	SARE MADY	95	PM
							5343037	OUNDOUNDOU MED.ND.BA	34	NEANT
							5333083	VELINGARA DIOUTE	257	PM
A	3	31	MISSIRAH	DIALACOTO	MDI-1	1,918	5341002	BADI NIERIKO	530	PM
							5341017	GNONGHANI	169	NEANT
							5341034	OUASSADOU DEPOT	1039	NEANT
							5341007	DAMANTAN	119	PM
A	3	31	MISSIRAH	MISSIRAH	MMS-10	1,714	5342014	HAMDALLAYE PONT	333	NEANT
							5342024	LAREDJI	127	NEANT
							5342046	PAKALI	61	PM
							5342067	TIMPAFOULOU	59	NEANT
							5342071	VELINGARA OUMAR	71	NEANT
							5342064	TABADIAN DIALIKO	701	NEANT
							5342007	DIAM WELI I	132	NEANT
							5342008	DIAMWELY II	135	PM
							5342072	VELINGARA PONT	95	F+P
A	3	31	MISSIRAH	MISSIRAH	MMS-14	1,527	5342002	ARDOULAYE	84	NEANT
							5342013	HAMDALLAYE NDIAPALDE	350	NEANT
							5342020	KOLONDIARO(GOUREL B)	412	PM
							5342057	SARE PATHE FOUGOULOU	480	NEANT
							5342034	MEDINA MAMADOU(BARK)	201	PM

Table 5-1-5 List of projects of priority ranking A
Target: Bakel and Goudiry Departments, Tambacounda Region East

Priority		Point	Arrondissement	C/R	Village Group		Village			
Rank	No.				Group No.	Group Pop	Village Name	PEPAM Code	Village Pop	Facility
A	1	32	BALA	KOTHIARY	BKO-3	1078	5113015	KOAR	1078	PM
A	2	31	BAKEL	BALOU	BBL-7	4459	5121007	GOLMY	4459	PM
A	2	31	BAKEL	GABOU	BGA-7	3447	5122006	DIABAL	680	solar
							5122002	ALAHINA MAURE	33	F+P
							5122005	BORDE DIAWARA	485	F+P
							5122008	GOUNIA	727	F+P
							5122020	MISSIRA SAMBA YIDE	819	PM
							5122001	ALAHINA BAMBARA	487	PM
							5122004	BEMA	624	ForPMH
							5122021	MORIBOUGOU	272	PM
A	2	31	BAKEL	BALOU	BBL-8	3294	5121009	KOUNGANY	3294	PM
A	2	31	KENIEBA	GATHIARY SADATOU	KSD-10	2599	5153009	SADATOU	2599	ForPMH
A	2	31	KIDIRA	SINTHUOU FISSA	KSF-10	1704	5142025	YOUPE HAMADI	420	ForPMH
							5142026	YOUPE PATHE	361	PM
							5142004	DIAMVELI PATE	117	PM
							NA	SINTHIOU SAMBA NDIARN	341	ForPMH
							5142012	SAKHO COUNDA	465	ForPMH
A	2	31	BAKEL	BALOU	BBL-6	1695	5121011	YAFERA	1695	PM

Table 5-1-6 List of projects of priority ranking A Target: Matam Region

Priority		Point	Arrondissement	C/R	Village Group		Village			
Rank	No.				Group No.	Group Pop	Village Name	PEPAM Code	Village Pop	Facility
A	1	32	AGNAMCIVOL	AGNAMCIVOL	AAG-4	1,571	11211010	NDIAFFANE BELITHINDE	544	NEANT
							11211011	NDAFFANE SOROKOUM	1,027	F+P,PM
							11211013	SINTHIOU BOUMAKA	593	AEP
							11211014	SINTHIOU CIRE MATOU	243	AEP
A	2	31	ORKADIERE	BOKILADJI	OBO-11	3,417	11112028	SAMBA	174	NEANT
							11112016	GAOUDE WOUNBABE	243	NEANT
							11112017	GOUREL GUEDA	143	NEANT
							11112026	THIAVALOL	395	NEANT
							11112009	BONDJI NDIOBO	35	PM
							11112010	BONDJI WALLY	1,025	PM
							11112015	GAOUDE BOFFE	563	PM
							11112020	OURO MBOULEL	797	PM
							11112021	OURO SILAMAKA	42	PM
A	2	31	SHINTHIOU BAMANBE	WOUROU SIDY	SWS-13	2,737	11122009	FORA DIAWARA	310	PM
							11122032	SORINGHO SEBBE	2,427	PM
							11122031	SORINGHO PULAR	1,118	AEP
							11122030	SINTHIANE	2,186	AEP
A	2	31	AGNAMCIVOL	OREFONDE	AOR-3	1,525	11213002	DABIA OREFONDE	653	PM
							11213001	ASNDE BALLA	533	AEP
							11213003	DIALAGNOL	958	AEP
							11213010	NDIAKIR	439	AEP
							11213011	OREFONDE	3,124	AEP
							11213007	HODIO	579	AEP
							11213012	OURO MOLLO	812	AEP

]

Table 5-1-7 List of projects of priority ranking A Target: Kedougou Region

Priority		Point	Arrondissement	C/R	Village Group		Village			
Rank	No.				Group No.	Group Pop	Village Name	PEPAM Code	Village Pop	Facility
A	1	31	BANDAFASSI	BANDAFASSI	BBF-17	2,524	5211023	LAMINIYA	736	NEANT
							5211035	SAMECOUTA	1112	F+P
							5211037	SYLLACOUNDA DIAKHA	676	F+P
A	1	31	BANDAFASSI	TOMBORONKOTO	BTO-6	2,051	5212013	MAKO	1454	ForPMH
							5212018	NIEMENIKE	80	ForPMH
							5212020	SEGUEKHO PEULH	508	NEANT
							5212025	TOUBA DIAKHA	9	NEANT

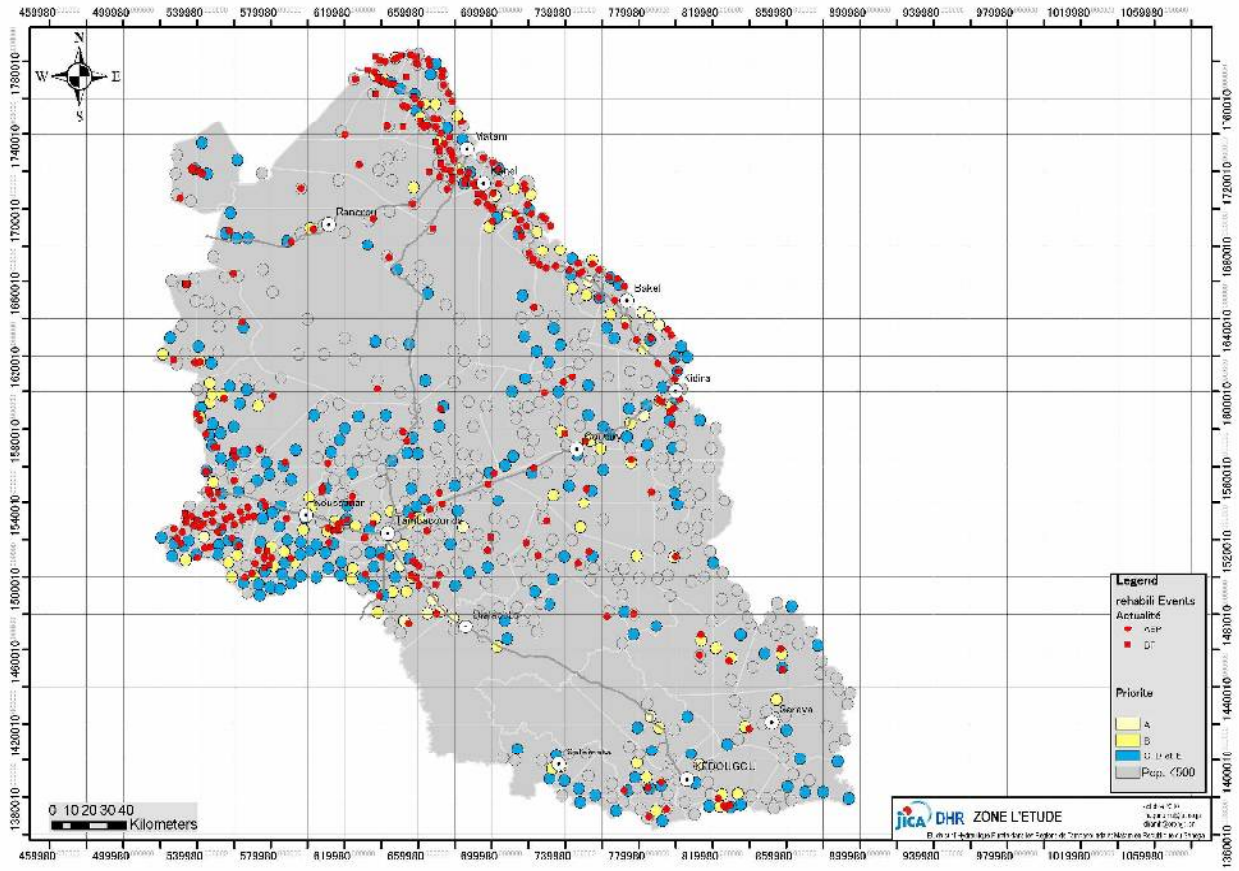


Figure 5-1-1 Distribution of groups prioritized into 5 ranks

5.2 Proposed Projects

According to the priority ranking list, the projects which are desirable to be implemented as short term projects from 2011 to 2015 are proposed in Tables 5-2-1 to 5-2-4.

Tableau 5-2-1 Résume du projet

Region	Numbers	Population 2002	Population end of term	Direct construction cost	Direct construction cost personne
Short term			2015	Millions FCFA	Thousands CFA
Région de Tambacounda	47	79 334	116 505	12 654	109
Région de Matam	25	50 950	76 346	7 817	102
Région de Kédougou	13	20 007	29 381	3 305	113
Medium term			2021		
Région de Tambacounda	62	70 682	123 941	17 358	140
Région de Matam	26	20 234	50 475	8 601	170
Région de Kédougou	10	9 912	17 381	2 288	132
Long term			2027		
Région de Tambacounda	82	61 350	128 453	18 095	141
Région de Matam	28	14 120	29 564	5 562	188
Région de Kédougou	11	7 236	15 151	2 328	154

Table 5-2-2 Summary List of Project Proposal in Tambacounda Region

Court terme projet 1

	Département	CR	Groupe	Bénéficier	Bénéficier	village centre	type	cout direct pour hydraulique	Coûts directs /personne	notes
				Année 2002	Année 2015			millions de FCFA	milliers de FCFA	
TS1-1	Tambacounda	MISSIRAH	MMS-6	1 792	2 632	MADINA BALANCOUNDA	AEMV	272	103	
TS1-2	Tambacounda	MISSIRAH	MMS-5	1 924	2 825	MEDINA DIAKHA	AEMV	283	100	F/S S2
TS1-3	Tambacounda	MISSIRAH	MMS-3	2 832	4 159	KOUAR III	AEMV	369	89	
TS1-4	Tambacounda	BAMBA NDIAYENE	KBO-3	2 092	3 072	MASSEMBE	AEMV	297	97	
TS1-5	Tambacounda	NETBOULOU	MNE-7	1 977	2 903	DJINKORE PEULH	AEMV	287	99	F/S S3
TS1-6	Tambacounda	DIALAKOTO	MDI-1	1 918	2 817	OUASSADOU DEPOT	AEMV	282	100	BAD
TS1-7	Tambacounda	MISSIRAH	MMS-10	1 714	2 517	TABADIAN DIALIKO	AEMV	266	106	
TS1-8	Tambacounda	MISSIRAH	MMS-14	1 527	2 242	SARE PATHE FOUGOULOU	AEMV	251	112	
TS1-9	Tambacounda	MISSIRAH	MMS-7	1 454	2 135	TOUBA	AEMV	246	115	
TS1-10	Tambacounda	MAKA	MMA-13	1 336	1 962	SINTHIOU KALDING(MAKA)	AEMV	238	121	
TS1-11	Tambacounda	KOUNPENTOUM	KKO-7	1 159	1 702	MEDINA NIANA II	AEMV	226	133	
TS1-12	Tambacounda	MAKA	MMA-10	1 106	1 624	BALL MBASSOU	AEMV	222	137	
				20 831	30 591	Total		3 238	106	
					37 205	AEMV-I (AEMVx1.5)		4 431	119	

Court terme projet 2

	Département	CR	Groupe	Bénéficier	Bénéficier	village centre	type	cout direct pour hydraulique	Coûts directs /pe	notes
				Année 2002	Année 2015			millions de FCFA	milliers de FCFA	
TS2-1	Tambacounda	KOUTHINBA WOLOF	KUK-14	2 247	3 300	BOKI SADA (altnative SARE WOKA)	AEMV	311	94	F/S S1
TS2-2	Tambacounda	MAKA	MMA-9	2 241	3 291	MAKADING	AEMV	310	94	
TS2-3	Tambacounda	MISSIRAH	MMS-1	2 100	3 084	SANKAGNE I	AEMV	298	96	BAD
TS2-4	Tambacounda	KAHEN	MKA-14	1 783	2 618	CISSECOUNDA	AEMV	271	104	
TS2-5	Tambacounda	SINTHOU MALEME	KSM-6	1 739	2 554	MEDINA NIANA I	AEMV	268	105	
TS2-6	Tambacounda	KOUTHINBA WOLOF	KUK-9	1 657	2 433	LOUMBY SIMBING	AEMV	261	107	
TS2-7	Tambacounda	NETBOULOU	MNE-9	1 616	2 373	DAR SALAM	AEMV	258	109	
TS2-8	Tambacounda	KOUTHINBA WOLOF	KUK-13	1 576	2 314	PAYAR	AEMV	255	110	
TS2-9	Tambacounda	NETBOULOU	MNE-1	1 531	2 248	BANTANTINTI	AEMV	252	112	
TS2-10	Tambacounda	KAHEN	MKA-2	1 519	2 231	KANOUMA	AEMV	251	112	
TS2-11	Tambacounda	NDAGA BABACAR	MND-4	1 510	2 217	NDEMOU GAYO	AEMV	250	113	
TS2-12	Tambacounda	NDAGA BABACAR	MND-2	1 350	1 983	NGOLOL MANDINGUE	AEMV	239	120	
				20 869	30 647	Total		3 223	105	
					38 854	AEMV-I (AEMVx1.5)		4 679	120	

Court terme projet 3

	Département	CR	Groupe	Bénéficier	Bénéficier	village centre	type	cout direct pour hydraulique	Coûts directs /pe	notes
				Année 2002	Année 2015			milliers de FCFA	milliers de FCFA	
TS3-1	Tambacounda	MISSIRAH	MMS-8	1 273	1 869	MADINA ALY	AEMV	233	125	
TS3-2	Tambacounda	DIALAKOTO	MDI-3	1 235	1 814	MADINA COUTA II	AEMV	231	127	
TS3-3	Tambacounda	SINTHOU MALEME	KSM-14	1 075	1 579	MEDINA TOUATTE (C.R.G	AEMV	220	139	
TS3-4	Tambacounda	SINTHOU MALEME	KSM-3	1 079	1 585	PADAH PEULH	AEMV	220	139	
TS3-5	Tambacounda	SINTHOU MALEME	KSM-2	1 035	1 520	SINTHIOU GAYO	AEMV	218	143	
TS3-6	Tambacounda	MAKA	MMA-3	2 465	3 620	BOULIMBOU	AEMV	331	91	
TS3-7	Tambacounda	KOUTHINBA WOLOF	KUK-18	1 427	2 096	DIATMEL II	AEMV	244	117	
TS3-8	Tambacounda	MISSIRAH	MMS-13	1 266	1 859	NIAOULE TANOU	AEMV	233	125	
TS3-9	Tambacounda	KOUTHINBA WOLOF	KUK-11	1 265	1 858	NAYOM BAPEL	AEMV	233	125	
TS3-10	Tambacounda	KOUTHINBA WOLOF	KUK-22	1 158	1 701	DAROU MINAME	AEMV	226	133	
TS3-11	Tambacounda	KOUSSANAR	KKU-3	1 103	1 620	DIOKOUL THIECKENE	AEMV	222	137	
TS3-12	Tambacounda	KOUNPENTOUM	KKO-5	1 078	1 583	SINTHIOU SAMBOUROU	AEMV	220	139	
				15 459	22 702	Total		2 831	125	
					28 493	AEMV-I (AEMVx1.5)		4 130	145	

Court terme projet 1

	Département	CR	Groupe	Bénéficier	Bénéficier	village centre	type	cout direct pour hydraulique	Coûts directs /personne	notes
				Année 2002	Année 2015			millions de FCFA	milliers de FCFA	
BS1-1	Bakel	KOTHARY	BKO-3	1 078	1 583	KOAR	AEMV	220	139	
BS1-2	Bakel	BALOU	BBL-7	4 459	6 548	GOLMY	AEV-ST	595	91	Non AEMV-I
BS1-3	Bakel	BALOU	BBL-8	3 294	4 837	KOUNGANY	AEV-ST	422	87	F/S S7
BS1-4	Bakel	SADATOU	KSD-10	2 599	3 817	SADATOU	AEMV-SS	344	90	F/S S8
BS1-5	Bakel	BALOU	BBL-6	1 695	2 489	YAFERA	AEV-ST	264	106	Non AEMV-I
BS1-6	Goudiry	GOUDIRY	GGO-5	2 250	3 304	SINTHIOU MAMADOU BOUBOU	AEMV-I	311	94	F/S S6
BS1-7	Bakel	BELLE	KBE-10	1 930	2 834	SENEDEBOU	AEMV	283	100	Non AEMV-I
BS1-8	Goudiry	DOUGUE	BDO-5	1 445	2 122	BODE	AEMV	245	116	Non AEMV-I
BS1-9	Bakel	MOUDIRY	BMO-5	1 199	1 761	GANDE	AEV	228	130	Forage d'essia
BS1-10	Goudiry	DOUGUE	BDO-13	741	1 088	KOUSSAN	AEMV	200	183	PAISD
BS1-11	Goudiry	GOUDIRY	GGO-29	1 485	2 181	SINTHIOU LELEKONE	AEMV	248	114	
				22 175	32 565	Total		3 362	103	
					34 331	AEMV-I (AEMVx1.5)		3 719	108	

Table 5-2-3 Summary List of Project Proposal in Matam Region

Projet1

	Département	Groupe	CR	Bénéficier	Bénéficier	village centre	type	cout projet avec assainissement	cout direct pour hydraulique	Coûts directs /personne	notes
				Année 2002	Année 2015			millions de FCFA	millions de FCFA	milliers de FCFA	
MS1-1	Matam	AAG-4	AGNAMCIVOL	1 571	2 307	NDAFFANE SOROKOUM	AEMV	495	255	110	
MS1-2	Kanel	SWS-13	WOUROU SIDY	2 737	4 019	SORINGHO SEBBE	AEMV	697	359	89	Non AEMV-I
MS1-3	Matam	AOR-3	OREFONDE	1 525	2 240	DIOWGUEL	AEMV	488	251	112	
MS1-4	Kanel	OBO-1	BOKILADJI	4 920	7 225	ADABERE	AEMV	1 323	681	94	Non AEMV-I
MS1-5	Kanel	SSB-2	SHINTHIOU BAMANBE	3 962	5 818	NDENDORY	AEMV	999	514	88	Non AEMV-I
MS1-6	Matam	ONA-8	NABADJI-CIVOL	3 216	4 723	WOUDOUROU	AEMV	802	413	87	Non AEMV-I
MS1-7	Kanel	SSB-1	SHINTHIOU BAMANBE	3 198	4 696	NGANO	AEMV	798	411	87	Non AEMV-I
MS1-8	Matam	OGB-4	BOKODIAVE	2 916	4 282	DOUMGMA RINDIAW	AEMV	735	378	88	Non AEMV-I
MS1-9	Kanel	OAO-13	AOURE	2 462	3 616	DIAOUBE KOBILO	AEMV	643	331	92	Non AEMV-I
MS1-10	Kanel	OBO-7	BOKILADJI	2 276	3 342	GANGUEL MAKA	AEMV-I	609	313	94	F/S S11
MS1-11	Matam	OGB-5	BOKODIAVE	2 149	3 156	MBAKHNA I (MBAKHNA DEUW)	AEMV	586	302	96	Non AEMV-I
MS1-12	Matam	OOR-1	ORKADIERE	2 017	2 962	GOURIKI COLIYABE	AEMV	564	290	98	Non AEMV-I
			TOTAL	32 949	48 387	Total		8 739	4 498	93	
					49 751	AEMV-I (AEMVx1.5)			4 751	95	

Projet2

	Département	Groupe	CR	Bénéficier	Bénéficier	village centre	type	cout projet avec assainissement	cout direct pour hydraulique	Coûts directs /personne	notes
				Année 2002	Année 2015			millions de FCFA	millions de FCFA	milliers de FCFA	
MS2-1	Matam	OOG-5	OGO	1 525	2 240	DIANDIOLY TOUCOULEUR	AEMV	488	251	112	
MS2-2	Kanel	OOR-4	ORKADIERE	3 729	5 476	DIELLA	AEMV	933	480	88	Non AEMV-I
MS2-3	Matam	ONA-3	NABADJI-CIVOL	1 236	1 815	HONTOR BE	AEMV	448	231	127	
MS2-4	Matam	SSB-5	SHINTHIOU BAMANBE	1 193	1 752	KELLOL	AEMV	443	228	130	
MS2-5	Ranerou	VVE-1	VELINGARA	1 131	1 661	BOUNDOU MBABA BARKEDJI	AEMV	435	224	135	
MS2-6	Ranerou	VVE-7	VELINGARA	1 069	1 570	MBONAYE I	AEMV	427	220	140	
MS2-7	Ranerou	VOU-18	OUDALAYE	1 064	1 563	DAR SALAM	AEMV-I	426	219	140	F/S S10
MS2-8	Matam	AAG-3	AGNAMCIVOL	946	1 389	AGNAM LIDOUBE	AEMV	412	212	153	
MS2-9	Matam	OGB-1	BOKODIAVE	760	1 116	THIEHEL SEBBE	AEMV	390	201	180	
MS2-10	Matam	OOG-12	OGO	699	1 226	LAMBANGO	AEMV	399	205	167	
MS2-11	Ranerou	VVE-5	VELINGARA	927	1 626	DAYANE GASSEL	AEMV	432	222	137	
MS2-12	Ranerou	VVE-14	VELINGARA	1 365	2 394	NDIANOYE	AEMV	503	259	108	
MS2-13	Matam	OGB-2	BOKODIAVE	2 357	4 133	SARACOURO DIALLOUBE	AEMV	713	367	89	
			TOTAL	18 001	27 959	Total		4 402	3 319	119	
					34 235	AEMV-I (AEMVx1.5)			3 670	107	

Table 5-2-4 Summary List of Project Proposal in Kédougou Region

Court terme projet 1

	Département	Groupe	CR	Bénéficier	Bénéficier	village centre	type	cout direct pour hydraulique	Coûts directs /personne	notes
				Année 2002	Année 2015			millions de FCFA	milliers de FCFA	
KS1-1	Kedougou	BBF-17	BANDAFASSI	2 524	3 707	SAMECOUTA	AEMV	337	91	F/S S13
KS1-2	Kedougou	BTO-6	TOMBORONKOTO	2 051	3 012	MAKO	AEMV	293	97	F/S S12
KS1-3	Salemata	SAS-5	SALEMATA	2 010	2 952	ETHIOLO	AEMV	290	98	Non AEMV-I
KS1-4	Kedougou	BBF-7	BANDAFASSI	1 757	2 580	LANDE BAYTIL	AEMV	269	104	Non AEMV-I
KS1-5	Saraya	SKH-2	KHOSSANTO	1 422	2 088	MAMAKHONO	AEMV	244	117	Non AEMV-I
KS1-6	Salemata	SAS-6	SALEMATA	1 313	1 928	NANGAR PEULH	AEMV	236	122	Non AEMV-I
KS1-7	Saraya	SKH-1	KHOSSANTO	1 235	1 814	KHOSSANTO	AEMV	231	127	Non AEMV-I
KS1-8	Saraya	SSA-14	SARAYA	1 063	1 561	BEMBOU	AEMV	219	141	Non AEMV-I
KS1-9	Kedougou	FFO-2	FONGOLEMBI	1 533	2 251	FONGOLIMBI	AEMV	252	112	Non AEMV-I
KS1-10	Kedougou	BBF-14	BANDAFASSI	1 465	2 151	DINDIFELLO	AEMV	247	115	Non AEMV-I
KS1-11	Saraya	SKH-3	KHOSSANTO	1 319	1 937	BRANSAN	AEMV	237	122	Non AEMV-I
KS1-12	Kedougou	FDI-4	DIMBOLI	1 158	1 701	DIMBOLI	AEMV	226	133	Non AEMV-I
KS1-13	Kedougou	FDI-5	DIMBOLI	1 157	1 699	KAFORI	AEMV	226	133	Non AEMV-I
				20 007	29 381	Total		3 305	113	

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Chapter 6 Rehabilitation Project for Water Supply Facilities

6.1 Type of Rehabilitation

Facilities to be rehabilitated have a variety of situations. In addition, the scale of the rehabilitation varies depending on the policy of the authority in charge. Not only repair works for the failure part that caused suspension of the facilities but also overall repair works are required because the facilities became deteriorted with time. The repair works in the rehabilitation project are classified as shown below.

(1) Re-drilling of water sources
(2) Replacement of pumping equipment
(3) Expansion of whole facilities
(4) Extension of pipeline networks inside villages
(5) Extension of pipelines to satellite villages
(6) Commercial electrification
(7) Support to house connections

6.2 Short-term Rehabilitation Project

6.2.1 Outline of Short-term Project

The suspensions of water supply facilities in target areas are mostly attributed to malfunctions of boreholes or pumping equipment. In the case where the borehole is out of service, we can detect sand coming into the casing pipe from corroded slits resulting in pumping up sand and an extreme decrease in water discharge. As for the problem related to pumping equipment, the malfunction of the water pump or generator is causing the problems.

The short-term project aims to refurbish the above mentioned water supply facilities, where the borehole is out of service and where the pumping equipment is out of service. As a result of the survey, it was confirmed that the number of the facilities whose borehole is out of service is 21 and whose pumping equipment is out of service is 26 (See Table 6-2-1 below). For some of the sites, rehabilitation works are planned to be implemented in 2011 by Japanese Grant Aid and other donor projects. The figures in parentheses in Table 6-2-1 show the number of sites to be implemented in 2011.

Table 6-2-1 Schedule of urgent rehabilitation for sites where operation is suspended

Regulating BPF	Number of sites with unusable boreholes 2010 (Number definite for implementation)	Number of sites for borehole construction					Number of sites with unusable pumping equipment 2010 (Number definite for implementation)	Number of sites pumping equipment replacement				
		2011	2012	2013	2014	2015		2011	2012	2013	2014	2015
Tambacounda	18(4)	(4)	4	4	4	2	8(4)	(4)	2	2		
Goudiry	2		2				6		3	3		
Matam	1		1				7(3)	(3)	3	1		
Kedougou	0						5		3	2		
Total	21(4)	(4)	7	4	4	2	26(7)	(7)	11	8	0	0

Source : Discussions with BPF based on the list of existing facilities and 2008 Report on facility failure

6.2.2 Contents of Rehabilitation Project

(1) Rehabilitation of boreholes
From the viewpoint of promoting maintenance outsourcing of water supply facilities in the target area, we established a target, by which rehabilitation works will be completed by 2016 when the outsourcing to private companies will be officially introduced, so that the facilities out of service can be resumed operation by that time. Tables 6-2-2 to 6-2-4 show the sites in each BPF areas where

another borehole should be constructed and some repair works will be required.

Table 6-2-2 Sites for borehole re-drilling in Department of Tambacounda

Name of village	Proposed year for rehabilitation	Pop (2002)	Pop 2015	Village community	Project cost	Project cost per-capita	Cost for emergency rehabilitation
					Million CFA	Thousand CFA	Million CFA
Diagle Sine	2011*	1 129	1 922	BAMBA NDIAYENE	144	75	72
Darou Ndiawene	2011*	886	1 508	BAMBA NDIAYENE	133	88	72
Hamadallaye Tessang	2011*	1 441	2 453	MISSIRAH	160	65	72
Velingara Bidiankoto	2011*	890	1 515	MISSIRAH	133	88	72
Malemba	2012	1 285	2 188	KOUTHIABA OUOLOF	152	70	72
Payar	2012	1 055	1 796	KOUTHIABA OUOLOF	141	78	128
Ainoumane	2012	693	1 180	BAMBA NDIAYENE	124	105	72
Touba Sine	2012	674	1 147	BAMBA NDIAYENE	124	108	72
Ndiambour	2013	600	1 021	BAMBA NDIAYENE	120	118	72
Bohe Dialigue	2013	716	1 219	KOUSSANAR	125	103	72
Kissang	2013	570	970	BAMBA NDIAYENE	119	123	72
Djender	2013	553	941	MAKA	119	126	72
Sare Faring (Faricounda)	2014	550	936	SINTHIOU MALEME	118	126	72
Barsafo	2014	445	758	KAHENE	114	151	72
Daroul Mana	2014	428	729	KOUTHIABA OUOLOF	114	156	128
Kountouata	2014	405	689	BAMBA NDIAYENE	113	164	72
Loumby Travaux	2015	366	623	KOUTHIABA OUOLOF	111	179	128
Diamevely	2015	323	550	MALEME NIANI	110	199	72
Total		13 009	22 147		2 275	103	1 461

* Work had started already

Table 6-2-3 Sites for borehole re-drilling in Department of Bakel and Goudiry

Name of village	Proposed year for rehabilitation	Population (2002)	Pop 2015	Village community	Project cost	Project cost per-capita	Cost for emergency rehabilitation
					Million CFA	Thousand CFA	Million CFA
Sinthiou Diohe	2012	767	1 306	BELE	128	98	67
Koussan	2012	741	1 262	DOUGUE	126	100	67
Total		1 508	2 567		254	99	134

Table 6-2-4 Sites for borehole re-drilling in Matam Region

Name of village	Proposed year for rehabilitation	Population (2002)	Pop 2015	Village community	Project cost	Project cost per-capita	Cost for emergency rehabilitation
					Million CFA	Thousand CFA	Million CFA
Loumbal Baladj	2012	2 101	3577	OREFONDE	201	56	72
Total		2 101	3577		201	56	72

(2) Rehabilitation of pumping equipment

A Japanese grant aid project for rehabilitation of water pumping facilities is to be implemented in 2011. It is suggested that remaining water pumping facilities, which are out of service, should also be resumed in 2012 or 2013 as shown in Tables 6-2-5 to 6-2-8

Table 6-2-5 Sites for rehabilitation of pumping equipment in Department of Tambacounda

Name of village	Proposed year for rehabilitation	Population (2002)	Pop 2015	Village community	Project cost	Project cost per-capita	Cost for emergency rehabilitation
					Million CFA	Thousand CFA	Million CFA
Sinthiou Maleme	2011*	3 977	6 771	SINTHIOU MALEME	72	11	46
Darou Salam II Sine	2011*	962	1 638	KOUMPENTOUM	59	36	46
Kalbirom Kobo	2011*	465	792	KOUSSANAR	57	72	46
Koundiao Souare	2011*	269	458	BAMBA NDIAYENE	56	122	46
Galle	2012	921	1 568	BAMBA NDIAYENE	59	37	46
Darou Fall	2012	845	1 439	BAMBA NDIAYENE	58	41	46
Darou Ndiayene	2013	343	584	KOUTHIABA OUOLOF	56	96	46
Belly Wamedaka	2013	529	901	DIALAKOTO	57	63	46
Total		8 311	14 149		474	33	366

Table 6-2-6 Sites for rehabilitation of pumping equipment in Departments of Bakel and Goudiry

Name of village	Proposed year for rehabilitation	Population (2002)	Pop 2015	Village community	Project cost	Project cost per-capita	Cost for emergency rehabilitation
					Million CFA	Thousand CFA	Million CFA
Bantanani	2012	380	647	BANI ISRAEL	82	215	67
Dindedji	2012	456	776	KOULAR	82	180	67
Dounde*	2012	96	163	BELE	81	841	67
Didie Gassama	2013	439	747	Sadatou	82	187	67
Galo	2013	371	632	BANI ISRAEL	82	220	67
Mbaniou	2013	225	383	GOUDIRY	81	361	67
Total		2 839	3 349		653		536

* Although the present population of Dounde village is small because people left the village after the facility had broken down, the village used to have a population of 300 to 400 and also people from surrounding villages came and used the facility when the pumping facility was in good condition. The BPF is sure that people will come back to the village if the facility was rehabilitated. Therefore it insisted that not only Dounde village but also similar villages should be included on the list. The final decision is to be made based on the survey before construction.

Table6-2-7 Sites for rehabilitation of pumping equipment in Region of Matam

Name of village	Proposed year for rehabilitation	Population (2002)	Population (2015)	Village community	Project cost	Project cost per-capita	Cost for emergency rehabilitation
					Million CFA	Thousand CFA	Million CFA
Dialloube	2011*	2 602	4 430	Aoure	66	15	46
Dounoubel	2011*	379	645	Oudalaye	56	88	46
Ranerou Orient	2011*	186	317	Wourou Sidy	56	176	46
Hombo Fresbe	2012	1 508	2 567	OGO	61	24	46
Dendoudy (Ndendoudy Travaux)	2012	769	1 309	OGO	58	44	46
Mbem Mbem	2012	196	334	VELINGARA	56	167	46
Velingara Ouolof I	2013	189	322	VELINGARA	56	173	46
Total		5 829	9 923		409	41	320

* Work had started already

Table 6-2-8 Sites for rehabilitation of pumping equipment in Region of Kegoudou

Name of village	Proposed year for rehabilitation	Population (2002)	Population (2015)	Village community	Project cost	Project cost per-capita	Cost for emergency rehabilitation
					Million CFA	Thousand CFA	Million CFA
Daloto	2012	808	1 376	MISSIRAH SIRIMANA	58	42	46
Pelel Kindissa	2012	809	1 377	BANDAFASSI	58	42	46
Niagalancome	2012	540	919	FONGOLEMBI	57	62	46
Dioulafoundou	2013	299	509	SARAYA	56	110	46
Bransan	2013	744	1267	KHOSSANTO	56	175	46
Total		3 387	5766		344	60	275

6.3 Rehabilitations for Mid-term Project and Thereafter

(1) Outline

Even for the piped water supply facilities in operation, rehabilitation works described below are requested.

- To extend pipelines to satellite villages and install water faucets there in order to ease the burden of carrying water
- To extend pipelines and install water faucets at expanded target areas, and also increase the number of water faucets at areas where water has already been provided in order to shorten water transport distance
- To intensify the density of pipeline networks to increase possibilities for house connections
- To replace water pumping equipment to increase well pumping capacities
- To replace the present pipes with larger diameter ones and install bypass pipes to increase water distribution
- To extend commercial power lines to reduce management costs

In this plan, it is suggested that by increasing reserve fund, new elevated water tanks and pipelines can be constructed and water pumping equipments be replaced for integrating small scale water supply facilities.

(2) Priority order

At the inception of rehabilitation projects, target villages for rehabilitation are prioritized based on the following criteria: population of beneficiaries, urgent necessity, impact and expandability, the same as that for newly construction projects. Then the list of priority order is developed. By checking several tens of highly prioritized sites, information to help make decisions on whether rehabilitation works would be feasible or which kind of rehabilitation works would be appropriate is collected.

6.4 Rehabilitation Project Costs

Rehabilitation project costs were reviewed by classifying them into the following two groups: 1) rehabilitation including construction of new boreholes and 2) rehabilitation utilizing existing boreholes. The project for water supply in Tambacounda Region by Japanese grant aid consists of improvement in appearance of water supply facilities and replacement of roofs, valves, water pumping equipment, and motor. The project aims to extend the life of the facilities. For reference, the cost for emergency rehabilitation such as repairing only the failure part is also described below.

(1) Rehabilitation including construction of new boreholes

The relation between project cost and population of beneficiaries is expressed as follows:

Project cost (million CFA) = 143.78×EXP(0.0002×Population of beneficiaries) (Figure 6-4-1)

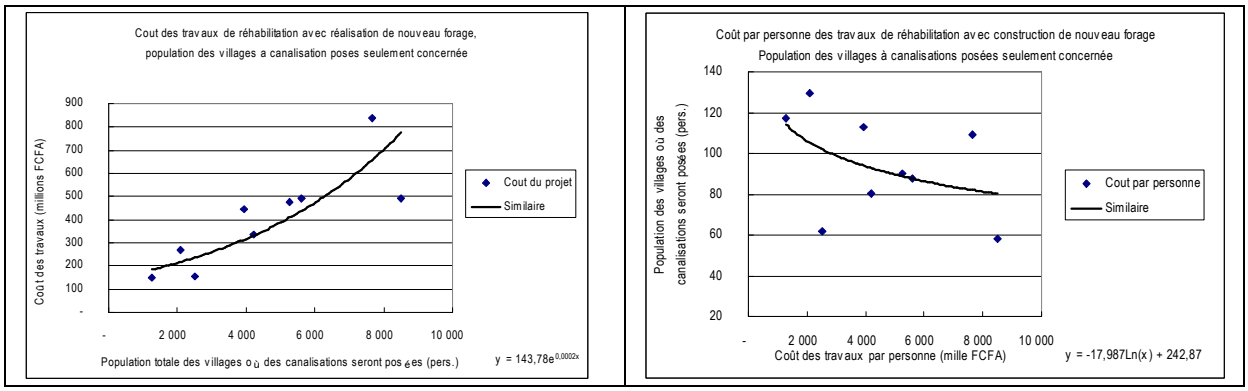

Figure 6-4-1 Relation between rehabilitation project cost, which includes construction of new boreholes, and population of beneficiaries

Even for emergency rehabilitation, it is necessary at least to repair the machinery room, replace pumping equipment and support the management maintenance system. According to past projects, it costs about 188 million CFA (36 million JPY) for a 400m borehole, 105 million CFA (20 million JPY) for a 150m borehole and 98 million CFA (18,9 million JPY) for a 100m borehole.

(2) Rehabilitation utilizing existing boreholes

Regarding rehabilitation utilizing existing boreholes, failure parts are limited because the facilities are in operation and most parts are in good condition. Compared to construction of new boreholes, the cost is about one fifth. The relation between project cost and population of beneficiaries is expressed as follows:

Project cost (million CFA) = 0.0036×Population of beneficiaries+80.37 (Figure 6-4-2)

Even in the case that only water pumping equipment is replaced as an emergency procedure, it is necessary at least to repair the machinery room and support the management maintenance system. According to past projects, it costs about 67 million CFA (13million JPY).

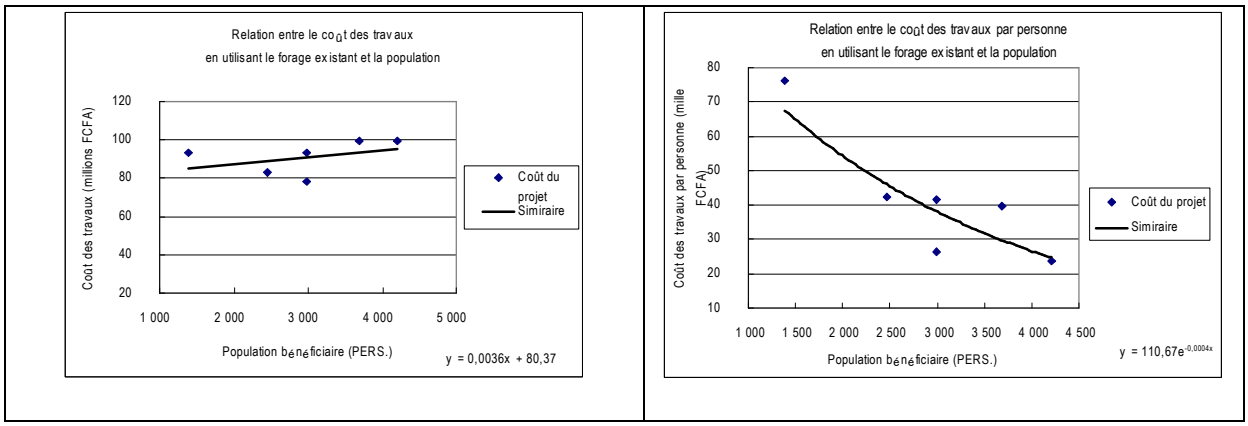

Figure 6-4-2 Relation between rehabilitation project cost, which utilizes existing boreholes, and population of beneficiaries

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Chapter 7 Operation and Maintenance Plan

7.1 Consignment of Maintenance to Private Sector

7.1.1 Policy on Consignment of Maintenance to Private Sector

According to the sector policy document of 2005 (Lettre de politique sectorielle de l'hydraulique et de l'assainissement en milieu urbain et rural, June 2005), which was agreed by 4 Ministries, the maintenance activities were officially noted to be consigned to a private sector by DEM. The plan for structural reform of DEM after the consignment has been already established (though the report has not been disclosed yet). However, the capacity for execution of maintenance activities by the private companies has been questioned in the central area of Senegal, where the consignment to private sector was planned to be commenced earlier than the other areas of Senegal, resulting in a situation where no company was selected for the consignment.

In the target area, there are comparatively worse conditions than the central area, such as aging facilities, delay of establishment of ASUFORs, low density of facilities, and absence of private companies capable of maintenance consignment within the target area, and therefore, it is hard to realize the consignment. Without implementation of any projects in the future to overcome these challenges, the difference between the central and the target area shall be more obvious.

7.1.2 Promotion Period for Consignment of Maintenance Activities to Private Sector

Promotion of consignment to the private sector in Senegal is supposed to be commenced from the central area of Senegal. It is desirable to implement the consignment to the private sector in the target area using model cases or lessons learnt in the central area. Therefore, promotion of the consignment to the private sector will be described in the mid-term plan (2016-2021).

On the other hand, in comparison with the preceded areas, the target area suffers from such situations as, 1) delay of transition into ASUFOR, and 2) breakdowns and severe deteriorations of most facilities. Therefore, conditions of the consignment to the private sector (rehabilitation of facilities, exchange of equipments, establishment of ASUFORs, and installation of meters for metered billing) shall be prepared as much as possible during the period of the short term plan.

7.1.3 Project Plan

(1) Preparation Stage (Short Term Plan 2011 - 2015)
As a preparation stage for promotion of the consignment to the private sector, such activities are planned as, 1) transition of the water management committees into ASUFORs, and 2) resolution of issues of facilities rehabilitation before 2015.

(2) Implementation Stage (Mid-term Plan 2016 - 2022)
There is no plan for financing except for an expression of support to private sector consignment by BAD. Therefore, DHR and DEM shall raise funds in order to promote the following activities.

- Formulation of the Terms of Reference (TOR) for the consignment to the private sector, and selection of the target villages
- Supervisory works of the tender for the consignment to the private sector
- Resolution of the issues of the contract (rehabilitation of facilities, exchange of equipments and establishment of ASUFORs)
- Support of SM/BPF for strengthening its supervisory works of consignment to the private sector
- Monitoring of the consignment to the private sector for a year after commencement

The above activities are the standard works for promoting the consignment to the private sector.

(3) Implementation Schedule

Table 7-1-1 Implementation Schedule of Consignment of Maintenance Activities to Private Sector

Component		2015	2016	2017	2018	2019
	Condition: The consignment in the central area will be on track before 2015.					
1	Rehabilitation of facilities (Refunctiong of all broken down facilities)	●				
2	Support to selection of consignment (Deciding the framework and listing the facilities for additional rehabilitation)	■				
3	Support to contracting procedures	■				
4	Start of consignment (For facilities operating in 2015)		●			
5	Support to consignment after starting (Organizational strengthening and monitoring of consignment management organization)		■	■		
6	Rehabilitation works at the villages		■	■		
7	Reorganization of ASUFORs at the villages		■	■		
8	Beginning of the consignment for additional facilities				●	

7.2 Transition of Operation to the SDE

7.2.1 Policies on Transition of Operation to the SDE

A survey report prepared by DEM said that the operation of the facilities in the villages with a population of several thousands should be transferred to SDE. Among the communes in the target area, Koussanar, Goudiry and Kidira in Tambacounda Region, and Ourosougui in Matam Region correspond to the above villages, and among them SDE expressed to take over the operations of Kidira and Ourosougui. However, this transition process faltered due to refusal by these villages for fear that the water price will rise and that they cannot engage directly in management of the facilities. Meanwhile, it is recommended that the management should be transferred to the management company immediately as it is difficult to operate the facilities at urban water supply service level through community management in terms of financial management, sustainability of service level and formulation of future plans.

In addition, BPF, supervising the water supply facilities, has an opinion that management of the water supply facilities in the villages excluded from the report (Kounpentoun in Tambacounda Region, and Kanel, Boki Diave, Sinthou Bamanbe, Orkadiere, Orefonde and Dembankane in Matam Region) should be transferred from ASUFOR into SDE or other private companies specialized in management, according to the recent situation of water supply.

Table 7-2-1 Transition of Management of Large Scale Facilities to Private Sector

Component		2015	2016	2017	2018	2019
1	Discussions and decisions on conditions of acceptance and candidate sites	●				
2	Explanation and publicity of transition plan to candidate sites	●				
3	Implementation of transition at the sites which do not require rehabilitation or expansions		●			
4	Formulation of rehabilitation and expansion plans to meet conditions of acceptance		■			
5	Implementation of rehabilitation and expansion works			■	■	
6	Hand over of completed facilities					●

7.3 Budgetary Measures for Large Scale Rehabilitations

Large scale rehabilitations such as replacement of the elevated tank is under the responsibility of the government. And at present, ASUFOR is not in an economic situation to bear such finance. Therefore, it is necessary to generate options regarding financial measures for such large scale rehabilitations. For instance,

a part of the revenues of ASUFORs should be totally pooled and then the financial resources can be distributed from them in a case of necessity of large scale rehabilitations.

As there is naturally a limit in financial resources, the priority of usage of the financial measures shall be considered, for instance, based on 1) accumulated amount of funding from the area until then, 2) existence of financial assistances for large scale rehabilitations in the area, and 3) situations of submissions of operation and maintenance reports. It is a prerequisite for the financial measures that the financial reports are disclosed annually and that transparency of the financial management is secured.

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Chapter 8 Rural Sanitation Development Plan

8.1 Purpose of developing the rural sanitation development plan

This Master Plan aims particularly in order to contribute for improving the access rate of safe water and amerilorated sanitation system, to formulate the enformcement programme (hereinafter stated as "M/P") of water resources development, rural water supply system, as well as rural sanitation system in the project tagert three regions of Tambacounda, Kedougou and Matam. Especially enforcement in sanitation sector, main objective is to amerilorate social and physical environement in target reagions that mainly cause the water-related diseases, through promotion of effective and efficient water use as well as improvement of village saniataion environment.

8.1.1 Defining the water-borne diseases

Water-borne diseases specifically affecting health may be classified into two categories: the diseases resulting from contamination by micro-organisms included in the water used to cover daily human needs and the diseases resulting from chemicals. Consequently, water-related diseases will be defined herein as health disorders resulting from contamination by micro-organisms, as indicated in the Table below.

Table 8-1-1 Categorization of the water-related diseases

Type	Examples of diseases	Measures
waterborne diseases	Diarrheal diseases, cholera, dysentery, typhoid fever, hepatitis, etc.	Improvement of drinking water quality, protection of water sources
Diseases resulting from water shortage	Diarrheal diseases, cholera, dysentery, trachoma, scabies, skin diseases, ocular diseases, acute respiratory infections (ARI) [1], etc.	Increase in the volume of drinking water for daily human needs, improvement and preservation of a good living environment and good health conditions
Diseases caused by water-borne parasites	Bilharziasis (schistosomiasis), dracunculiasis (guinea worm disease), etc.	Reduction of contacts with contaminated water sources, improvement and protection of surface waters good quality and environment
Waterborne diseases caused by insects	Malaria, onchocerciasis, dengue fever, yellow fever, etc.	Enhanced control on surface waters and ponds, destruction and extermination of insect sources that develop along river banks

Source: Developed by the survey team on the basis of a document. Translation in Japanese of the disease names by the survey team.

8.1.2 Protection against water borne diseases

Water borne diseases result from the living environment and the human activities. As the colum "measures" indicated in the above section 8-1-1, water borne diseases are preventable by following :

1. Promoting the safe water selecting, promoting provision of sare water from appropriate water supply facilities.
2. Promoting appropriate water storage in every household, use of measures to purify drinking water (water purification)
3. Promoting a safe water use both in terms of quality and quantity; promoting hygiene awareness activitieys at the individual level in order to eliminate bad habits such as open defecation and bathing in pond waters, etc.
4. Execution of removal of pathogens and demolition of the vermin's nest through collaborative work such as "SET-SETAL".

[1] Acute Respiratory Infection

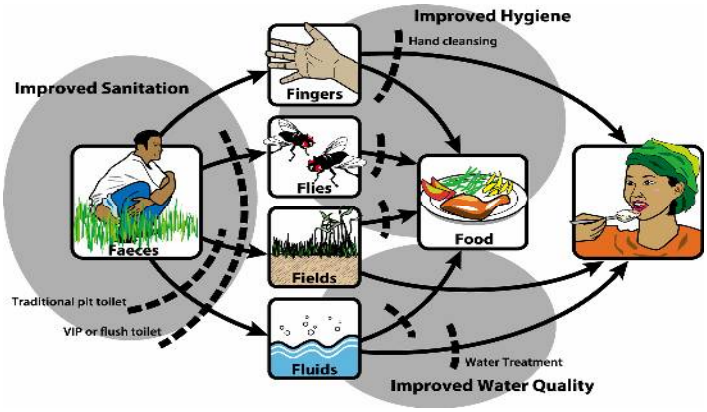

Figure on the left shows the contamination route of oral-fecal diseases that are transmitted by oral route; it also shows the related prevented measures along with the water, hygiene and environment relation.

Legend
Black lines: contamination routes
Doted lines: Barrier against contamination by diseases
Grey Zones: Scope of the contamination barrier

Figure 8-1-1 Fi-diagram and relations between water, sanitation facilities and health notions[2]

Water supply development projects and sanitation facilities development projects are two key mainstays to promote living conditions' improvement in rural villages. In this present master plan, the four measures above mentioned will be applied in order to overcome the issues in the project's target regions.

8.2 Issues relating to the improvement of sanitation conditions

(1) Issues

Under the current sanitation status in the target region, the issues to be overcome may be classified into the two major categories below:

Current status	Causes
• Inappropriate defacation and attitude to human excreta based on the low accessibility of improved latrines. • Incompleate drainage based on the non-introdution of domestic wastewater treatment system • Lack of preventive activities against water related deseas such as utilization of in-purified water from shallow wells and river. • Lack of public sanitation service	• Low priority because of poor awareness on hygiene and health • Worse saniataion environment caused by lack of information and knowledge on it. • Lack of future plans for amelioration of the environment • Differences between regarding important issues and competence of service providers, as well as the speed of providing basic social infrustructures.

(2) Step of improvement for the sanitation conditions

Taking into account the above conditions in the target region, a stepwise rank[3] of the sanitation related issues could be shown as follows:

First step: Developing the basic hygiene environment

- Definition：Step where it is necessary to keep away the village people everyday life from human and livestock excreta and prevent water borne diseases resulting from inappropriate drainage of wastewater.
- Situation of the target region：Almost the entire target region are on this firsst step.
- PEPAM Framework：The package is standardized and its implementation is recommended.

Second step: Developing the health environment in community area

- Definition：A certain number of households already experiences to deal with some hygiene and saniation related issues. This Step is aimed at avoiding water sources pollution caused by the

[2]Source : Developed by the survey team referring to a revision of the Windbland U. & Daddly Diagram, 1997

[3]The related concepts for the establishment of a health environment and improvement of the living environment are often depicted by the image of a staircase that one has to go up step by step (health scale). On the basis of those concepts, it was intended to undertake a stepwise classification of the current situation in order to catch it up in this step of the Master plan.

environmental degradation, such as inappropriate treatment of the various types of waste water, rainwater, domestic wastewater and filthy water also by disposed waste in the villages and in the entire community, in order to prevent an outburst and formation of microbe nests as well as pathogens.

- Status of the target region : A certain number of villages are on this step.
- PEPAM Framework : Along with household level measures, community level measures are recommended for rain water drainage in the area and for improving the health environment. Even if the facilities are defined as public sanitation facilities, the criteria relating to the required capacities and nature for those applying services providers are not clearly defined yet.

Third step: Developping environment imporovement in the area

Definition : In this step a comprehensive and more advance development of public sanitation facilities, as compared to the above two steps is necessary. At the village level some disparities are observed ; a few of wealthier people have latrines or septic tanks for wastewater drainage and this situation is one cause to verify the measures to be taken inside one village. In this step we need to another study for sewage connection with septic tanks and wastewater treatment facilities (including ditch deposits) and large waste treatment plants that may possibly operated in the target region.

- Situation of the target region: These are very few, those grand villages that might become Rural Community County towns[4] are on this step.
- PEPAM Framework: Situation on this step has been beyond the category of rural sanitation development. However, the consideration on the development for semi-urban public sanitation service is urgently necessary.

In the three target regions, most of sites still remain at the first step where it is still necessary to develop basic health environment. However, the communes, commercial hub, transportation hub along the national road, or grand villages along with the Senegal River (more than 5000 population) are on the third steps.

8.3 Basic Rural Sanitation Plan

8.3.1 Designing the basic rural sanitation plan

In order to sustainably improve the living condition in the villages, the related orientations for the sanitation development projects (introducing sanitation systems) will be planned reflecting the mutual relation between water, sanitation and health.

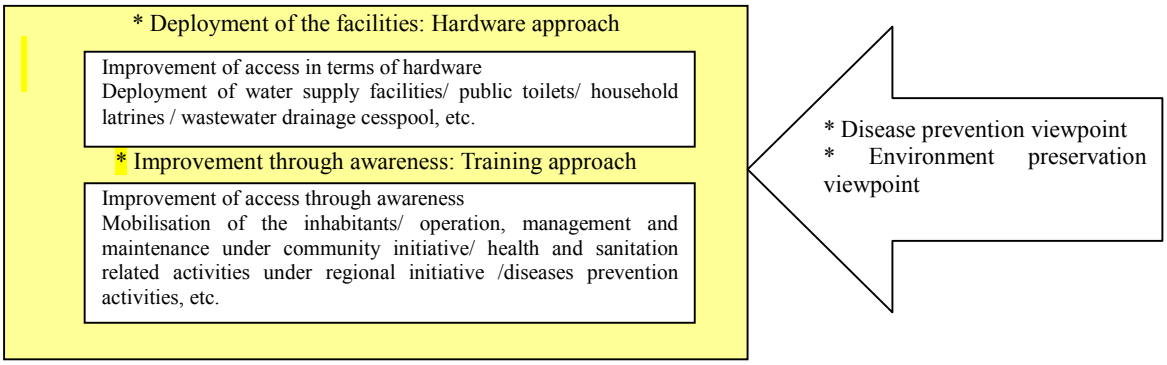

Figure 8-3-1 Conceptual Scheme of sustainable environment preservation

The issues to be considered during the study on the orientations are as follows:

- To increase the number of household latrines, it is indispensable to promote a health and hygiene notions and willingness to improve the environment trough building their ownership of the facilities. The Rural Sanitation Department (DAR) also initiated an approach called as

[4] Rural Community county town

Community-Lead Total Sanitation (CLTS) that particularly stresses the importance of enhancing hygiene notions; in particular the awareness on ora-feces transmitted diseases in order to keep away the villages from excreta. The study on the introduction of such activities is shown herein in section 8.3.4 (4) in Chapter 8 of Main Report.

- To promote a comprehensive hygiene and health education at the village and regional levels, it is desirable to provide with training the community based extension worker (relais) that are the main executing agents of health education activities within the village, and support village level health education activities as well as to train the technicians (masons)[5] who construct the facilities; and on the other hand, combining creation of the system with promoting community participation is indispensable.
- Providing support the Communaute Rurals (CR) that are responsible for establishing Local Water supply and sanitation plans (PLHA[6]), in order to improve information management functions withinis also necessary.
- In order to correctly use, properly manage and maintain the sanitation facilities, village population (users) will be required to bear about 10%[7]of the latrines construction costs. Moreover, it will be difficult for the most disadvantaged village people to afford those 10%, so we propose the establishment of a micro-credit system using the funds or savings of the community based organization (CBO) such as the ASUFOR.

8.3.2 Measures taken in the Master Plan towards sanitation facilities

The status of public and household sanitation facilities deployment, are shown below along with the measures proposed in the present project.

Table 8-3-1 Current status of public sanitation facilities and measures proposed by this project

Specifications	Proposed number of facilities	Measures suggested by the present project
VIP latrines with open ditch	About 90%	Confirming the lapse of time since construction and establishment of a management and maintenance system is indispensable. [Issues to be considered] The existing latrines in schools and health centers in the target region are mostly open ditch VIP latrines. Consequently, in most case the lifespan of the latrines is limited to the capacity of the ditch. We already experienced overflow in some areas and it is quite difficult to keep on using it. Moreover latrines are not provided with lavatories. Such situation is observed in most of the sites in the target region. Consequently, we are suggesting constructing new latrines reflecting the level of priority.
VIP latrine with dual ditch	About 10%	
TCM	Very few	

Remark: As for the proportion of household, the baseline survey results conducted in 2009 for the selection of the priority sites and the results of the baseline qualitative survey were added.

Table 8-3-2 Current status of household sanitation facilities and measures proposed by this Project

Specifications	Proposed number of facilities	Measures taken by the present project
Simple traditional hole	about 80%	Does not match with ongoing sanitation facilities standards and are not considered as existing facilities. Construction of new facilities. [Issues to be considered] Consider that if it may be used continuously until the completion of the facilities, these need to be filled up and not used anymore.
Simple hole fitted with a slab	About 20%	Necessary to check by eyes if it meets the standards. [Issues to be considered] If people keep on using it, raise people's awareness on that fact that it is the lowest health and promote plans for constructing new improved latrines (VIP latrines).

[5] In Senegal masons, refer to standalone sanitation facilities construction technicians.
[6] Local Water Supply and Sanitation Plan: PLHA, established within the RC with the support of the World Bank. (See section 2.2.2 of Chapter 2)
[7] In the household survey results (qualitative survey), 100% of the household expressed their willingness to pay for the cost. On the other hand, if the number of households that agreed to give cash contribution still remains low, most household responded that they could afford about 10% of the costs by providing their labor force or locally available materials.

VIP and DLV	Very few	Give directions on a methodology for an appropriate use, management and maintenance.

Remark: as for the proportion of households, the baseline survey results conducted in 2009 for the selection of the priority sites and the results of the baseline qualitative survey were added.

8.3.3 Project implementation units

According to the survey results, the smallest target unit for the implementation of the master plan will be a village.

Study was conducted to try establishing master plan with the wide scale as based on the village groupe like water supply master plan. However in target region, while considering that differences could not be observed in the mutual relations between the administrative units such as the regions, the departments and the districts, etc.; and the population size among others. It was difficult to specify the parameters enabling making up some large-scale groups. Consequently, the smallest unit in this present master plan will be a village.

8.3.4 Reviewing the Sanitation Master Plan

The sanitation systems include the following three constituents, namely 1) the construction of sanitary facilities, 2) an appropriate application of hygiene notions and health and sanitation related knowledge; and 3) a sustainable implementation system within the villages. It is made of the below six components:

- Component 1 : Construction of household and public sanitation facilities
- Component 2 : Activities to identify local resources (human, budget, existing approach, natural resource…)
- Component 3 : Activities to improve capabilities of human resources
    - Development (training) of rural sanitation education staff (mainly women)
    - Development (training) of technician and staff of ASUFOR or CBO related to amelioration of sanitation condition in villages
- Component 4 : Implementation of activities to improve sanitation concept within village
- Component 5 : Establishment of a sustainable implementation system (including supervision and evaluation)
- Component 6 : Other activities (to prevent open-air defecation)

The study on the content was conducted in line with the results of the study on the sanitation system's components, on the PEPAM monitoring indicator[8] and on the relaxing of the PEPAM specifications already mention in section 2.2.5 in Chapter 2 of Main Report.

(1) Scope of the plan
The scope of the Master Plan will be same as that of the rural sanitation sytstem (onsite saniataion) .

(2) Selecting the target regions for the introduction of the sanitation facilities
For the installation of the sanitation facilities, priority is given to the regions where daily water supply is possible. It is aimed to ensure that an improved sanitary environment will be established in the villages through the sanitation facilities development project and by achieving synergy with the water supply facilities development program. But the water utilized to improve sanitation condition and behaviour change on hygiene and sanitation, it is not necessary to controle water quality as same way as drinking water, also it is essential that the villagers that are forced to use the water from shallow well (puits) or river, need to get knowledge and do appropreate practice concening health and hygiene. So, the selection of the target site shall be taken into consideration for the villages where usually get

[8] Supporting the establishment of system for the monitoring of the Millennium Drinking water supply and sanitation program, Report No2 ; Definition of the final version of the PEPAM monitoring indicators, September 2006,

water neither from water supply facilities or the other source. The procedure of the selection shall be indicated in Table 4-8-2 in 4.8.2 of Chapter 4 of Summary Report.

(3) Sanitation facilities (Component 1)

The provision of sanitation facilitie component is indicated hereinafter. Reffrence designs are shown in Figure8-3-2 until 8-3-5 in Chapter 8, Main Report. As regards the study on the specifications, we referred to the PEPAM criteria and the specifications of 4 household latrines; those are constructed in the project's target region.

Table 8-3-3 Component 1 Rural Sanitation System
(Construction of sanitation facilities)

No	Components	Definitions
1-1	Household sanitation facilities	(i) 2-tank VIP toilet (2 decomposition-tank toilet) Simple handwsh stand Washbasin with drainage ditch
1-2	Public sanitation facilities	(ii) Installation of 2-tank VIP toilet with Handwash stand(2 decomposition-tank toilet) Village washbasin with drainage ditch to be shared by villagers

1) Specifications for the household sanitation facilities

- Type： Dual ditch VIP latrines (2 septic tanks), simples lavatory, washing place with drainage gutter
- Deployment criteria：Plan for the installation of 1 latrine per household, with 1 household = 10 people in villages with more than 500 inhabitants.
- Premises[9] are not taken consideration into this Master plan.
- Conditions：share of the expense by the household of 10% of the construction cost.

2) Consideration on toilet type

Those 4 types of saniation facilities (latrines) were studied with out counterpart DAR by the follwoing points of view: by technical aspects such as the effect on prices, the robust of each type, the security against disease and for employement, also difficulty level for maintenance, the possiblitiy of firmly established the correct usage, and the applicaition of local community.

Table 8-3-4 Hosehold latrines suttisfied PEPAM's criteria and those promoted in target regions

Improved latrines suttisfied PEPAM's criteria	(1) 2- tank VIP toilet (VIP double fosse) (2) Pour-flush latrine
Constructed latrines in target regions (added to above 2 types)	(3) Urine-diversion toilet (ECOSAN toilet) (4) 2-set Ventilated latrine (DLV)

The survey results are shown in the 3.1 of Chapter 3 on the "Technical Options for sanitation facilities" in the Supporting Report.

a) Result comparison of 2-tank VIP toilet and 2-set Ventilated latirne

The relaxation of the technical standard of latrines at the PEPAM in year 2009 encouraged to construction of DLV by developpement partners. The study team examined and compared each type of latrines for elaboration of master plan in target areas, achiedved at the result that VIP double fosse is much prefable in three regions because; large number of shallow wells are still under used, ground elevation is low, and gross wadi usually formes in the rainy seasons. The procedure of comparison is shown in 8.3.4 (3) of Chapter 8 in Main Report.

b) Concerning Kedougou reagion

Because of the solid rock ground is layed in n Kedougou region, it is desirable that the infrastructure

[9]One premises corresponds to a residential unit where several households belong to the same family or else live together, with 10 people or more living in the premises.

might be durable for long-term use once we excavate the pit for latine, at the view of cost effectiveness. Furthermore, the construction cost for DLV shall be much higher than other areas because of that gound condition. Fundarmentaly, in these kinds of areas the ECOSAN type toilet, which is not necessary the gross excvation for infrastructure shall be recommended. However in order to introduce ECOSAN, we need to combine those component of small-scale agricultural promotion or environmental sanitation promotion component, for getting better undersand for re-cycles usage of human excreta and it requires certain period. So, we reached a conclusion to adopt VIP type in this Mater Plan.

3) Study on the Washbasin with drainage ditch at household

Concerning sanitation facilities in the project, it was recommended under PEPAM to construct Washbasin with drainage ditch at the household. The respective results were not obtained in the target regions but collected by the survey team in other reasions, the households that own this kind of facilities declared that it contributes to improving health conditions. Moreover, if ever it is planned to construct sanitation facilities as a combine compornet with the water supply project, that there are high possibilities for having smooth procurement system for construction materials as well as providing technical support in construction works itself, so that study team will integrate it as a compoment of Master Plan.

4) Specifications for the public sanitation facilities

a) Specification

Type：4 toilets with 2- tank VIP toilet, 1 handwashing stand, 4 booth par building

Installation criteria: as indicated below

b) Requirements

・ Conditions: Installation of extention pipeline to the lavatory by the CR exercises juridiction over the water supply area.

Public facilities	Schools/Health centers	Places of worship	Public place
Installation criteria	2 buildings in one place (female and male)	ditto	Villages with more than 500 inhabitants 1 latrine/ 500 inhabitants
Target users	Population using the public facilities		Collective use

5) Study on public sanitation facilities

Concerning public toilet, VIP double fosse latrine (two-tanks) will be adopted it as in household. As regards the number of toilets per one block , we compared the model observed so far, which is composed of 6 toiletes and the above model that includes 4 toilets per block. Thus, it is assumed that the cost-effectiveness for VIP double fosse latrines will increase. Consequently, this type of latrine was selected even applying a ratio of one open ditch latrine for 100 people as suggested by PEPAM, so we considered that it was relevant having 4 toiletes per one block.

(4) Priority of the installation place for public sanitation system

According to discussion and mutual agreement with counterpart DAR, the priority of the installation place for public saniation system shall be as follows. The priority is given to those important public institutions in villages.

Table 8-3-5 Installation priorities for public sanitation system in village

Priority	First (same priority)		Thrid place	Fourth place
Place	School	Health service institution	Cultural institution	Public space

1) Schools and Health service institution

In the villages that both have one school and one health center, it would be desirable undertaking a simultaneous installation of latrines in both institutions, The blocks are always planned separately for one female and one for male. In this water supply master plan, schools and health service institution

will be always installed one public faucet so that CR will not be face to the difficulities of pipeline extention when the project will be inpremented in this master plan’s framework.

2) Public Place in a village

The pubic toilet in fourth place for public space has a different orientation, as the users are unspecified larger numbers than other public saniataion system. In the village with an over 500 populations where the population has willing to use and to handle collectively together with other villagers, unless they have no measure to settle their own latrines, this kind of public latrines installation will be promoted.

(5) Technical support (Components 2 to 5)

Rural sanitation promotion project shoule be consisting of those components that correspond to the acutual sanitation environment. In order to execute the construction component, the sensitizing activities such as the hygiene and sanitation promotion and for the durable system establishing should be carried out before or at the same time of the construction works for sanitation installation.
The table below summarizes the provided technical support, in terms of soft component.

Table 8-3-6 Component 2 to 5 rural sanitation systems (technical support)

Component	Content
2. Resources development activities	
2-1 Confirmation of villages resources	Use the existing organization without setting up a new committee. Identify local resources (human, budget, existing approach, natural resource…)
2-2 Supporting activities for the introduction of public sanitation facilities	For the latrines to be installed in public institutions or places, it is necessary to identify the situation with each institution, village or responsible CR Confirm the existing management and maintenance system.
3. Human resources capacity building activities	
3-1 Training for rural health and hygiene stuffs	To train the rural health staffs (mainly women[10]) in the village (health extension female officers or ／Focal point/ members of the health personnel
3-2 Training for technicien or staffs of ASUFOR	Assuring the necessary human resources (technicians/ masons/staff of ASUFOR/CBO) to continue the diffusion of the improved latrines, related to amelioration of sanitation condition in villageswithin the villages.
4. Content of activities relating to the improvement of hygiene notions	
Activities for the improvement of water and hygiene related notions	Improvement of the households’ health condition using mainly the PHAST method, awareness raising activities on the protection of the regional water resources and improvement of village environment (using the results of PEPTAC 2 by JICA)
5. Content of the activities relating to the set up of a sustainable implementing system	
Supporting the regional administrations in supervision activities	Creation of some measures to be supported by the CR as the responsible bodies for the rural water supply and sanitation plan ; while enabling an identification of the situation surrounding the introduction of the sanitation facilities and the implementation of sensitization activities for behavior change ; as well as monitoring activities. It would be desirable to provide for monitoring elements to be shared between ARDs, the regional branches of the National Hygiene Department and the Regional Offices of the Ministry of Health in order to manage and collected at all levels, CR, district administrations, departments and regional levels.

(6) Other components of the rural sanitation system

Table 8-3-7 Component 6 of the sanitation systems (other activities)

6. Other activities	
Sensitization activities aimed at preventing open defecation	Sensitization activities aimed at preventing open defecation using the "Community-Lead Total Sanitation (CLTS[11])" (including individual initiatives for latrines construction by villagers and capacity building for the facilitators conducting directly the activities in the villages.

1) Elements involved in the establishment of the CLTS

- Installations : Installation of traditional latrines, stressing the importance of eliminating open air defection habits while giving due consideration to security

[10] In the target area, they are called Relais féminin.
[11] For further details on Assainissement Total Piloté par les Communautés (ATPC); Community-Lead Total Sanitation: CLTS), refer to the supporting report.

- Implementation criteria : Villages with less than 500 inhabitants, located in an isolated region with a high proportion of population used to open air defecation habits. (CLTS implementation test score was 24% but there still is room for some revisions by each project.)
- Conditions : As a result of the sensitization activities, villagers themselves constructed latrines with the available materials at the village level. In such case, latrine specifications do not necessary match with the standards but this could be considered as a first step as far as hygiene is concerned and as a first step towards future improvements.

2) Study of the establishment of the CLTS

As indicated in Chapter 2, even if in August 2010 the CLTS test phase was considered as successful, there still remain some issues to be studied. The issues that might be considered as the most important are the ones relating to the specification of the constructed facilities and to the quality of the works. Each issues is analyzed in 8.3.4(5) of Chapter 8 in Main Report and in 3.5 of Chapter 3 in Supporting Book. In January 2011, CLTS approach is defined as "sentiziting activities for behaviour change concerning hygiene and sanitation" in Senegal (See 2.2.8 in Chapter 2 of Main Report). After pilot project in Bani Israel, SNH continues their activities with CLTS at 60 villages in three regions of Tambacounda, Kolda and Fatick. This activities also permited us that CLTS shall be positioned as "supporting acitivities of soft component". CLTS is to be effective in the area where the elements number 1) as above confomed and with the small amount of budget.

(7) Numbers of sanitary facilities along with Water Supply Project

Numbers of sanitary failicities constructed along with water supply project shall be defiend; as for individual saniation be 10%, as for public sanitation be 1% of village population as follows;

Table 8-3-8 Numbers of Sanitation facilitieis allong with water supply project

	Water supply facilities	Pop. 2002	Pop. At target year	Individual Saniataion facilities (10% of Pop.)	Numbers of place for Public sanitation (1% of Pop.)	Numbers of bloks of public toiltes (Places x 2, one for each sex)
Short Temr by year 2015						
Tambacounda	47	79 334	116 505	11 650	1 163	2 326
Matam	25	50 950	76 346	7 635	762	1 524
Kedougou	13	20 007	29 381	2 938	293	586
Middle Term by year 2021						
Tambacounda	62	70 682	123 941	12 394	1 237	2 474
Matam	26	20 234	50 475	5 047	502	1 004
Kedougou	10	9 912	17 381	1 738	174	348
Long Term by year 2027						
Tambacounda	82	61 350	128 453	12 845	1 280	2 560
Matam	28	14 120	29 564	2 956	151	302
Kedougou	11	7 236	15 151	1 515	151	302

8.4 Methodology for introduction of rural sanitation system

8.4.1 Implementing system for the introduction of facilities

At this present time we may identify the Ministry of Town planning and Sanitation and the Ministry of Health and Medical Prevention as the major organizations playing the key roles in the rural sanitation development projects in Senegal. The Regional Development Agency (ARD), under the Ministry of Decentralization acts as the responsible body for onsite coordination. In addition, the Department of Sanitation, under the Ministry of Urban planning and Sanitation is the body in charge of implementing the water supply and sanitation projects recently undertaken by the other donors, under PEPAM, whereas the Reginal Office (SRA) are responsible for onsite supervision.

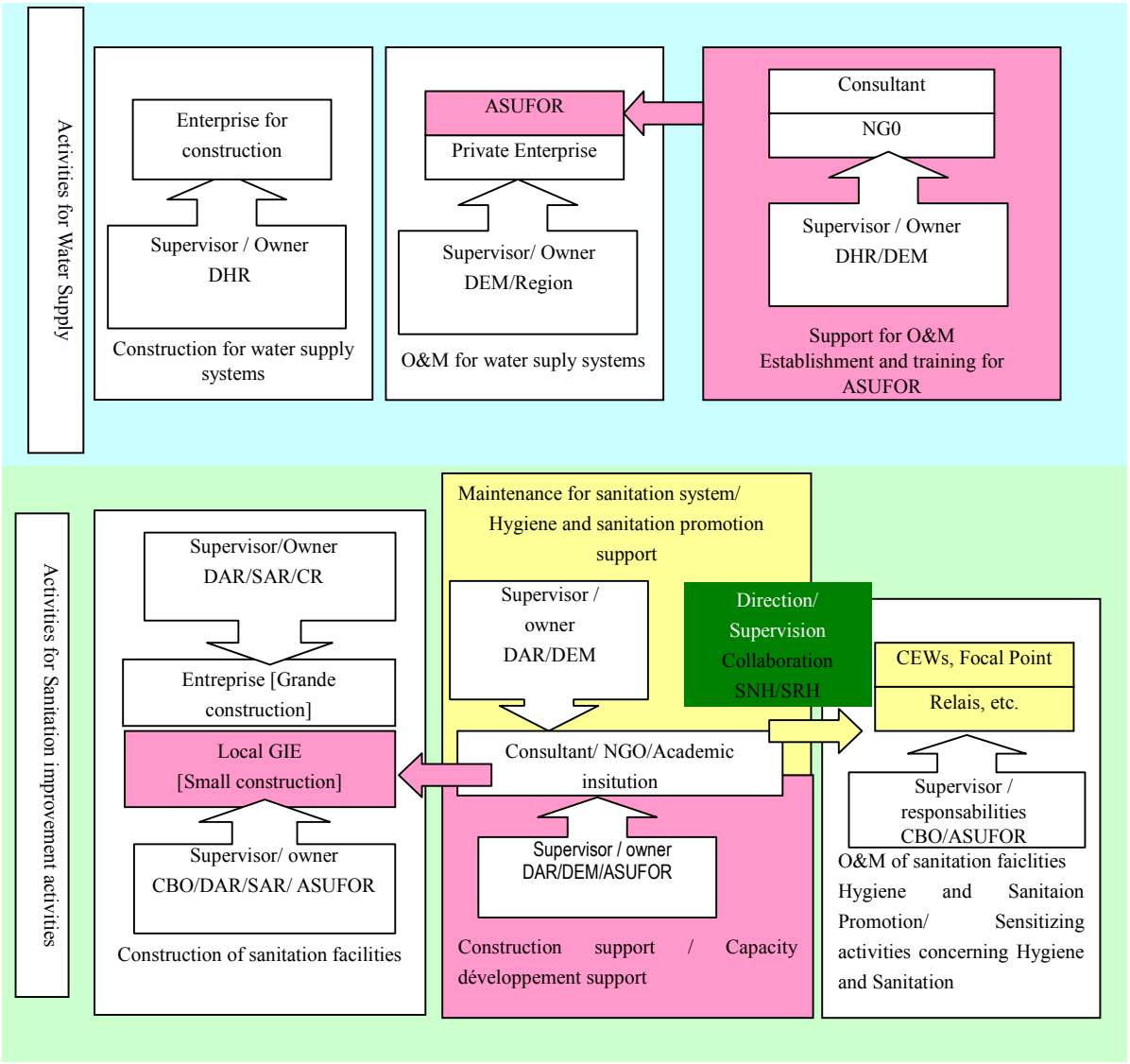

Figure 8-4-1 Conceptual Schema for exécution of Rural Water and Sanitation project

8.4.2 Executing bodies of the sanitation components in villages

The sanitation facilities installation project's implementing system is as indicated in the above figure and the roles and responsibilities of the village-level executing bodies are shown below.

(1) Constructing the sanitation facilities
Personnel：Masons (Technician), GIE（Economic Interest Grouping）
Role：Construction of latrines（Benefit: remunerated (each order）

Conducted to have sanitary latrines for every household. The masons in charge of constructing the latrines are trained under the frame of the projects by NGOs or consultants, at the ratio of one or two people referring to the regional administrations' unit base (RC and village units, groupings of villages). It generally is On-the-Job-Training (OJT). Employment and payment conditions vary from one project to the other.
(When GIEs are incharge of construction, the training program will not be provided.)

(2) Hygiene and Sanitation promotion (providing awareness program)
Personnel：Commuity Extension workers (female)-Focal Point -Sanitation Officer[12]
Role : Coordination among the villages and the ASUFORs, and the SBH (Sous- Brigade de l'hygiène) and SRH (officials of the Ministry of Health). Implementation of promotion activities in order to make behaviour change with improved health related knowledge as well as identification of the situation regarding the diseases.（Benefit: remunerated/free）

One person from the village or villages where there is an ASUFOR, one person selected by that association. Women are mainly selected. If ever there are differences between projects regarding training courses related to the health and sanitation with focusing on water; PHAST and SARAR methodologies are generally used. As for conducting training activities, the CREPA （Centre Régional pour l'Eau Potable et l'Assainissement à faible coût）Dakar that are mainly involved, and there is other initiative (Training on Trainers) like made in JICA PEPTAC 2. Regional Health Officer attends the training courses on the PHAST methodology that provide by PEPTAC2 project and they train some focal Points or a female extension workers in the target village.

(3) Project Implementation drive in village
Personnel: village people
Role: Training for self-awareness as project beneficiaries and autonomous participation in the activities organized in order to promote transparency, equality, sustainability and future planning of the project. The voluntary participate in the activities to improve the sanitation environment in the village is desirable.

(4) Project implementation supervisors
Personnel: Personnel of local administrations, mainly CR
Role: Measures in order to identify all the projects involved in sanitation systems' installation, supervision, support to village activities, ripple effect on the neighboring regions, etc.

8.4.3 Management and maintenance of the public sanitation facilities

The operation and maintenance of public institutions' latrines will be the responsibility of the respective institutions, as the use of the latrines being reserved for the persons related with the institutions or with the institution's users. Those latrines could normally be used sustainably while preserving its good hygiene status and cleanliness by conducting supporting activities aimed at promoting improved hygiene notions in rural areas; based on the consideration of the each character of those institutions, it will be possible to identify the users, so that sustainable use shall be possible with the sanitation facilities meet PEPAM's standards.

8.4.4 Methodology for the selection of the project components

The present sanitation condition in the three target project regions is generally largely identical[13]. If the number of household latrines possession is higher in Tambacounda region than in the two other regions, traditional latrine (with single hole pits) that do not match with the criteria are still mostly used. Referring to the aforementioned and depending of the scope of the projects, the below implementation diagram is suggested for appropriately selecting the project implementing components.

[12] Terms used in Senegal (from left to right): Relais féminin, Point focal, Agent sanitaire
[13] The baseline survey for the selection of the priority projects conducted in 2009 shows that malaria is the top disease among water-borne diseases, in front of diarrheal diseases. The number of people suffering from other types of water-borne diseases (schistosomiasis, skins diseases such as scabies) is also high although the year.

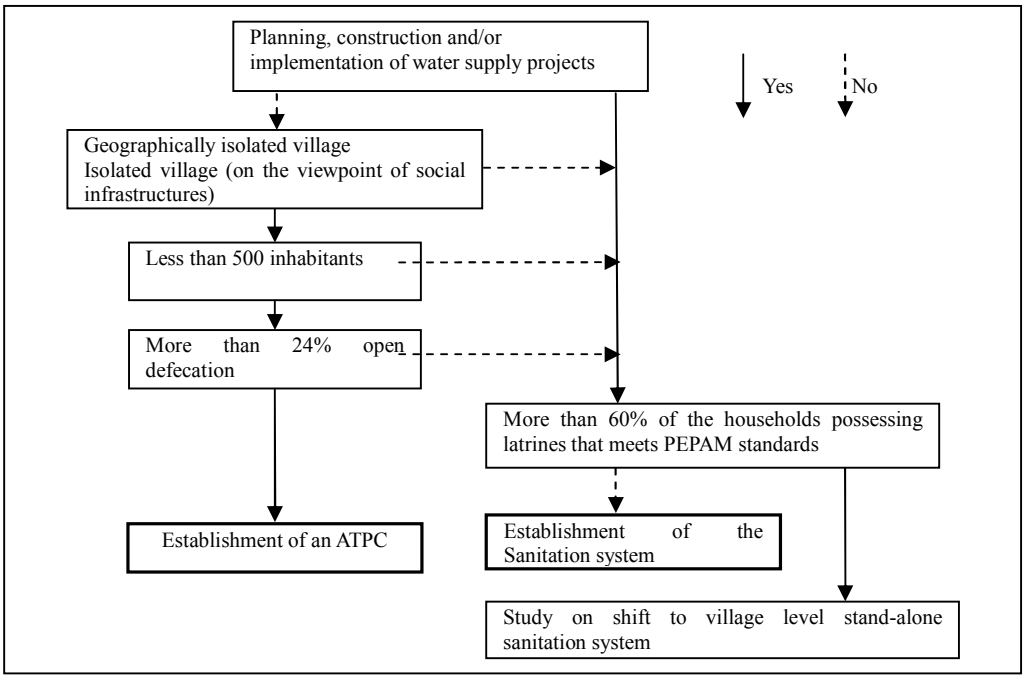

Figure 8-4-2 rural sanitation service components' selection Diagram

8.5 Establishment of the sanitation system

Some proposals are shown below for the implementation of the sanitation systems. The component combination modifications are possible depending on various project situations. Details of each system are shown in 8.4.6 Chapter of Main Report.

(1) Establishing the total sanitation system in the rural areas

[Objectives] To construct household sanitation facilities and public sanitation facilities in the villages. To strengthen the capacities of the human resources in order to create stand-alone sanitation systems in the villages
[Achievement indicators] Number of latrines installed, trained extension officers, number of masons, total contribution from the households, entering of public sanitation facilities management records, elaboration of rural sanitation activity planning.
[Component to be implemented] 1-1) Construction of household sanitation facilities, 1-2) construction of public sanitation facilities, 4) Water and sanitation related notions promotion activities, 2-1) verification of the resources in the village, 2-2) supporting activities for the introduction of public sanitation facilities, 3-1) regional health authorities management training activities, 3-2) training for the people in charge of constructing the rural sanitation facilities 5 Support for the supervision of the local administrations

1) Support activities for capacity development: Technical staffs works for water supply systems
In the area where water supply system managed by ASUFOR, maintenance of water supply facilities training program that bases on the view of hygiene and sanitation will be provided at the time of creation or re-training the ASUFOR. Especially for pump operator who works daily with the equipment and the facilities, insiste the importance of keeping cleaness for water source srounding, inside pomp machinery house also in the water tanks. Furthermore, to make them understand that there is a possibility of the antropogenic water contamination by themselves due to poor quality of pulumbling wrok for household connection as well as repair work for berried pipes, water taps, and so on. At the same time, counter measures for those issues also provide sufficiently.

2) Hygiene and sanitation promotion activities / population mobilization activities in a village

At the time of commencement of sanitation improvement project, it is important that the villages themselves should analise themselves and might have their notice for actual situation (baseline) inside their village, along with the participatory method (PRA, PHAST/ SARAR). The series of activities with PHAST method as the contents of support is proposed as follows. In addition, the guideline that was elaborated in JICA PEPTAC 2 can be adopted.

3) Series of Hygiene and sanitation promotion (For exemple)

Appropriate hygiene habits / practice	Applied PHAT tools (situation analysis, promotion)
1) Selection of water source, utilization of water	
・ Fetch the water from protected source	Community mapping /Pocket chart
・ Conserve the fetched water ・ Purified water as the safe water	Three piles sorting card
2) Daily hygiene habits	
・ Use one fixed toilete	Sanitation ladder/ Pocket chart
・ Wash-hands after defecation ・ Wash-hands after care the babys defecation ・ Wash-hand before cooking ・ Keep clean own body ・ Landry/ washing in fixed place, maintain the used water (drain)	Pocket chart / Three piles sorting card
3) Knowledge concerning water related disease (diarrhea/ parasite)	
・ Obtain correct knowledge and make counter measures	Disease Transmission / Barrier for Disease Three piles sorting card (oral-feacal disease)
4) Improvement of villages sanitary environment	
・ Do the SET-SETAL (Cooperative cleaning), ・ Making barrier sorrounding water source against livestocks, ・ Collecting and treatement of gabages, settle the compost fields	Open ended story, etc...

(2) Total rural sanitation system using CLTS 《 Community-Lead Total Sanitation 》

[Objectives] Total elimination of open defecation. Construction of first rate sanitation facilities.
[Implementation indicators] Elaboration of village maps (situation of sanitation), number of households engaging to fund the construction of sanitation facilities, elaboration of an open defecation elimination plan in the village, number of constructed household latrines and number of days before the completion of the works.
[Implementation component] Water and health related notions' improvement activities, 2) implementation of the Community-Lead Total Sanitation (CLTS)

(3) Possibilities for establishing a stand-alone sanitation system in the village (Semi-collective sanitation)

As shown by the above Figure 8-4-2, in villages with more than 60% households possessing improved sanitation facilities or as indicated in the paragraph on the current situation (Chapter 2), in order to avoid the degrading or making more serious the sanitation problem in big semi-urban villages, it is necessary to study the possibilities for the set up semi-collectif sanitation systems in those villages.
"The other technical options" stated in 3.2 of Chapter 3 in Supporting Report shows that the possibilities of introduction for TCM type toiletes in the villages where the usable water quantity per day would increase. The other, for the possibility of collective implementation of wastewater treatment or the collective excreta treatment with sewerage pipe, collective waste management are undertaken at the village level with the neighboring villages in the same CR. Details are shown in 8.4.6(3) of Chapter 8 in Main Report.

Component of a semi-collectif sanitation system in the village

1) Establishment of a TCM and establishment of wastewater treatment system.
Element to be study:
Ensuring water treatment; an environment favorable or not where the treatment of collected excreta is done properly; possibility for installing sewerages pipes with treatment tanks to undertake collective treatment.

2) Study the possibility for installing a site for collective waste treatment in the village
Elements to be studied : Are Collection and sorting of waste possible? Does the environment enable collective collection and treatment of the waste?

Semi-collectif sanitation system based in the big villages or CR (semi-collective sanitation)
[Pilot installation for targeting the development of directives for the semi-collectif sanitation systems in the rural areas]

Prior to the study on the implementation of the urban type sanitation improvement project in the village and at the stage of establishing the development conditions, we will try and set some directives. Such directive will aim at improving the village environment through compound activities in order to improve regional health conditions, and through various examples obtained from a process aimed at establishing models sites to be made more attractive.

[Establishment conditions]
1) In the event flush toilets (including TCM) are installed, consideration of install collective septic tanks, sewerage pipes and to install the night-soil collecting systems while reflecting the consideration relating to environment preservation with all over the region.
2) As a regard of waste treatment, we will study the possibility for creating a waste collection system and constructing a waste treatment station (dumping site), that will be properly taken by good management and maintenance.

(4) Introduction of sanitation activities in schools

As for the children those have future responsibility for their communities, it would be effective introducing a health education component on the viewpoint of medical prevention, dealing with everyday life usages aimed at protection against existing diseases, the importance of ensuring a healthy surrounding environment ; and moreover conducting school cleaning activities in order to keep schools cleanliness, providing directions on appropriate defecation habits and correct toilet operation and maintenance systems. Also to organize training activities where children play the key role on hygiene and saniation promotion, as part and parcel of the improvement of the regional communities' living conditions. Based upon such concept, we are suggesting the introduction of the following activities.

SchoolSanitation Program (HAMS : Hygiene and Sanitation at School): Reference Example

Such approach aims at reflecting the effects from hygiene and sanitation related principles with children being the focal points; from children to children, from children to parents and families, from families to neighboring families and from neighboring families to the region.

Under HAMS activities, the schools are considered as information sources and we may expect that this will further enhance the effects on the neighboring communities, considering the close relation with influential persons and community representatives.

8.6 Verification of the effects of the Master Plan on sanitation

This Master Plan was developed to contribute in the short term to the achievement of the Millennium Development Goal in Senegal, while programming a project implementation plan under the form of a package setup a sanitation system improvement, along with the implementation of the water supply facilities construction project. The implementation of the project under the package form with water sypply project is also a precondition for being able to indentify the mid-term and long-term objectives. In order to reduce the prevalence of the waterborne diseases in the villages, which is a major problem in the target region, the priority action is constructing individual sanitation facilities; this is the most appropriate way to improve hygiene conditions within the village. The construction of sanitation facilities at the household level, combined with water supply facilities will better directly preserve women and children's health.

The effects from the project implementation as a package will be measured in the feasibility study on the priority projects.

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Chapter 9 Prediction by 3-Dimensional Groundwater Model

9.1 Prediction Analysis in accordance with the Master Plan (M/P)

The following three scenarios based on the M/P described in Chapter 4 were made and the groundwater drawdown was examined according to the water supply facilities construction and pumping (prediction period: 25 years from 2008 to 2032).

- Scenario 1: No changes to population or water supply facilities
- Scenario 2: Population growth rate 0% and construction of water supply facilities according to M/P
- Scenario 3: Population growth rate 3% and construction of water supply facilities according to M/P

In the M/P, the target years were set as follows:

- Short-term plan: 2015
- Medium-term plan: 2021
- Long-term plan: 2027

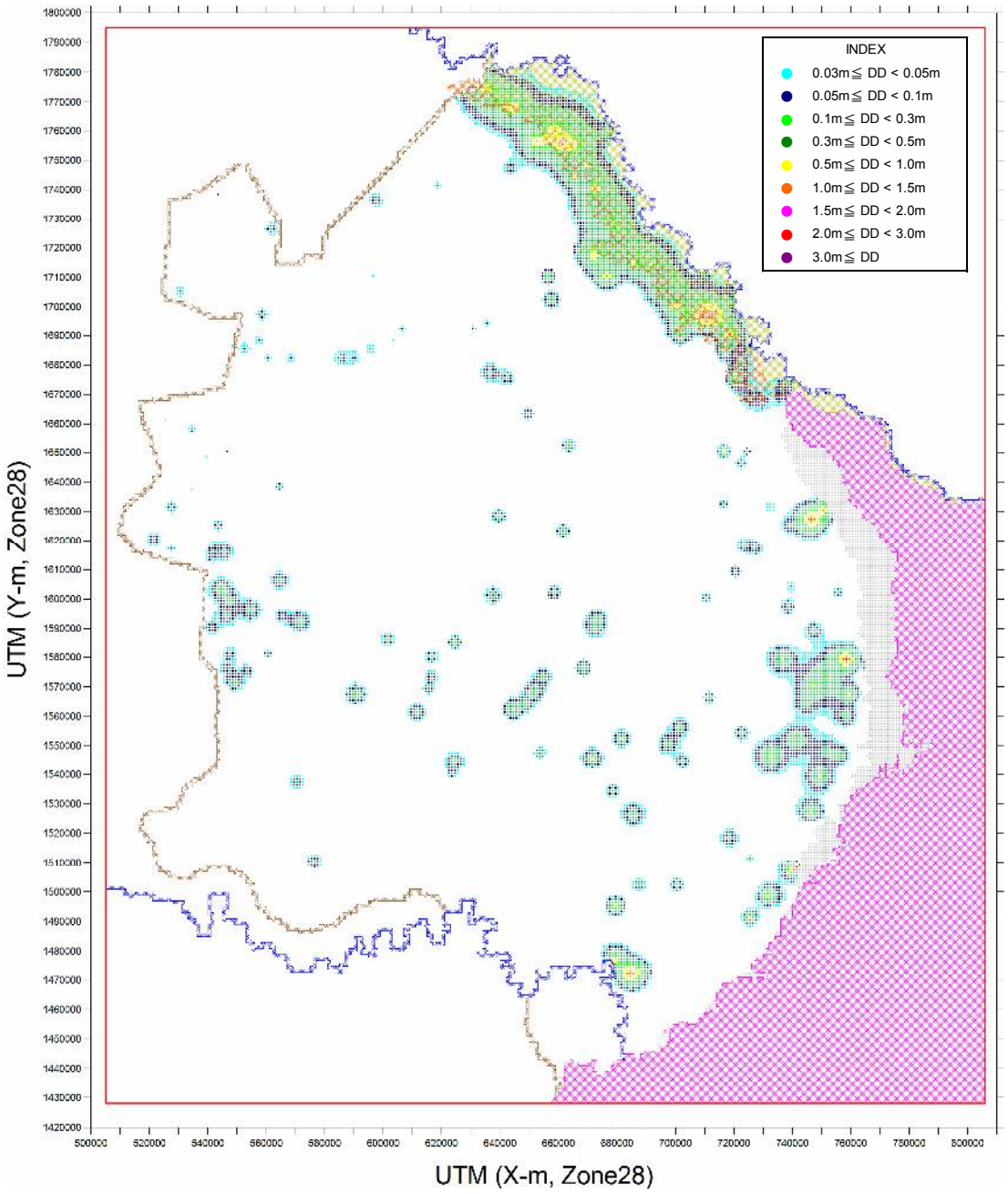
The groundwater level is to be calculated one year after each target year (one year after the completion of all water supply facilities planned in each term) and five years after the end of the long-term plan. Fluctuations of groundwater levels were calculated for each scenario listed above, and differences between scenario 1 and scenario 2 and differences between scenario 1 and scenario 3 were calculated.

The above-mentioned maximum values for differences of groundwater level are shown in Table 9-1-1.

Table 9-1-1 Maximum values of groundwater drawdown resulting from the construction and rehabilitation of water supply facilities in accordance with M/P

Scenario	Aquifer	31/12/2016	31/12/2022	31/12/2028	31/12/2032
Scenario 2	Co aquifer	0,83m X : 654 500、Y : 1 474 500	1,33m X : 654 500、Y : 1 474 500	1,62m X : 654 500、Y : 1 474 500	1,75m X : 654 500、Y : 1 474 500
	Ma aquifer	1,49m X : 709 500、Y : 1 697 500	1,79m X : 709 500、Y : 1 697 500	1,97m X : 709 500、Y : 1 697 500	2,07m X : 709 500、Y : 1 697 500
Scenario 3	Co aquifer	1,03m X : 654 500、Y : 1 474 500	1,87m X : 654 500、Y : 1 474 500	2,60m X : 654 500、Y : 1 474 500	3,10m X : 654 500、Y : 1 474 500
	Ma aquifer	1,61m X : 709 500、Y : 1 697 500	2,05m X : 709 500、Y : 1 697 500	2,42m X : 709 500、Y : 1 697 500	2,67m X : 709 500、Y : 1 697 500

An example prediction is shown on the next page (Figure 9-1-1).



UTM (X)	UTM (Y)	Drawdown (m)	VILLAGE_PR	REGION	DEPARTMENT	ARRONDISSEMENT	CR
709 500	1 697 500	2,67	Ndendory	MATAM	KANEL	SINTHIOU BAMAMBE	SINTHIOU BAMAMBE
684 500	1 472 500	2,64	Madina Couta II	TAMBACOUNDA	TAMBACOUNDA	MISSIRAH	DIALACOTO
758 500	1 579 500	2,39	Dindoudi Daka	TAMBACOUNDA	BAKEL	GOUDIRI	GOUDIRY
712 500	1 697 500	2,38	Hamady (Amady) Ounare	MATAM	KANEL	SINTHIOU BAMAMBE	SINTHIOU BAMAMBE
713 500	1 697 500	2,25	-	-	-	-	-
746 500	1 627 500	2,18	Thiengolel Demba. Djiby	MATAM	KANEL	ORKADIERE	AOURE
678 500	1 476 500	2,11	Ouassadou Depot	TAMBACOUNDA	TAMBACOUNDA	MISSIRAH	DIALACOTO
741 500	1 508 500	2,04	-	-	-	-	-
740 500	1 508 500	1,95	Kothie	TAMBACOUNDA	BAKEL	BALA	BANI ISRAEL
741 500	1 507 500	1,84	-	-	-	-	-

Figure 9-1-1 Distribution of groundwater level difference between scenario 1 and scenario 3, and top ten grids of groundwater level difference and villages included in these grids
(Ma aquifer, 300 steps: 31/12/ 2032)

9.2 Impact from Nearby Wells

Regarding individual wells, it is difficult to understand the impact of pumping wells nearby, because the groundwater model described in the previous section is analyzed with a 1km mesh. In the case of new well construction in the neighborhood of a water supply well, the impact (drawdown) on the latter from the former can be estimated by a simple method (Cooper-Jacob equation).

When the coefficient is assumed as follows, depending on the distance from the pumping well and the elapsed time, the drawdown values change as shown in Table 9-2-1.

Q: 800m3/day, T: 300m2/day, S: 0.005

Thus, when a well for agriculture is constructed or two or more wells in one water supply facility are planned due to the necessary water volume, it is preferable to examine the impact on the existing well by roughly calculating as in the above-mentioned method during the planning stage, and to advance the project considering the submerged depth, pump power, position and other parameters of the existing wells.

Table 9-2-1 Interference drawdown (distance-pumping time)

Lapsed days Distance from pumping well (m)	1	2	3	5	7	15	30	185	365	730	1 095	1 825	3 650
0,0762	3,60	3,74	3,83	3,94	4,01	4,17	4,32	4,70	4,85	4,99	5,08	5,19	5,33
1	2,50	2,65	2,74	2,85	2,92	3,08	3,22	3,61	3,75	3,90	3,99	4,10	4,24
5	1,82	1,97	2,05	2,16	2,23	2,40	2,54	2,93	3,07	3,22	3,31	3,41	3,56
10	1,53	1,67	1,76	1,87	1,94	2,10	2,25	2,63	2,78	2,93	3,01	3,12	3,27
20	1,23	1,38	1,47	1,58	1,65	1,81	1,95	2,34	2,48	2,63	2,72	2,83	2,97
30	1,06	1,21	1,29	1,40	1,47	1,64	1,78	2,17	2,31	2,46	2,55	2,65	2,80
50	0,85	0,99	1,08	1,19	1,26	1,42	1,57	1,95	2,10	2,24	2,33	2,44	2,58
100	0,55	0,70	0,78	0,89	0,96	1,13	1,27	1,66	1,80	1,95	2,04	2,14	2,29
200	0,26	0,40	0,49	0,60	0,67	0,83	0,98	1,36	1,51	1,66	1,74	1,85	2,00
300	0,09	0,23	0,32	0,43	0,50	0,66	0,81	1,19	1,34	1,48	1,57	1,68	1,82
400	0,00	0,11	0,20	0,31	0,38	0,54	0,68	1,07	1,21	1,36	1,45	1,56	1,70
500	0,00	0,02	0,10	0,21	0,28	0,44	0,59	0,98	1,12	1,27	1,35	1,46	1,61
1 000	0,00	0,00	0,00	0,00	0,00	0,15	0,30	0,68	0,83	0,97	1,06	1,17	1,31
1 500	0,00	0,00	0,00	0,00	0,00	0,00	0,12	0,51	0,65	0,80	0,89	1,00	1,14
2 000	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,39	0,53	0,68	0,77	0,87	1,02
2 500	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,29	0,44	0,58	0,67	0,78	0,93
3 000	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,22	0,36	0,51	0,59	0,70	0,85
3 500	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,15	0,30	0,44	0,53	0,64	0,78
4 000	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,09	0,24	0,39	0,47	0,58	0,73
4 500	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,19	0,34	0,42	0,53	0,68
5 000	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,14	0,29	0,38	0,48	0,63

(Unit: m)

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Chapter 10 Feasibility Study (F/S)

10.1 Outline of Feasibility Study

10.1.1 Objectives

The F/S was conducted in order to verify the possibility for realization of the plans for projects in the master plan which target the sites where early implementation is anticipated with high priority.

10.1.2 Contents

The F/S is composed of the following items and the results of selection of the target sites are shown in Section 10.2. The implementation sites for F/S were selected in the view of the Urgency of water need, capability of maintenance.

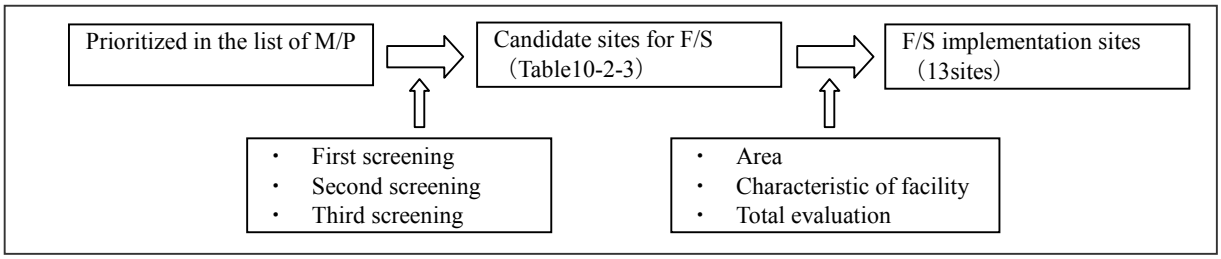

図 10-1-1 Flow chart of site selection for F/Simplementation

（1） Site Selection
（2） Route Surveying
（3） Water Supply Planning and Draft Design Survey of Facilities
（4） Cost Estimations on Construction and Operation and Maintenance
（5） Survey on Plan for Operation and Maintenance of Facilities

10.2 Selection of Target Sites for Feasibility Study

10.2.1 Method of Selection

The target sites of the F/S were selected from the priority list shown in the Chapter 5 “Design of Water Supply Facilities” through the following three steps of screening.

(1) First Screening
The first screening selected the 103 groups where “projects are desirable to be implemented before 2015”, graded as “A” in the priority list prepared by M/P. (Refer to Appendix A-1)

(2) Second Screening
In order to avoid uneven distribution of the target sites, one group was selected from each CR (village community). In addition, the groups having geographical conditions suitable to propose systems such as AEMV-T or AEMV-I were given priority. As a result, the groups were narrowed down to 21 in total. (Refer to Table 10-2-1)

(3) Third Screening
In order to further narrow down the number of groups, the study team evaluated them in view of difficulty for water supply and operation and maintenance of water supply facilities.

10.2.2 Results of Selection

The following 13 groups were selected as targets for F/S.

Table 10-2-1 Number of Selected Groups for F/S

Area Division	Number of Groups					
	AEMV	AEMV-I	AEMV-T	AEMV-S	AEMV-ST	Total after Evaluation
Western Tambacounda	2	2				4
Eastern Tambacounda		1	1	1	1	4
Matam		2	1			3
Kédougou	2					2
Total	4	5	2	1	1	13

Table 10-2-2 Target Group of F/S

Area	System No.	Village Community (CR)	Village Group		Expected Centre Village
			Code No.	Population	
Western Tambacounda Region (Tambacounda Department)	1 AEMV	Kouthiaba Ouolof	KUK-14	2247	Sare Woka
	2AEMV	Missirah	MMS-5	1924	Madina Diakha
	3 AEMV-I	Neteboulou	MNE-5	337	Djinkore Peulh
			MNE-6	557	Sare Saloum
			MNE-7	1977	Sitalule Mandingue
	4AEMV-I	Kahene	MKA-7	1273	Kahao Moussa Sy
			MKA-8	1080	Silame
			MKA-9	1151	Kahao Tabane
Eastern Tambacounda Region (Bakel, Goudiry Departments)	5 AEMV-T	Shinthou Fissa	KSF-9	1424	Seoudji
			KSF-10	1704	Youpe Hamadi
			KSF-11	712	Shinthiou Fissa
			KBE-3	1360	Gourel Mamadou Bara
	6 AEMV-I	Goudiry	GGO-4	330	Sinthiou Oumar Lile
			GGO-5	1360	Shinthiou Mamadou
	7 AEMV-ST	Balou	BBL-8	3294	Koungany
	8 AEMV-S	Sadatou	KDS-10	2599	Sadatou
Matam Region	9 AEMV-T	Aoure	OAO-5	240	Thingolel D. Djiby
			OAO-6	381	Niagana Thiedel
			OBO-10	876	Alana
			OBO-11	3417	Bondji Bally
	10 AEMV-I	Oualaye	VOU-16	726	Nghala Ndao
			VOU-17	446	Vendou Boubou
			VOU-18	2276	Samba Douguel
	11 AEMV-I	Bokiladji	OBO-6	840	Appe Dialube
			OBO-7	2276	Gangeul Maka
			OBO-9	1126	Kaval
Kédougou Region	12 AEMV	Banda Fassi	BBF-17	2524	Samecouta
	13 AEMV	Tomboron Koto	BTO-6	2051	Mako

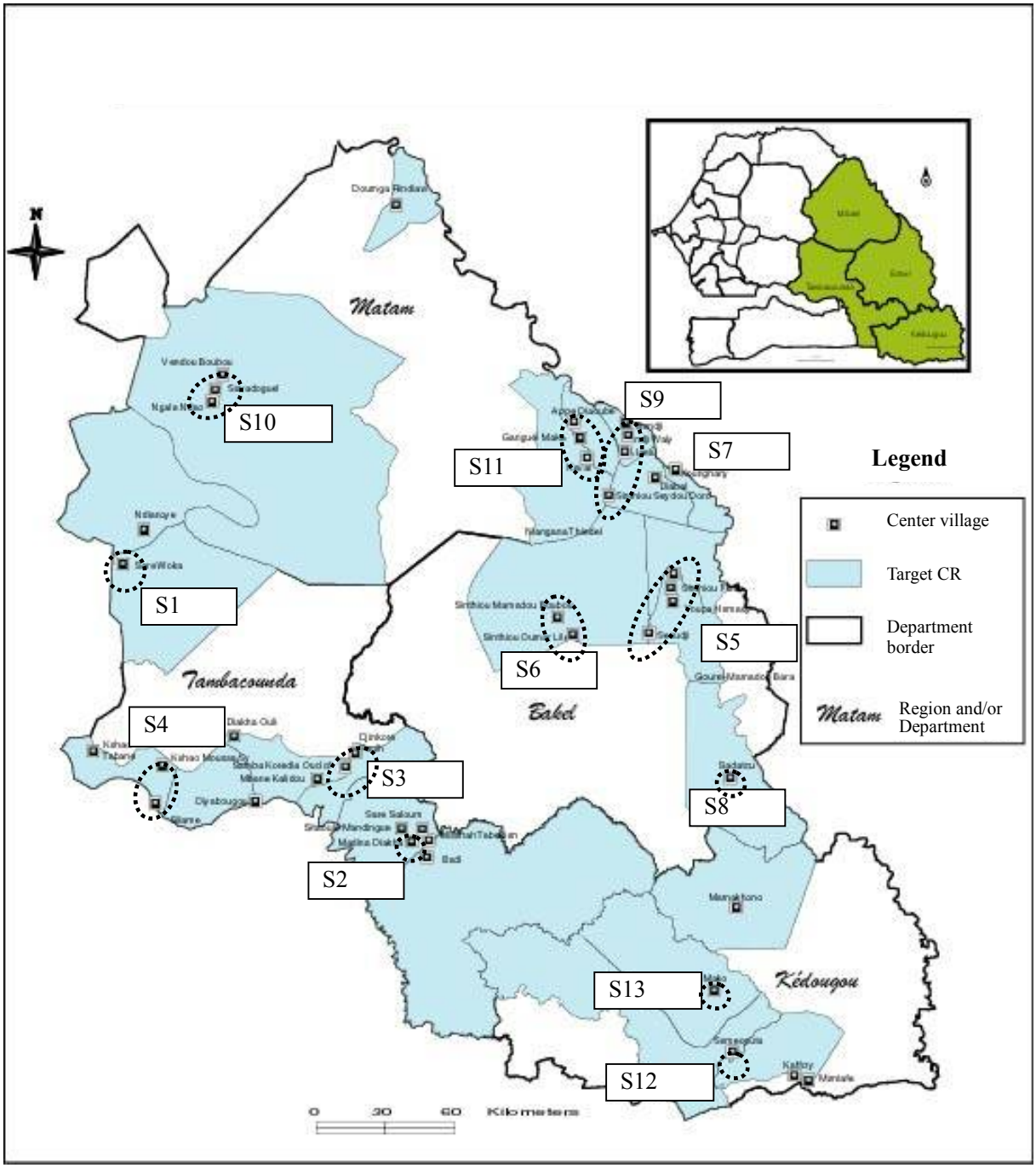

Figure 10-2-1 Target Villages of F/S

10.3 Water Supply Planning and Draft Design of Facilities

10.3.1 Draft Design

The plan for water supply of 13 schemes and the water supply facilities are arranged according to the following subjects.

Ⅰ) List of design specifications
Ⅱ) Design water supply rates
Ⅲ) Water sources
Ⅳ) List of populations, numbers of livestock, design water supply rates and numbers of major facilities as data for each village

V) Design pipe routings
VI) Pipeline hydraulic calculation sheets

The contents of the water supply plan and draft design of facilities are shown in the following pages (Tables 10-3-1 to 10-3-3). Arrangement of sanitary facilities is made through verification of the necessary number of sanitary facilities for each target group and their construction costs (Table 10-3-4).

10.3.2 Plan on Introduction of Sanitation Systems

For the 13 systems in the 3 target Regions where the F/S on water supply projects was conducted, the plan on introduction of sanitation systems was established simultaneously for improving sanitary conditions.
The contents of the plan are as follows.

1) To secure access for 50% of households to household sanitation facilities (component 1-1 of rural sanitation systems) in the villages with populations of more than 500 where access to safe water has been or is to be ensured
2) To install public sanitation facilities (component 1-2 of rural sanitation systems) at public facilities
3) To introduce ATPC (component 6 of rural sanitation systems) in the villages with populations of less than 500

Costs for construction of those 13 systems were estimated together with the above mentioned water supply projects and are shown in Table 10-3-4.

Table 10-3-1 Lists of Facilities Plan
(Water Supply Plans, Water Sources, Power Sources and Machinery Houses)

	Régions	CR	Groupes	Village central du groupe	Population	Nombre de villages	Population prévue (2020) Taux croissance 3% par an	Têtes de bétail actuel	Têtes bétail prévu (2020) Taux croissance 2% par an	Volumes d'eau prévus (m3/jour)	Systèmes	Sources d'eau		Pompes de captage	Pompe submergée	Unité de filtrage lent	Pompes transfert	Energie motrice		
							Central + satellite	UBT	UBT			Eaux de surface	Forage					Générateurs	Réseau électrique national	Energie solaire
1	Tambacounda	Kouthiaba Ouolof	KUK-14	Sare Woka	3 746	8	6 378	9 627	13 750	773	AEMV		1		1			1		
2		Missirah	MMS-5	Madina Diakha	3 053	6	5 198	7 846	11 207	630	AEMV		1		1			1		
3		Neteboulou	MNE-5,6,7	Djinkore Peulh, Sare Saloum, Sitaoule Mandingue	3 060	13	5 210	7 864	11 232	632	AEMV-J		1		1			1	1	
4		Kahene	MKA-7,8,9	Kahao Moussa Sy, Silame, Kahao Tabane	1 371	6	2 335	3 523	5 032	283	AEMV-J		1		1			1		
5		Sinthuou Fissa, Belle	KSI-9,10,14, KBE-3	Youpe Hamadi, Seoudji, Sinthiou Fissa, Gourel Mamadou Bara	7 213	25	12 280	18 537	26 476	1 489	AEMV-T		2		2		3	3	3	
6		Goudiry	GGO-5	Sinthiou Mamadou Boubou, Sinthiou Oumar Lile	2 250	15	3 831	5 783	8 260	464	AEMV-I		1		1			1		
7		Balou	BBL-8	Koungany	3 294	1	5 608	0	0	196	AEMV-ST	1	2	1	2	1	1	2(1)	1	
8		Sadatou	KSB-10	Sadatou	2 719	2	4 629	4 629	6 612	426	FSS		3		3			1		1
9	Matam	Bokiladji, Modery, Aoure	OBO-10,11,12, AOR-6	Bondji Vally, Alana, Bondji, Niangana Thiedel	8 551	23	14 558	21 976	31 388	1 765	AEMV-T		1		1		1	1	1	
10		Oudalaye	VOU-16,17,18	Samba Doguel, Vendou Boubou, Nghala Ndao	4 994	15	8 502	12 835	18 332	1 031	AEMV-I		2		2			2		
11		Bokiladji	OBO-6,7,9	Ganguel Maka, Appe Diaoube, Kaval	3 764	10	6 408	9 673	13 816	777	AEMV-I		1		1			1		
12	Kedougou	Banda Fassi	BAB-17	Samecouta	1 848	4	3 147	0	0	110	AEMV		2		2		1	1	1	
13		Tomboronkoto	BTO-6	Mako	2 705	2	4 606	0	0	161	AEMV-I		3		3			1		

Table 10-3-2 Lists of Facilities Plan
(Reservoir Tanks and Water Supply Facilities)

	Régions	CR	Groupes	Village central du groupe	Energie motrice			Salle des machines	Salle du conducteur	Clôture (m)	Réservoir d'eau										Bornes fontaines	Abreuvoir bétail	Potence
					Générateurs	Réseau électrique national	Energie solaire				Principal 1	Principal 2	Auxiliaire 1	Auxiliaire 2	Auxiliaire 3	Auxiliaire 4	Auxiliaire 5	Auxiliaire 6	Auxiliaire 7	Auxiliaire 8			
1	Tambacounda	Kouthiaba Ouolof	KUK-14	Sare Woka	1			1	1	140	300m3-20mH										15	2	1
2		Missirah	MMS-5	Madina Diakha	1			1	1	140	250m3-20mH										13	2	1
3		Neteboulou	MNE-5,6,7	Djinkore Peulh, Sare Saloum, Sitaoule Mandingue	1	1		1	1	140	250m3-20mH										16	2	1
4		Kahene	MKA-7,8,9	Kahao Moussa Sy, Silame, Kahao Tabane	1			1	1	140	100m3-20mH										8	2	1
5		Sinthuou Fissa, Belle	KSI-9,10,14, KBE-3	Youpe Hamadi, Seoudji, Sinthiou Fissa, Gourel Mamadou Bara	3	3		3	3	770	550m3-dusol		30m3-20mH	40m3-20mH	100m3-25mH	110m3-20mH	30m3-20mH	110m3-20mH	40m3-10mH	70m3-dusol	40	8	8
6		Goudiry	GGO-5	Sinthiou Mamadou Boubou, Sinthiou Oumar Lile	1			1	1	210	200m3-20mH		70m3-10mH	30m3-20mH							17	3	1
7		Balou	BBL-8	Koungany	2(1)	1		1(0)	1	140	200m3-20mH										14	0	1
8		Sadatou	KSB-10	Sadatou	1		1	1	1	140	150m3-20mH										12	0	1
9	Matam	Bokiladji, Modery, Aoure	OBO-10,11,12, AOR-6	Bondji Vally, Alana, Bondji, Niangana Thiedel	1	1		1	3	490	550m3-dusol		50m3-20mH	80m3-20mH	220m3-15mH	140m3-15mH					43	5	5
10		Oudalaye	VOU-16,17,18	Samba Doguel, Vendou Boubou, Nghala Ndao	2			2	2	280	200m3-20mH	200m3-25mH									24	3	2
11		Bokiladji	OBO-6,7,9	Ganguel Maka, Appe Diaoube, Kaval	1			1	1	140	250m3-20mH										19	2	1
12	Kedougou	Banda Fassi	BAB-17	Samecouta	1	1		1	1	140	100m3-20mH										8	0	1
13		Tomboronkoto	BTO-6	Mako	1			1	1	140	150m3-20mH										18	0	1

Table 10-3-3 lists of Facilities Plan
(Transmission and Distribution Pipes)

	Régions	Canalisations de transfert (m)						Total canalisations transfert	Canalisations de distribution(m)												Total canalisations distribution	Total canalisations transfert + distribution
		PVC						Total canalisations	PVC												Total canalisations	Total canalisations
		Φ50	Φ110	Φ160	Φ200	Φ260	Φ316	(m)	Φ25	Φ32	Φ50	Φ63	Φ75	Φ90	Φ110	Φ160	Φ200	Φ225	Φ260	Φ316	(m)	(m)
1	Tambacounda		100					100	75	0	30	0	0	4 851	8 266	1 614	0	5 563	0	0	20 399	20 499
2			100					100	65	0	30	0	0	6 822	4 238	0	2 015	0	0	0	13 170	13 270
3			100					100	80	0	30	7 224	0	6 369	6 879	3 202	5 147	0	0	0	28 931	29 031
4			50					50	40	0	3 819	800	0	1 147	4 413	3 689	0	0	0	0	13 908	13 958
5				662	200		17 368	18 230	200	0	160	10 400	0	5 165	17 635	12 370	25 804	0	0	6 106	77 840	96 070
6			100					100	85	0	40	10 326	0	3 307	1 000	5 802	4 461	6 999	0	0	32 020	32 120
7			100 (1,050)					100 (1,050)	187	0	0	1 256	0	1 007	0	264	0	0	0	0	2 714	2,814 (3,764)
8		160						160	197	0	0	546	0	1 518	1 430	0	0	0	0	0	3 691	3 851
9	Matam				200		16 820	17 020	215	0	100	753	0	6 733	21 378	3 027	2 758	13 276	0	10 417	58 657	75 677
10			200					200	120	0	50	2 796	0	8 296	14 627	0	9 611	0	0	8 012	43 512	43 712
11			200					200	95	0	30	2 602	0	936	10 058	4 648	2 215	0	0	0	20 584	20 784
12	Kedougou	1 600						1 600	40	0	10	0	0	0	13 706	550	1 402	0	0	0	15 708	17 308
13		690	525					1 215	969	0	10	761	0	530	4 586	0	0	0	0	0	6 856	8 071

10.4 Cost Estimation

10.4.1 Estimation of Construction Costs and Implementation Schedule

Costs of the project shall be calculated based on the following policies on cost estimation.

(1) Direct construction costs estimation method
The method of facilities unit costs is adopted.

(2) Method of estimation on indirect construction costs, general overhead costs and consulting fees
The facilities unit costs which are adopted by DHR are the direct construction costs combined with and common temporary construction costs (hereinafter, the direct construction costs are defined as the integrated costs of both direct construction and common temporary construction), and exclude the field management costs and the general overhead costs. The construction costs are calculated as these civil engineering construction costs together with consulting fees or design and supervision costs.

The indirect costs are calculated by using the ratios of indirect costs from the draft project costs of past Japanese Grant Aid projects of "The Project for Rural Water Supply (2004)" and the "Project for Establishment of Water Supply Facility in Tambacounda Region (2010)".

(3) Project Costs
Calculated based on the above policies (1) and (2), the project costs are shown in Table 10-4-1. As for System 7, the project costs are estimated for cases using both surface water and boreholes in order to confirm their difference.

Table 10-4-1 List of Facilities for Feasibility Study（Cost Estimates, Intake Facilities, Treatment Plants and Storage Tanks）

System No.	Village central	Type de système	Montant approx. année des travaux	Taux (annuel) variation PC	Année des travaux	Montant approx. (haut : 1000 FCFA ; bas : 1000 Yens) en 2011	Rapport des coûts indirects	Montant approx. direct des travaux (haut : 1000 FCFA ; bas : 1000 Yens) en 2011		Installations captage d'eau (forage)						Installations de captage d'eau et traitement eaux de surface				Château d'eau												Réservoir au sol		Cabine pompes de transfert		
										Travaux forage	Fosse de forage	Cabine des machines	Equipements salle des machines (motopompes submergées, générateurs, vannes, etc.)	Câblage réseau électrique national	Equipements énergie solaire	Cabine pompes de captage	Equipements captage d'eau (pompes, générateurs, etc.)	Unité de filtrage lent	Câblage réseau électrique national	50m3-10mH	50m3-20mH	80m3-10mH	80m3-20mH	100m3-10mH	100m3-20mH	100m3-25mH	150m3-15mH	150m3-20mH	200m3-20mH	200m3-25mH	250m3-15mH	250m3-20mH	300m3-20mH	550m3	100m3	Cabine	Equipements (pompes, générateurs, etc.)	Câblage réseau électrique national
1	Sare Woka, Boki Sada	AEMV	1 130 000	0	2011	1 130 000	46,4%	772 000	Qté	1	1	1	1																	1				
			218 000	0		218 000	46,4%	149 000	Coûts estimatifs	17 516	167	1 843	4 011							0	0	0	0	0	0	0	0	0	0	0	0	27 756	0	0			
2	Madina Diakha	AEMV	727 000	0	2011	727 000	46,4%	497 000	Qté	1	1	1	1	0																1				
			140 000	0		140 000	46,4%	96 000	Coûts estimatifs	12 555	167	1 843	4 011							0	0	0	0	0	0	0	0	0	0	0	0	20 446	0	0			
3	Djinkore Peulh, Sare Saloum, Sitaoule Mandingue	AEMV-I	1 068 000	0	2011	1 068 000	46,4%	730 000	Qté	1	1	1	1	1																1				
			206 000	0		206 000	46,4%	141 000	Coûts estimatifs	9 881	167	1 843	4 011	2 956						0	0	0	0	0	0	0	0	0	0	0	0	20 446	0	0			
														1.2km																					
														de route national de Kedougou																					
4	Kahao Moussa Sy, Silame, Kahao Tabane	AEMV-I	515 000	0	2011	515 000	46,4%	352 000	Qté	1	1	1	1	0																				
			99 000	0		99 000	46,4%	68 000	Coûts estimatifs	8 105	167	1 843	4 011							0	0	0	0	0	11 186	0	0	0	0	0	0	0	0	0			
5	Youpe Hamadi, Seoudji, Sinthiou Fissa, Gourel Mamadou Bara	AEMV-T	5 789 630	2.2	2012	5 665 000	46,4%	3 870 000	Qté	2	2	2	2	2						1	3					1		2					1	1	2	2	1
			1 117 046	2.2		1 093 000	46,4%	747 000	Coûts estimatifs	12 200	334	3 687	8 022	31 232						2 958	12 884	0	0	0	0	12 920	0	28 471	0	0	0	0	16 837	4 209	4 469	y compris m	637
														15.5km																					0km
														de Goudiry																					
6	Sinthiou Mamadou Boubou, Sinthiou Oumar Lile	AEMV-I	1 386 854	2.2	2012	1 357 000	46,4%	927 000	Qté	1	1	1	1	0							1		1					1							
			267 764	2.2		262 000	46,4%	179 000	Coûts estimatifs	12 461	167	1 843	4 011							0	4 295	0	6 928	0	0	0	0	0	14 409	0	0	0	0	0	0			
7	Koungany	AEMV-F	540 638	2.2	2012	529 000	46,4%	362 000	Qté	3	3	1	1	1														1							
			104 244	2.2		102 000	46,4%	70 000	Coûts estimatifs	12 784	501	1 843	4 011	2 778						0	0	0	0	0	0	0	0	0	14 409	0	0	0	0	0	0			
														200m																					
7	Koungany	AEMV-ST	913 668	2.2	2012	894 000	46,4%	611 000	Qté					1				1	1	2								1							
			175 784	2.2		172 000	46,4%	118 000	Coûts estimatifs	0	0	0	0	2 778		y compris unité de filtrage lent		59 430	5 557	0	0	0	0	0	0	0	0	0	14 409	0	0	0	0	0	0			
														200m					200m																
8	Sadatou	FSS	727 664	2.2	2012	712 000	46,4%	487 000	Qté	3	3	1	1	0	1																			
			140 014	2.2		137 000	46,4%	94 000	Coûts estimatifs	13 631	501	1 843	4 011		30 578					0	0	0	0	0	0	0	0	14 236	0	0	0	0	0	0	0			
9	Bondji Vally, Alana, Bondji, Niangana Thiedel	AEMV-T	5 465 785	2.2	2013	5 233 000	46,4%	3 575 000	Qté	2	2	1	1	1							1		1			1				1			1	1	1
			1 054 929	2.2		1 010 000	46,4%	690 000	Coûts estimatifs	13 537	334	1 843	4 011	58 621						0	4 295	0	6 928	0	0	0	12 174	0	0	0	18 472	0	0	16 837	0	2 234	左記に含む	
														30km																					
														De Bakel																					
10	Samba Doguel, Vendou Boubou, Nghala Ndao	AEMV-I	2 193 416	2.2	2013	2 100 000	46,4%	1 435 000	Qté	1	1	2	2	0														1	1						
			423 016	2.2		405 000	46,4%	277 000	Coûts estimatifs	13 651	167	3 687	8 022							0	0	0	0	0	0	0	0	14 409	16 383	0	0	0	0	0			
11	Ganguel Maka, Appe Diaoube, Kaval	AEMV-I	1 036 128	2.2	2013	992 000	46,4%	678 000	Qté	3	3	1	1	0																1				
			199 496	2.2		191 000	46,4%	131 000	Coûts estimatifs	16 252	501	1 843	4 011							0	0	0	0	0	0	0	0	0	0	0	0	20 446	0	0			
12	Samecouta	AEMV	854 388	2.2	2013	818 000	46,4%	559 000	Qté	3	3	1	1	1												1									
			165 028	2.2		158 000	46,4%	108 000	Coûts estimatifs	14 915	501	1 843	4 011	14 166						0	0	0	0	0	11 186	0	0	0	0	0	0	0	0	0			
														7km																					
														De Kedougou																					
13	Mako	AEMV-I	593 267	2.2	2013	568 000	46,4%	388 000	Qté	3	3	1	1	0														1							
			113 849	2.2		109 000	46,4%	75 000	Coûts estimatifs	14 915	501	1 843	4 011							0	0	0	0	0	0	0	0	14 236	0	0	0	0	0	0			
		Total	22 400 800					14 881 000																											

1FCFA= 0,1930 4 319 927 mille yen
(moyenne des 6 derniers mois à partir du 31 mai 2010)

2 873 000 (Total proposition eaux de surface no. 7)

Table 10-4-2 List of Facilities for Feasibility Study（Transmission Pumps, Transmit ion and Distribution Pipelines, Sanitation Facilities, Soft Components）

System No.	Village central	Type de système	Canalisations transfert et distribution (PVC, m)																													Dispositifs auxiliaires canalisations (évents, vannes de drainage, vannes d'arrêt, vannes divisions) 5% canalisations	Bornes fontaines	Abreuvoir bétail	Potence	Salle conducteur	Clôture	Installations sanitaires			Composante soft
			ϕ25、PN6	ϕ32、PN6	ϕ50、PN6	ϕ63、PN6	ϕ63、PN10	ϕ75、PN6	ϕ75、PN10	ϕ90、PN6	ϕ90、PN10	ϕ110、PN6	ϕ110、PN10	ϕ110、PN16	ϕ160、PN6	ϕ160、PN10	ϕ160、PN16	ϕ200、PN6	ϕ200、PN10	ϕ200、PN16	ϕ225、PN6	ϕ225、PN10	ϕ225、PN16	ϕ260、PN6	ϕ260、PN10	ϕ260、PN16	ϕ316、PN6	ϕ316、PN10	ϕ316、PN16						Latrines familiales	Latrines publiques	Puisard d'infiltration eaux usées ménagères	
1	Sare Woka, Boki Sada	AEMV	75	0	30	0		0		4 851		8 366			1 614			0			5 563			0			0				15	2	1	1	140				
			61	0	33	0	0	0	0	7 993	0	15 424	0	0	5 157	0	0	0	0	0	33 171	0	0	0	0	0	0	0	0	3 092	1 341	1 899	223	1 462	703	13 911	2 810	9 060	2 271
2	Madina Diakha	AEMV	65	0	30	0		0		6 822		4 338			0			2 015			0			0			0				13	2	1	1	140				
			53	0	33	0	0	0	0	11 241	0	7 998	0	0	0	0	0	9 314	0	0	0	0	0	0	0	0	0	0	0	1 432	1 162	1 899	223	0	703	11 348	2 810	7 380	2 271
3	Djinkore Peulh, Sare Saloum, Sitaoule Mandingue	AEMV-I	80	0	30	7 224		0		6 369		6 979			3 202			5 147			0			0			0				16	2	1	1	140				
			65	0	33	8 544	0	0	0	10 495	0	12 867	0	0	10 231	0	0	23 791	0	0	0	0	0	0	0	0	0	0	0	3 301	1 430	1 899	223	0	703	11 055	7 493	7 124	2 574
4	Kahao Moussa Sy, Silame, Kahao Tabane	AEMV-I	40	0	3 819	800		0		1 147		4 463			3 689			0			0			0			0				8	2	1	1	140				
			33	0	4 140	946	0	0	0	1 890	0	8 228	0	0	11 788	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 351	715	1 899	223	0	703	5 052	937	3 233	2 271
5	Youpe Hamadi, Seoudji, Sinthiou Fissa, Gourel Mamadou Bara	AEMV-T	200	0	160	10 400		0		5 165		17 635			12 370		662	7 167	18837		0			0			0	14 542	8 932		40	8	8	3	770				
			163	0	173	12 300	0	0	0	8 511	0	32 514	0	0	39 526	0	3 617	33 128	99 261	0	0	0	0	0	0	0	0	164 752	115 361	11 460	3 575	7 597	1 788	0	3 867	30 652	12 176	19 884	8 365
6	Sinthiou Mamadou Boubou, Sinthiou Oumar Lile	AEMV-I	85	0	40	10 326		0		3 307		1 100			5 802			4 461			6 999			0			0				17	3	1	1	210				
			69	0	43	12 213	0	0	0	5 449	0	2 028	0	0	18 539	0	0	20 620	0	0	41 734	0	0	0	0	0	0	0	0	5 035	1 519	2 849	223	0	1 055	8 200	8 430	5 253	2 574
7	Koungany	AEMV-F	187	0	0	1 256		0		1 007		100			264			0			0			0			0				14	0	1	1	140				
			152	0	0	1 485	0	0	0	1 659	0	184	0	0	844	0	0	0	0	0	0	0	0	0	0	0	0	0	0	216	1 251	0	223	0	703	12 300	2 810	8 039	4 384
7	Koungany	AEMV-ST	187	0	0	1 256		0		1 007		1 050			264			0			0			0			0				14	0	1	1	140				
			152	0	0	1 485	0	0	0	1 659	0	1 936	0	0	844	0	0	0	0	0	0	0	0	0	0	0	0	0	0	304	1 251	0	223	0	703	12 300	2 810	8 039	4 384
8	Sadatou	FSS	197	0	160	546		0		1 518		1 430			0			0			0			0			0				12	0	1	1	140				
			161	0	173	646	0	0	0	2 501	0	2 636	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	306	1 073	0	223	0	703	10 128	1 873	6 614	2 799
9	Bondji Vally, Alana, Bondji, Niangana Thiedel	AEMV-T	215	0	100	753		0		6 733		21 378			2 589	438		2 958			13 276			0				27 237			43	5	5	3	490				
			175	0	108	891	0	0	0	11 094	0	39 415	0	0	8 273	2 099	0	13 673	0	0	79 163	0	0	0	0	0	0	308 579	0	7 745	3 843	4 748	1 117	0	2 461	31 726	8 430	20 565	7 556
10	Samba Doguel, Vendou Boubou, Nghala Ndao	AEMV-I	120	0	50	2 796		0		8 296		14 827			0			9 611			0			0			8 012				24	3	2	2	280				
			98	0	54	3 307	0	0	0	13 670	0	27 337	0	0	0	0	0	44 425	0	0	0	0	0	0	0	0	79 624	0	0	4 445	2 145	2 849	447	0	1 406	18 499	8 430	11 952	2 771
11	Ganguel Maka, Appe Diaoube, Kaval	AEMV-I	95	0	30	2 602		0		936		10 258			4 648			2 215			0			0			0				19	2	1	1	140				
			77	0	33	3 077	0	0	0	1 542	0	18 913	0	0	14 852	0	0	10 239	0	0	0	0	0	0	0	0	0	0	0	2 437	1 698	1 899	223	0	703	13 935	7 493	9 038	2 271
12	Samecouta	AEMV	40	0	1 610	0		0		0		13 706			550			1 402			0			0			0				8	0	1	1	140				
			33	0	1 745	0	0	0	0	0	0	25 270	0	0	1 757	0	0	6 481	0	0	0	0	0	0	0	0	0	0	0	1 764	715	0	223	0	703	9 982	3 747	6 486	2 997
13	Mako	AEMV-I	969	0	700	761		0		530		5 111			0			0			0			0			0				18	0	1	1	140				
			790	0	759	900	0	0	0	873	0	9 423	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	637	1 609	0	223	0	703	10 030	5 620	6 465	2 271
		Total																																					

1FCFA= 0,1930
(moyenne des 6 derniers mois à partir du 31 mai 2010)

Table 10-3-4 Lists of Facilities Plan
(Sanitation Facilities)

	Region	CR	Village centre	Pop. 2020	Nombre village	Latrines familiales				Edicule publique (bloc=lieu x2)				lavoirs puisards			
						Quantité	Prix (CFA)	Total (mille CFA)	Total (mille YEN)	Quantité Block	Prix (CFA)	Total (mille CFA)	Total (mille YEN)	Quantité	Prix (CFA)	Total (mille CFA)	Total (mille YEN)
1	Tambacounda	Kouthiaba Ouolof	Sare Woka	6 378	8	570	126 450	72 077	13 911	6	2 426 547	14 559	2 810	426	110 190	46 941	9 060
2		Missirah	Madina Diakha	5 198	6	465	126 450	58 799	11 348	6	2 426 547	14 559	2 810	347	110 190	38 236	7 380
3		Neteboulou	Djinkore Peulh, Sare Saloum, Sitaoule Mandingue	5 210	13	453	126 450	57 282	11 055	16	2 426 547	38 825	7 493	335	110 190	36 914	7 124
4		Kahene	Kahao Moussa Sy, Silame, Kahao Tabane	2 335	6	207	126 450	26 175	5 052	2	2 426 547	4 853	937	152	110 190	16 749	3 233
5		Sinthuou Fissa, Belle	Youpe Hamadi, Seoudji, Sinthiou Fissa, Gourel Mamadou Bara	14 069	25	1 256	126 450	158 821	30 652	26	2 426 547	63 090	12 176	935	110 190	103 028	19 884
6		Goudiry	Sinthiou Mamadou Boubou, Sinthiou Oumar Lile	3 831	15	336	126 450	42 487	8 200	18	2 426 547	43 678	8 430	247	110 190	27 217	5 253
7		Balou	Koungany	5 608	1	504	126 450	63 731	12 300	6	2 426 547	14 559	2 810	378	110 190	41 652	8 039
8		Sadatou	Sadatou	4 629	2	415	126 450	52 477	10 128	4	2 426 547	9 706	1 873	311	110 190	34 269	6 614
9	Matam	Bokiladji, Modery, Aoure	Bondji Vally, Alana, Bondji, Niangana Thiedel	14 558	23	1 300	126 450	164 385	31 726	18	2 426 547	43 678	8 430	967	110 190	106 554	20 565
10		Oudalaye	Samba Doguel, Vendou Boubou, Nghala Ndao	8 502	15	758	126 450	95 849	18 499	18	2 426 547	43 678	8 430	562	110 190	61 927	11 952
11		Bokiladji	Ganguel Maka, Appe Diaoube, Kaval	6 408	10	571	126 450	72 203	13 935	16	2 426 547	38 825	7 493	425	110 190	46 831	9 038
12	Kedougou	Banda Fassi	Samecouta	4 561	4	409	126 450	51 718	9 982	8	2 426 547	19 412	3 747	305	110 190	33 608	6 486
13		Tomboronkoto	Mako	4 606	2	411	126 450	51 971	10 030	12	2 426 547	29 119	5 620	304	110 190	33 498	6 465

10.4.2 Costs for Operation and Maintenance of the Facilities

The details of costs for operation and maintenance of the facilities are shown in the annex (A-4). This report basically shows calculations for plan of revenue and expenditure after 10 years.

The conditions for cost estimations on operation and maintenance are as follows. The revenue is defined as the sum of income from both water tariffs and initial payments. The expenditure includes the costs for power, maintenance, personnel, and exchange of pumps and generators. The water tariffs estimated on cost-recovery basis is to be 200-500FCFA/ m^3 and differs according to the type of the system.

In the rural water supply sector, ASUFORs are established as the main actors for management and consigned to decide the price of water tariffs. However, as conditions for management of the water supply facilities are similar and DEM instructs harmonized pricing of water with surrounding facilities in order to avoid disparities in water tariffs between facilities, the water tariff does not differ according to the facilities and is around 400FCFA/m^3. Also, the facilities installed by PRS and operated by photovoltaic energy adopt 400FCFA/m^3.

As a result of cost estimations by F/S, in order to secure the costs for updating pumping facilities, it is necessary to set the water tariff at 200CFA/m^3 for AEMV which charges an average price, 300FCFA/m^3 for AEMV-T, and 500FCFA/m^3 for AEMV-ST. As there is a risk of decrease in the amount of water used for livestock in the rainy season, resulting in halving the revenue, a safety factor should be taken into account and the price needs to be doubled. Therefore, the water tariff of AEMV will be at the same level of pricing as the present.

As per AEMV-ST, the design of water supply excludes the amount of water used by livestock, and domestic water except for drinking water can be fetched from the river which flows throughout the year. Therefore, as there are few seasonal flucutuations, it is possible to charge 500 FCFA/m^3.

As a conclusion, although the rural villages are suffering from the economic situation of lower cash income than that of urban areas, the present pricing of AEMV is assumed to be the minimum price for water to be borne by ASUFORs in order to secure maintenance costs of the facilities. Therefore, the average pricing of 400FCFA/m^3 shall be adopted for the AEMV facilities to be constructed in the future.

10.4.3 Costs for Training

It is necessary to conduct training for the operators of the water purification facilities on their operation and maintenance. Another kind of training needs to be conducted for both the board members of ASUFORs, functioning as managers of the operators, and BPFs who supervise ASUFORs. These trainings are to be basically conducted through On-the-Job Training (OJT) at the facilities which are already operating in Senegal.

10.5 Economic Valuation

From a viewpoint of economics, the 13 water supply systems proposed by the master plan shall be evaluated. There are various types of target facilities for evaluation, such as AEMV, AEMV-I, AEMV-T, AEV-ST, and AEV-FSS. Among these facilities, the facilities such as AEMV-I, AEMV-T, and AEMV-ST are proposed for solving issues of water supply in the target area, and to be evaluated on their comparative positioning for economic effects.

10.5.1 Methods of Analysis

(1) Conditions for Analyses (Conforming to the conditions of F/S)
The conditions for economic analysis are as follows.

- The currency exchange adopted is the average rates of exchange during the period from December 2009 to May 2010 (1FCFA=JPY0.193).
- The annual inflation rate is estimated as 2.2% at the same rate presented by IMF, and the period of project evaluation is to be 20 years from 2011 to 2030.
- One year (2011) is provided for the period of designing and another year (2012) for construction. The annual ratio of initial costs shall be 5% of the total costs in the first year and 95% in the second year. However, system 5 is provided with one year for designing and two years for construction and the annual costs shall be 5% in the first year, 50% in the second year and 45% in the third year.
- The construction costs use the project costs estimated in the feasibility study.
- The analysis conforms to the design service life of the facilities, such as the elevated tanks for 50 years, the pipes, boreholes and taps for 30 years, and the equipments such as pumps and generators for less than 10 years.

(2) Costs

The following items are calculated as economic costs.

1) Costs for construction: Cost estimations of F/S
2) Costs for operation: Costs for operation and management, 5% of costs for construction of the facilities except for boreholes and tanks
3) Costs for maintenance: 1% of costs for construction of the facilities except for boreholes and tanks, to be raised to 2% after 6 years
4) Costs for renewal: 10% of costs for electrical equipments

(3) Benefits

Two kinds of benefits are to be utilized in the economic analysis. The first benefit is reduction of labor hours for fetching water, and the second is reduction of costs for transportation between the houses and the water sources by horses or donkeys. The sums of benefits are calculated by multiplying the unit benefit by the amount of water supply. The list of costs and benefits is shown in Table 10-5-1.

(4) Sensibility Analysis

The basic case is economically analyzed as Case 1, and the two following cases are also analyzed by changing the conditions of costs.

・Change of Condition 1: 50% reduction of maintenance and renewal costs from the default conditions

・Change of Condition 2: 20% reduction of operation and management costs in addition to the above change

Then as Case 2, the costs for operation and management are to replace the costs estimated by F/S. Under this condition, Case 2 shall also be analyzed on its sensitivity by using the above changes of conditions 1 and 2.

Table 10-5-1 List of Costs and Benefits

Cas 1 couts estime par taux pour opération et maintenance — mille FCFA

			Couts (C) calcule par chaque année sur o, p, q, r, s					Bénéfice (B) a, b, c, d value premier année pour référence			
			o	p	q	r	s	a	b	c	d
			construction	opération	maintenance	remplacement	risque	puisard d'eau	transport d'eau	ouvrage 50 ans	ouvrage 30 ans
1	Boki Sada	AEMV	939 000	28 859	5 772	3 042	0	84 077	92 714	143 815	466 773
2	Madina Diakah	AEMV	568 000	14 861	2 972	3 042	0	68 523	60 948	105 938	251 935
3	Djinkore Peulh	AEMV-I	871 000	31 045	6 209	3 042	0	77 658	84 870	105 938	442 873
4	Silame,	AEMV-I	446 000	14 102	2 820	3 042	0	83 493	99 086	57 961	217 783
5	Goudiry nord-est	AEMV-T	5 188 000	221 837	44 367	6 085	0	154 162	109 178	405 594	3 054 482
6	Sinthiou Mamadou Boubou	AEMV-I	1 197 000	44 421	8 884	3 042	0	50 500	55 508	132 805	652 064
7	Koungany	AEMV-F	355 000	5 640	1 128	3 042	0	20 639	0	74 657	113 205
7	Koungany	AEMV-ST	720 000	28 883	5 777	4 508	0	20 639	0	74 657	381 063
8	Sadatou	FSS	575 000	17 126	3 425	3 042	0	17 036	3 606	73 760	284 850
9	Bakel sud-ouest	AEMV-T	4 778 000	208 595	41 719	3 042	0	191 923	165 714	304 173	2 901 308
10	DarSalam, Fouroudou Mbaila	AEMV-I	1 805 000	72 248	14 450	6 085	0	112 088	101 850	159 542	1 022 339
11	Ganguel Maka	AEMV-I	765 000	23 303	4 661	3 042	0	54 032	63 953	105 938	384 924
12	Samecouta	AEMV	666 000	22 124	4 425	3 042	0	16 786	47 093	57 961	289 903
13	Mako	AEMV-I	401 000	8 031	1 606	3 042	0	16 949	27 439	73 760	171 907

Cas2 Couts de opération est calcule par résultat de faisabilité, couts estime par taux pour maintenance — mille FCFA

1	Boki Sada	AEMV	939 000	19 412	5 772	3 042	0	84 077	92 714	143 815	466 773
2	Madina Diakah	AEMV	568 000	12 215	2 972	3 042	0	68 523	60 948	105 938	251 935
3	Djinkore Peulh	AEMV-I	871 000	18 181	6 209	3 042	0	77 658	84 870	105 938	442 873
4	Silame,	AEMV-I	446 000	6 699	2 820	3 042	0	83 493	99 086	57 961	217 783
5	Goudiry nord-est	AEMV-T	5 188 000	28 946	22 184	6 085	0	154 162	109 178	405 594	3 054 482
6	Sinthiou Mamadou Boubou	AEMV-I	1 197 000	13 022	8 884	3 042	0	50 500	55 508	132 805	652 064
7	Koungany	AEMV-F	355 000	5 988	1 128	3 042	0	20 639	0	74 657	113 205
7	Koungany	AEMV-ST	720 000	20 788	5 777	4 508	0	20 639	0	74 657	381 063
8	Sadatou	FSS	575 000	3 898	1 420	3 042	0	17 036	3 606	73 760	284 850
9	Bakel sud-ouest	AEMV-T	4 778 000	41 527	20 859	3 042	0	191 923	165 714	304 173	2 901 308
10	DarSalam, Fouroudou Mbaila	AEMV-I	1 805 000	18 589	14 450	6 085	0	112 088	101 850	159 542	1 022 339
11	Ganguel Maka	AEMV-I	765 000	11 254	4 661	3 042	0	54 032	63 953	105 938	384 924
12	Samecouta	AEMV	666 000	7 016	4 661	3 042	0	16 786	47 093	57 961	289 903
13	Mako	AEMV-I	401 000	6 470	1 606	3 042	0	16 949	27 439	73 760	171 907

10.5.2 Results of Evaluation

The results of analysis are shown in Table 10-5-2.

Table 10-5-2 Results of Economic Analysis for Basic Case

				Cas base	Analysais sensibilité	
ID	Village	Type			Cout E&G -50% Cout équipement -50%	Cout E&G -50% Cout équipement -50% Cout opération -20%
1	Boki Sada	AEMV	Taux de B et C	1,24	1,28	1,33
			EIRR	16%	17%	17%
2	Madina Diakah	AEMV	Taux de B et C	1,54	1,60	1,65
			EIRR	21%	22%	22%
3	Djinkore Peulh	AEMV-I	Taux de B et C	1,18	1,23	1,28
			EIRR	15%	16%	17%
4	Silame,	AEMV-I	Taux de B et C	0,83	0,87	0,90
			EIRR	9%	10%	10%
5	Goudiry nord-est	AEMV-T	Taux de B et C	0,31	0,32	0,34
			EIRR	non calculation	non calculation	non calculation
6	Sinthiou Mamadou	AEMV-I	Taux de B et C	0,57	0,59	0,61
			EIRR	2%	3%	4%
7	Koungany	AEMV-F	Taux de B et C	0,48	0,50	0,51
			EIRR	3%	4%	4%
7	Koungany	AEMV-ST	Taux de B et C	0,20	0,21	0,22
			EIRR	non calculation	non calculation	non calculation
8	Sadatou	FSS	Taux de B et C	0,27	0,29	0,30
			EIRR	non calculation	non calculation	non calculation
9	Bakel sud-ouest	AEMV-T	Taux de B et C	0,45	0,47	0,49
			EIRR	-3%	-1%	0%
10	DarSalam, Fourou	AEMV-I	Taux de B et C	0,73	0,76	0,79
			EIRR	6%	7%	8%
11	Ganguel Maka	AEMV-I	Taux de B et C	1,03	1,07	1,10
			EIRR	12%	13%	14%
12	Samecouta	AEMV	Taux de B et C	0,64	0,66	0,69
			EIRR	4%	5%	6%
13	Mako	AEMV-I	Taux de B et C	0,83	0,86	0,88
			EIRR	9%	10%	10%

(1) Sensibility Analysis

The results are shown in Table 10-5-3

Table 10-5-3 Results of Economic Analysis for Case 2

				Cas base	Analysais sensibilité	
ID	Village	Type			Cout E&G −50% Cout équipement -50%	Cout E&G −50% Cout équipement -50% Cout opération -20%
1	Boki Sada	AEMV	Taux de B et C	1,29	1,34	1,41
			EIRR	17,1%	17,7%	18,4%
2	Madina Diakah	AEMV	Taux de B et C	1,55	1,61	1,73
			EIRR	21,3%	21,9%	22,9%
3	Djinkore Peulh	AEMV-I	Taux de B et C	1,27	1,32	1,38
			EIRR	16,7%	17,4%	18,1%
4	Silame,	AEMV-I	Taux de B et C	0,91	0,95	0,99
			EIRR	10,4%	11,2%	11,9%
5	Goudiry nord-est	AEMV-T	Taux de B et C	0,39	0,40	0,42
			EIRR	-0,9%	-0,2%	1,0%
6	Sinthiou Mamadou	AEMV-I	Taux de B et C	0,65	0,68	0,70
			EIRR	5,4%	6,3%	6,8%
7	Koungany	AEMV-F	Taux de B et C	0,47	0,49	0,52
			EIRR	2,5%	3,2%	4,2%
7	Koungany	AEMV-ST	Taux de B et C	0,21	0,22	0,23
			EIRR	non calculation	non calculation	non calculation
8	Sadatou	FSS	Taux de B et C	0,32	0,33	0,34
			EIRR	-0,5%	0,2%	0,8%
9	Bakel sud-ouest	AEMV-T	Taux de B et C	0,57	0,58	0,62
			EIRR	3,7%	4,2%	5,5%
10	DarSalam, Fourou	AEMV-I	Taux de B et C	0,85	0,89	0,93
			EIRR	9,2%	10,1%	10,8%
11	Ganguel Maka	AEMV-I	Taux de B et C	1,11	1,16	1,21
			EIRR	13,9%	14,5%	15,3%
12	Samecouta	AEMV	Taux de B et C	0,73	0,76	0,78
			EIRR	7,1%	7,9%	8,4%
13	Mako	AEMV-I	Taux de B et C	0,84	0,87	0,91
			EIRR	9,2%	9,9%	10,6%

10.5.3 Conclusion of Evaluation

(1) The facilities such as AEMV and AEMV-I show good results from economic analysis. This is because large economic benefits can be achieved by reducing labor load for fetching water for livestock through supplying water through pipes into satellite villages.

(2) The facilities utilizing surface water or photovoltaic power cannot acquire enough economic benefits as the target area of these facilities is limited.

(3) The facilities utilizing surface water have difficulty in realizing the advantage of scale in terms of economic benefits as the costs for operation and management depend on the size of the facility and it is limited in level of rural water supply.

(4) In the area of bedrock such as in Kédougou Region, the target area for water supply needs to be limited as water sources are scarce and amount of available water is restricted. Therefore, compared with other Regions or areas, lower results are found in economic analysis.

(5) The characteristics of water supply systems based on the results of EIRR analysis for Case 2 are shown in Table 10-5-5. According to the " Study on Economic Evaluation Methods for JICA Master Plan Study, Groundwater Edition (March 2002)", EIRR for other project cases in the rural water supply sector show values from 1% to 20%. The value of EIRR tends to be larger if more quantifiable items of benefits are available. Especially in the case where items such as reduction of medical costs, improvement in agricultural production and increasing willingness to pay are considered, the value of EIRR shows more than 10%. As a conclusion, the facilities such as AEMV and AEMV-I are at standard levels for general rural water supply projects.

Table 10-5-4 Classification of Characteristics of Water Supply Systems based on Results of EIRR Analysis for Case 2

EIRR	System No.	Target Facility
10%-	1,2,3,4,11	Commonly disseminated AEMV and expanded AEMV-I
5-10%	6,10, 13	AEMV-I with small number of beneficiaries
0-5%	7-borehole,9,12	Water supply facilities excluding livestock; AEMV-T targeting expanded area in southwestern Bakel
Minus	5,8	Water supply for expanded area inn northwestern Goudiry; facilities using photovoltaic power
Unavailable	7-surface water	Facilities using surface water

10.5.4 Recommendations

(1) Economic analysis for AEMV, being promoted in Senegal and proposed by the Master Plan as a water supply system to be installed in the priority villages, gives good results as one facility can provide benefits to a large number of residents. Therefore, since it is reasonable to adopt the facility from a policy-wise viewpoint. the facility needs to be continuously constructed. On the other hand, compared with other African countries, the piped water supply facilities are highly developed in the rural areas in Senegal. This is because the residents are strongly aware of the economic effects of reducing load on labor for fetching water.

(2) As the benefits can be highly increased by extending pipes into the satellite villages, pipeline extensions into satellite villages is an important measure. However, as this measure raises the project costs, in actual situations, costs are shared in construction costs for new facilities and through restriction of piping lengths. Therefore, to enhance the economic benefits through construction of this facility, it is recommended to request financial assistances from other projects to maintain the necessary pipe extensions.

(3) The economic benefits will be less in the case of excluding water for livestock from the design of water supply. However, as the existing shallow wells are becoming contaminated in areas starting to be urbanized such as System 7, benefits need to be adjusted to include factors such as securing safe water.

(4) Compared with other Regions, Kédougou Region shows lower results of economic analysis. The region needs considerations as its changes for project selection can be hampered if the Region is compared with other Regions only on the basis of the results of economic analysis.

(5) Economical adequacy of AEMV-T facilities using groundwater which can serve a wide area is higher than that of the facilities using surface water.

10.6 Evaluation of Project Costs

10.6.1 Verification of Project Costs for Facilities

(1) Directs cost of construction

The direct cost of construction for each system is shown at the table 10-6-1.

Table 10-6-1 Direct cost of construction

				AEP＋San	AEP			Sanitation			
System ID	Type	Pop		Project cost	Project cost	Direct cost	Direct cost /capita	Project cost	Direct cost	Direct cost /capita	ASS/San
				b+B	b=ax1.464	a	c=a/Pop	B=Ax1.464	A	C=A/Pop	A/a
		2010	2020	millions FCFA	millions FCFA	millions FCFA	thousands FCFA	millions FCFA	millions FCFA	thousands FCFA	
System1	AEMV	3 746	6 378	1 133	939	642	101	194	133	21	21%
System2	AEMV	3 053	5 198	730	568	388	75	162	111	21	29%
System3	AEMV-I	3 060	5 210	1 065	871	595	114	194	133	26	22%
System4	AEMV-I	1 371	2 335	514	446	305	131	68	47	20	15%
System5	AEMV-T	8 264	14 069	5 662	5 188	3 544	289	474	324	23	9%
System6	AEMV-I	2 250	3 831	1 362	1 197	818	214	165	113	30	14%
System7	AEMV-F	3 294	5 608	529	355	243	43	174	119	21	49%
System7	AEMV-ST	3 294	5 608	894	720	492	88	174	119	21	24%
System8	AEV-FSS	2 719	4 629	715	575	393	85	140	96	21	24%
System9	AEMV-T	8 551	14 558	5 237	4 778	3 264	224	459	314	22	10%
System10	AEMV-I	4 994	8 502	2 099	1 805	1 233	145	294	201	24	16%
System11	AEMV-I	3 764	6 408	994	765	523	82	229	157	25	30%
System12	AEMV	2 679	4 561	818	666	455	100	152	104	23	23%
System13	AEMV-I	2 705	4 606	567	401	274	59	166	114	25	42%

* Cost for system 7 is estimated in the two assumptions of water sources, groundwater (F) and river water (ST).
* Water supply plan is established according to the population2020, then the Direct cost par capital is calculated by the population 2020.

(2) Project Costs regarding Construction of New Facilities

In addition to the basic concept of "improvements in ratio of water supply by piped water supply facilities" under M/P, the project plan is verified together with "construction of sanitation facilities", the concept for project implementation under PEPAM. The project costs verified under F/S are shown in the following section. As the project costs vary according to water supply facilities, the costs show the value intermediate between the lowest and the highest. The currency exchange rate adopts 1FCFA=JPY0,193.

Table 10-6-2 Project Costs (Case of Constructing both Water Supply Facilities and Sanitation Facilities)

Water Supply System	Average Number of Beneficiaries	Population 2020 beneficiaries	Project Costs (Intermediate Value)		Project Costs per Beneficiary (Intermediate Value)	
	2010	2020	Million FCFA	Million JPY	Thousand FCFA	Thousand of JPY
(1) AEMV	3 159	5 379	929	179	160	31
(2) AEMV-I	3 024	5 149	1 308	252	239	46
(3) AEMV-T	8 408	14 314	5 449	1 052	381	74
(4) AEV-ST	3 294	5 608	894	173	159	31
(4) AEV (remplacement de ST)	3 294	5 608	529	102	94	18
(5) AEV-Solaire	2 719	4 629	712	137	154	30

Source: Data in the list of project costs of F/S

Table 10-6-3 Project Costs (Case of Constructing Water Supply Facilities only)

Water Supply System	Average Number of Beneficiaries	Population 2020 beneficiaries	Project Costs (Intermediate Value)		Project Costs per Beneficiary (Intermediate Value)	
	2010	2020	Million FCFA	Million JPY	Thousand FCFA	Thousand of JPY
(1) AEMV	3 159	5 379	754	145	128	25
(2) AEMV-I	3 024	5 149	1 126	217	200	39
(3) AEMV-T	8 408	14 314	4 983	962	348	67
(4) AEV-ST	3 294	5 608	720	139	128	25
(4) AEV (remplacement de ST)	3 294	5 608	355	69	63	12
(5) AEV-Solaire	2 719	4 629	575	111	124	24
(6) PMH *	158	269	33	6	125	24

Source: Data in the list of project costs of F/S

*(6) The project costs for PMH are based on the assumption of costs for a pilot borehole of 90m depth added with 46,4% of indirect costs and the success rate of 70%
Total sum is calculated together with JPY500 000 as the cost for a borehole pit: Total JPY6 460 000

As a result of verification on the adequacy of project costs, it shows high projects costs in case of constructing both water supply and sanitation facilities. The unit cost of a sanitation facility (a household toilette) is about 126000FCFA (JPY24 000). Although the toilette itself is not so expensive, the household soakaways for drainage which are encouraged to be simultaneously installed costs 567 000FCFA (JPY109000) and the case where construction of the toilettes and soakaways is conducted for each household needs almost the same costs as that for construction of water supply facilities. The unit costs of constructing a public toilette is 2 427 000 (JPY468 000). One water supply system covers about 10 public facilities such as schools and health centers, and the total cost becomes 24 270 000FCFA (JPY4 680 000).

10.6.2 Verification of Investment Efficiency

Based on the results of F/S, the table below visualizes correlation between project costs and population to be benefitted, and for project costs per capita against population to be benefitted (Table 10-6-1, Table 10-6-2).

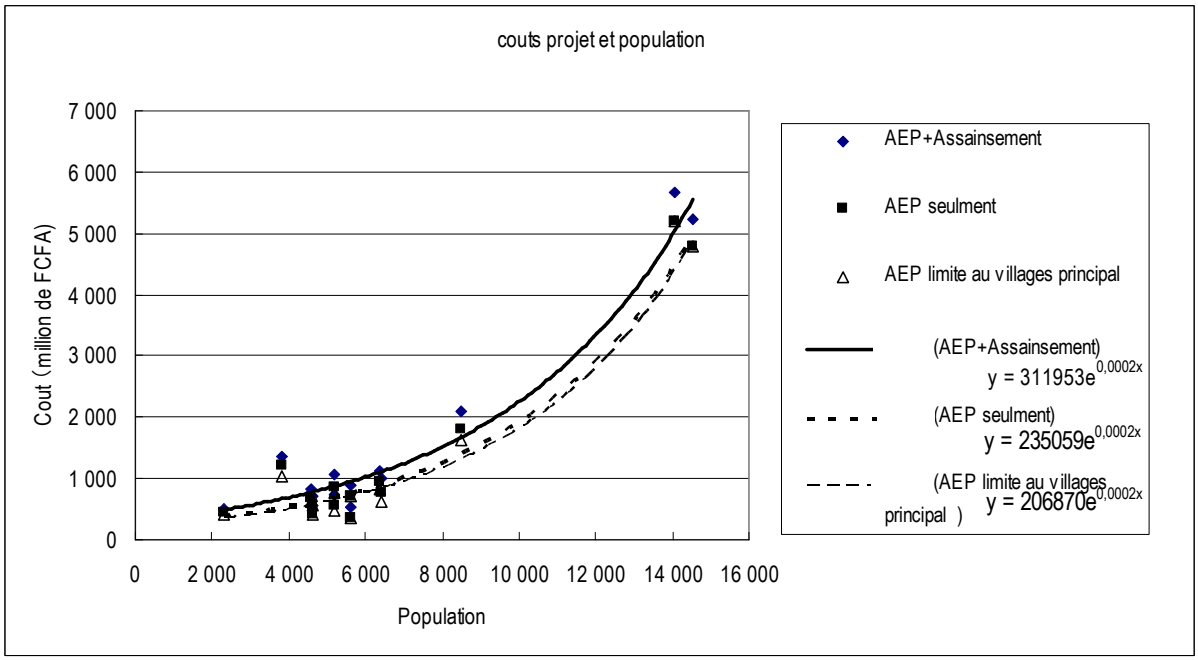

Figure10-6-1 Correlation between Project Costs and Population to be benefitted

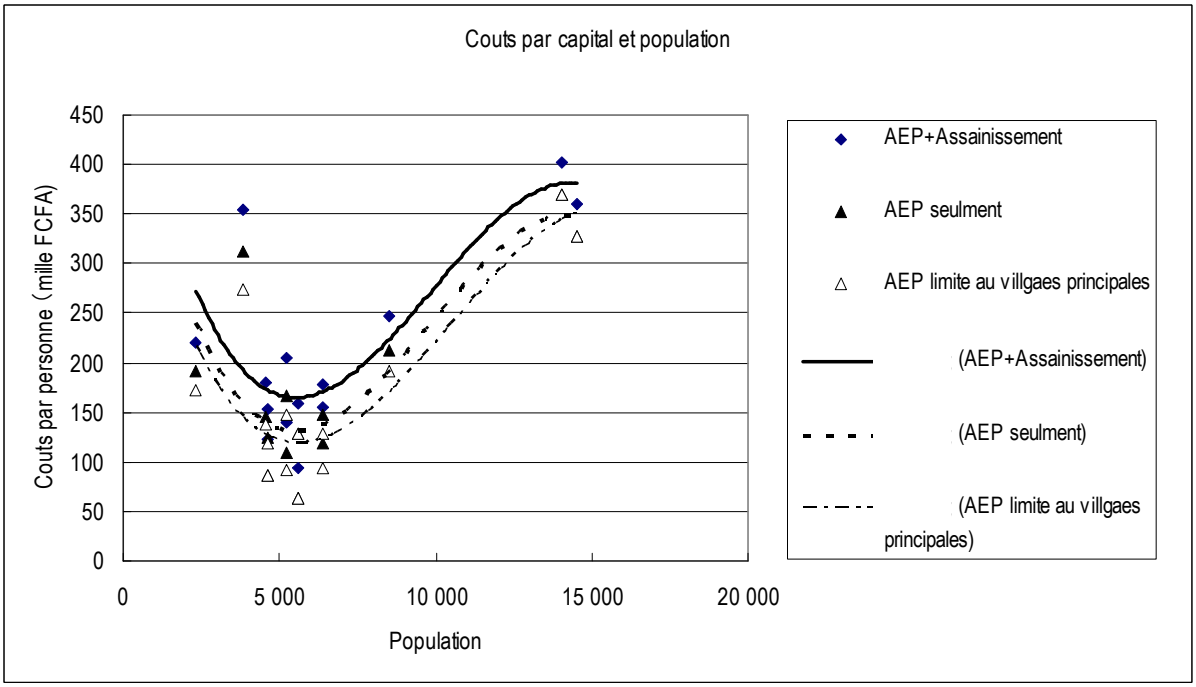

Figure 10-6-2 Correlation between Project Costs per Capita and Population to be benefitted

According to the correlation between project costs per capita and population to be benefitted (Table 10-6-2), it is found that the investment effect is highest for the water supply system targeting population of about 3000. In addition, it is revealed that selection of the target sites whose population to be benefitted range from 2000 to 5000 lowers the project costs per capita and enhances its investment efficiency.

The project costs of PMH per capita, 207 000FCFA, do not take into account water supply for livestock. According to the conditions of evaluation described in Section 4.2, the amount of water supply for livestock per day becomes about 2 to 3 times larger than that for people (the amount depends on the variety of livestock). Therefore, 2 to 3 additional PMH needs to be installed if livestock are to be served. That is, in order to bring PMH to the same service level as the piped water supply facilities, the project costs per capita become 621 000 to 828 000FCFA by simple arithmetic. In this regard, considering water supply for livestock, the piped water supply facilities are proven to provide good investment efficiency, and even in the case of AEMV-T where the project costs are relatively higher, the same investment efficiency as the handpump projects can be expected.

In the case where population is less than 2 000, the project costs per capita rise. This is because the construction costs are not proportional but in logarithmic relations, and the construction costs of boreholes share the increasing part in the costs for water supply facilities though the scale of the facility becomes smaller according to the size of population to be benefitted. Therefore, it is necessary to select large numbers of populations to be benefitted in order to improve the investment efficiency of borehole construction costs.

In the case where population is more than 5 000, the project costs per capita increase. The reason is that since the scheme requires long distance distribution to non-served area, the distances from the upstream villages to the villages at terminal points of the facility become about 30 to 50km.

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Chapter11 Environmental and Social Considerations

11.1 Scoping

The impacts on environment and society expected by the Master Plan are as follows (Table 11-1-1). The study team evaluated four items 1) Involuntary Resettlement, 2) The poor, indigenous and ethnic people, 3) Hazard and 4) Infectious diseases such as HIV/AIDS, 4) The poor to be "unclear", and the other impact to be "none".

Table 11-1-1 Scoping

Likely Impact			Rating	Remarks
Social Environment	1	Involuntary Resettlement	unclear	As a convention of the rural areas of Senegal, when selecting and determining a facility construction site, a field or vacant land should be selected in principle and the agreement of the village chief or the landowner is a prerequisite. It is necessary to acquire a site for the construction of each facility in the implementation of the master plan.
	2	Local economy such as employment and livelihoods, etc.	None	1) Farmers will not lose farmland or other production infrastructure. 2) Water sellers may lose their jobs after the construction of the facilities, although water sellers are not active in all villages. 3) Employment of villagers for facility construction will contribute to livelihood improvement, albeit temporarily. 4) Construction of water supply facilities within villages is expected to enable villagers to spend less time on fetching water and spend the surplus time on economic activities.
	3	Existing social infrastructures and services	None	As the required land is of small scale, it will not have an impact.
	4	Social institutions such as social infrastructure and local decision-making institutions	None	Construction of water supply facilities will require the formation of a resident organization for the maintenance and operation of each facility, but it is not expected to have a negative impact.
	5	Land use and utilization of local resources	None	The project will result in the creation of new water supply and sanitation services, but it is not expected to have a negative impact.
	6	The poor, indigenous and ethnic people	unclear	Construction of a surface water use facility will make the water rates higher than the construction of a facility using a deep well. Therefore, if no study is made to set the water rates at a reasonable level for poor households, there will be a greater possibility that a disparity will occur among the residents in terms of access to safe and clean water. Also, in some cases, it may be necessary to approach ethnic groups adopting a conservative stance to convince them to accept the new construction of water supply facilities.
	7	Misdistribution of benefit and damage	None	Because the water supply system and the sanitation facility are public properties, no impact will be made.
	8	Cultural heritage	None	There are no significant monuments or cultural heritage sites in the target area.
	9	Local conflict of interest	None	1) Inadequate explanation on the process and the details of the project to the residents may cause confrontation between and within the areas. 2) As it is confirmed that water shortage has caused conflicts of interest, construction of water supply facilities is expected to alleviate the conflicts. 3) If a pipeline-based multivillage water supply system (AEMV) is adopted, it is necessary to plan the network of distribution pipes and the maintenance and operation system, considering the relationship between the villages.
	10	Water usage or water rights and rights of common	None	Pumping up of groundwater does not create a problem concerning water rights. Even though water is taken from international rivers such as the Senegal River and the Gambia River, the water supply facility is of small scale and does not affect the cruising of vessels, water quality or the river course. Therefore, no problem will arise.

Likely Impact			Rating	Remarks
	11	Sanitation	None	Incidence of water-borne diseases is expected to decrease after the construction of facilities, because the use of contaminated shallow well and surface water as drinking water will decrease and the custom of hand washing will improve.
	12	Infectious diseases such as HIV/AIDS	unclear	There will be an inflow of workers during the construction of facilities. Therefore, it is necessary to take precautions against the spread of infectious diseases within the villages. On the other hand, no impact is expected during the use of the facilities.
Natural Environment	13	Topography and geographical features	None	The project does not involve a major clearing of land. Therefore, no impact is expected during or after the construction of the facilities.
	14	Soil erosion	None	The facilities to be constructed are of small scale and are dispersed. Therefore, no impact is expected. However, appropriate management is required of them. No problem is expected to arise from the view of the Forest Law of Senegal.
	15	Groundwater	None	As a result of survey and analysis, it was ascertained that no significant lowering of the groundwater level will occur in the future.
	16	Hydrological situation	None	This plan does not include the construction of a large dam, etc. The facilities taking water from the Senegal River, the Gambia River and their tributaries are not expected to make an impact, because the amount of water intake is minimal and the number of such facilities is limited.
	17	Coastal situation	None	There is no coast or sea area in the target area.
	18	Flora, fauna and biodiversity	None	The facilities will be constructed within the villages. Therefore, they are not expected to change the habitat conditions. The pipelines to be built between the villages will not make an impact on the habitat conditions, either, because they will be laid along the village roads. No problem is expected to arise from the view of the Hunting and Fauna Protection Law of Senegal.
	19	Meteorology	None	The facility use is not expected to make an impact on meteorology.
	20	Landscape	None	The construction of an elevated water tank is expected to change the landscape, but the impact is not significant.
	21	Global warming	None	The facility use is not expected to make an impact on global warming.
Contamination	22	Air pollution	None	As the construction is of small scale, air pollution is not expected to arise during the construction or the use of the facilities.
	23	Water pollution	None	As the construction is of small scale, water pollution is not expected to arise during the construction or the use of the facilities.
	24	Soil Contamination	None	As the construction is of small scale, soil contamination is not expected to arise during the construction or the use of the facilities.
	25	Waste product	None	As the construction is of small scale, waste products are not expected to be produced during the construction or the use of the facilities.
	26	Noise and vibration	None	Although a certain level of noise is expected to occur during the construction, the noise level will not be so significant as to cause health hazards to the residents. No noise or vibration will occur during the use of the facilities.
	27	Ground subsidence	None	There will be no large-scale pumping-up that may cause ground subsidence. As a result of survey and analysis, it was ascertained that no significant lowering of the groundwater level will occur in the future.
	28	Offensive odor	None	As the construction is of small scale, offensive odor is not expected to emanate during the construction or the use of the facilities.
	29	Sediment	None	As the construction is of small scale, sediment is not expected to be generated during the construction or the use of the facilities.
	30	Hazard	unclear	Although the construction is of small scale, it may cause traffic accidents involving trucks for material transportation and the residents along the road as well as accidents involving the workers at the construction site. On the other hand, no accidents are expected to occur during the use of the facilities.
Total evaluation: Necessity of implementing an IEE or EIA			No	It was ascertained that the water supply facilities in the master plan will not have a serious impact on the environment or society, because they are of small scale and are dispersed.

11.2 Monitoring and Countermeasures

Monitoring and countermeasures are as follows for four impacts which are evaluated to be "unclear" in the scoping.

(1) Involuntary Resettlement
In accordance with the conventions of the rural areas of Senegal, it is necessary to select a plurality of candidate facility construction sites and check if the land can be acquired in the planning stage. At the same time, it is also necessary to obtain the agreement of the village chief and the landowner. In principle, a field or vacant land should be selected as the candidate site so as not to cause involuntary resettlement of the residents. If involuntary resettlement is expected to occur, other land should be selected.

(2) The poor, indigenous and ethnic people

(2-1) The poor
Based on the maintenance and operation costs estimated in the F/S, it is assumed that the water rates for a general piped water supply facility will be 200-400 FCFA/m^3, while the water rates in using surface water with a simple water purification facility will be 500 FCFA/m^3. Therefore, the water rates will be at a level making piped water supply from the facility accessible to average households in the target area. However, since the poverty rate may be high in some villages, it is necessary to conduct a close examination in the planning stage to determine the amount payable by the residents and study the preferential measures for the poor as needed.

(2-2) Ethnic people
Multiple ethnic groups exist in the target area and different ethnic groups live in the same village. Also, there are ranks in the neighboring villages. The AEMV recommended by the M/P is a system that distributes water to the central village and surrounding villages and as such, consideration should be made to the different ethnic groups. As the distribution of water from the minority group to the majority group will induce conflicts of interest and obstruct the collection of water rates, it is necessary to carefully examine the location of the central village and the composition of the ASUFOR members in the planning stage.

(3)Traffic hazards and accidents on construction site
From the interviews with each BPF in the target area, it was ascertained that no traffic accident has so far occurred in the national road (Route nationale) or the regional roads (Voie ferrée) that will be involved in the construction of the facilities. At present, the construction company gathers the residents at the construction site before the start of construction to draw their attention to keeping children away from the site. In carrying out the construction work, the construction company should make efforts to share information not only with the residents of the vicinity of the site but also with those living along the regional roads stretching from the national road to the site.

(4) Infectious diseases such as HIV/AIDS
During the construction of facilities, there will be an inflow of workers from abroad and outside of the area. As it may lead to the spread of infectious diseases, the construction company should train the workers and take control measures to prevent the spread of infectious diseases in constructing the facilities.

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Chapter 12 Conclusions and Recommendations

12.1 Conclusions (Water Supply)

The ratios of water supply coverage including shallow wells are 67% in Tambacounda Region, 71% in Matam Region and 74% in Kédougou Region (as of December 2009, source: PEPAM 2010 review), and the targeted values of OMD2015 are expected to be achieved. However, DHR seeks for improving the ratios through dissemination of newly constructed piped water supply facilities as shallow wells have concern for contamination. The ratios of water supply served by piped water supply facilities are 26% in Tambacounda Region and 12% in Kédougou Region, which is extremely lower than that in other areas. On the other hand, it is 62% in Matam Region. It is around 70% in other Regions except for Casamance area.

Therefore, the master plan focuses on improving the coverage ratios of water supply through piped water supply facilities, establishes the targeted ratios and verifies the plan to achieve the goal. The areal issues to enhance the ratios of water supply through piped water supply facilities are that most of the villages are of small scale, or that restrictions in recharge storage do not meet the demands for water supply. Therefore, as an alternative proposal to the existing AEMV water supply facilities, the concepts of AEMV-I and AEMV-T are presented.

In order to clarify the target villages to be implemented through projects on short, middle and long terms, the master plan classifies all the villages into groups of villages to construct AEMV, and presents priority lists of villages in the groups. As a result, in Tambacounda and Kédougou Regions where the construction of facilities is lagging behind, the center villages in the areas of piped water supply facilities become the target group of villages. In Matam Region, the short-term plan showed that installation of the facilities should commence from the villages along with the national road and at the watershed of the Senegal River, and then transfer to the projects focusing on groups of villages in the inland area.

In addition to the plans for rehabilitation and operation and maintenance to support achieving goals for water supply coverage rate improvement through construction of new facilities, the plan for sanitation is also proposed in order to control waterborne diseases.

In order to verify the adequacy of implementation of the projects for the groups of villages prioritized under the above master plan, cost estimations of the projects and technical and economic evaluations were made through F/S.

As a result of F/S, in the case of projects for piped water supply facilities, it is revealed that the project costs per capita appear to be the lowest when the populations to be benefitted are around from 2,000 to 4,000. Also, from the economic evaluation, it is verified that enough economic benefits can be observed through extension of piped water supply facilities “AEMV” and increasing water supply to provide for livestock watering which are specifically encouraged in Senegal at present. Also, it is confirmed that AEMV-T and AEMV-I have technical adequacy.

On the other hand, if the number of piped water supply facilities increases at the speed which is proposed by the master plan, the amount of usage of groundwater rises extremely. As there is a concern for recharge storage, the effects from growing amount of water usage on water resource management are estimated through the groundwater flow simulation. As a result, in the case of progressing construction until the end of the long term plan (2027) as well as for the scenario where the populations to be benefitted will increase at 3%, the largest drawdown in a Co layer will occur in Missirah Commune in Tambacounda Region, and is estimated to be 3.10m. The largest drawdown in a Ma layer can be observed in Ndendory village (in Sinthiou Bamambe Commune in Matam Region) (2.67m), and in a wide area along with the national road No. 4. Meanwhile, in Dialacoto and Goudiry Communes in Tambacounda Region, drawdowns of more than 2.0m are estimated. The results show that

considerations on restrictions in usage of groundwater are not needed, but DEM needs to monitor the groundwater level fluctuations.

12.2 Recommendations (Water Supply)

12.2.1 Considerations for Implementation Stage of Water Supply Projects

(1) Understanding on Geographical Correlation of Whole Village in a Rural Village Community

The possibilities for a project differs between cases for grouped village and individual village. As AEMV is the main stream in construction of facilities at present, prioritization based on grouped village is proposed in the master plan. In this way, it is necessary to understand the whole geographical correlation of a rural village community.

(2) Improvements in Quality of Repair Works of Water Supply Facilities and Construction of House Connections

After construction of the water supply facilities, the villagers repair the equipments and make house connections through their own efforts. Unfortunately, such problems as breakdown of a facility or leakage occur as a result of such works. As acknowledgement of local construction companies and villagers on quality management of construction is not enough, it is often too late to tackle with these problems as they start considering the solution after problems arise. In this regard, DEM, the supervising authority, has heavy responsibilities. In the training of villagers on maintenance of a facility, assistance should be made for improvements in skill for works borne by villagers, and simultaneously DEM is requested to actively control its quality.

(3) Dealing with Private-Public Partnership

Through installation of new piped water supply facilities in accordance with the plan, the number of operating facilities increases by 20% in 2015. The present scale of DEM personnel in charge of repair works has difficulty in quick response to requests for repair works in the case of increasing facilities. As the transition plan into Private-Public Partnership proposed in the middle term plan is based on the prerequisite that the PPP progresses from the Central Region, it is important for the government of Senegal to promote PPP on maintenance of facilities in the Central Region as soon as possible.

(4) Considerations to Kédougou Region

It is difficult to develop groundwater in Kédougou Region due to the geological conditions of bedrock, and therefore, in the past the area was excluded from verification before the detail design stage of projects. However, if several boreholes having yields of $5m^3/h$ are combined, piped water supply facilities can be operated. Also, as installation of piped water supply facilities is not promoted even at the center villages in the target area, it is desirable to implement projects in this area.

(5) Considerations to Inland Areas of Matam Region

Most of the assistances have been focusing on projects for the area along the national road and watershed of Senegal River, but the target area for implementation of projects in the future will be the inland areas. It is necessary to share the current situation of lagging behind in the target area with stakeholders of the sector and to coordinate inside the Implementing Agency on prioritizing implementation of projects.

12.2.2 Recommendations to Policies regarding Water Supply

(1) Renewal of Network of Groundwater Level Monitoring and Forecasting

DGPRE's groundwater level monitoring is conducted at a pace of 3 to 4 times per year at present. As a result of the study, it is found that the water level fluctuations occur rapidly during the rainy season and that the fluctuation is affected in for cases where neighboring boreholes are located at a distance of less than several 100m. Therefore, existing machineries are replaced by automatic water-stage recorders which can continuously collect data on water levels of both groundwater and rivers, improvements in analytical accuracy of groundwater simulations and recharge structure can be

expected.

In addition, it is necessary for DGPRE to periodically update the results of simulation technically transferred and to manage appropriated usage of groundwater in cases in which the results of monitoring differ from their expectation and that more demand than estimation of simulation such as increase in amount of agricultural irrigation use arises.

(2) Continous Monitoring
Several issues are observed among ASUFORs such as unclear accounting and absence of a general assembly. As mentioned in recommendations of PEPTAC2, BPF as the supervising authority or Rural Community are requested to continue monitoring of management and accounting of ASUFORs in order to sustain appropriate management of ASUFORs. Therefore, the budget of the supervising authority on monitoring should be allocated appropriately.

(3) Merits of Promotion of Electrification in Bedrock Areas
Since electrification generally reduces the costs needed for installation of generators and its maintenance, it becomes quite possible to construct small scale water supply facilities. At present, the plan for rural electrification is rapidly promoted by the government of Senegal in rural areas along with the main roads, and it is desirable to disseminate the plan into other areas.

(4) Merits of Road Improvements
Improvements of roads were conducted in the sections of Koussanar-Maka-Kounpentoum, Kounpentoum-Payar and Gouloumbou-Koar in Tambacounda Region, and Moudery-Bakel and Linguere-Ranerou in Matam Region. As a result, accessibility is much improved and transportation for fuel procurement and repair works of facilities can be done quickly. It is recommended that the government of Senegal promote more improvements in unconstructed section of Tambacounda-Ranerou and Goudiry-Khossante-Bembou. It will improve accessibility for repair works of facilities and fuel procurement around the areas, and reduce costs for maintenance of water supply facilities.

12.2.3 Recommendations on Public Relation Activities, Training and Transmission of Information

1) Public Relation Activities of Master Plan for Promotion of Projects
At present, major projects such as PEPAM-USAID, PEPAM-BAD, PEPAM-IDA, CRS and UEMOA are being conducted; however, it is desirable to implement projects in accordance with the master plan in order to raise the coverage ratio of water supply through piped water supply facilities towards the targeted value. Therefore, the government of Senegal is requested to share the master plan with stakeholders of the water sector including other donors, and continue to transmit such information for effective use.

2) Recommendations on Sharing Existing Information of PEPAM
Although PEPAM coordinates implementation of projects in the water sector, it does not always acknowledge the necessary information in terms of project formulation. In addition, similar inventory surveys were conducted by various organizations, though the collected information is not accumulated centrally. Also, different information can be available from various reference sources and it is not easy to obtain intended information.

It is necessary to establish a system which easily displays the information collected by PEPAM including detailed information at the rural level.

3) Activation of Platform for Water and Sanitation at Regional Level
It is not easy to identify NGOs and donors acting in the target area. Most donors present their projects online, but it is not possible to access the details of outputs and progresses. This is also the case with the master plan study and outputs regarding activities conducted by JICA. In order to relieve the situation,

the platform for the water and sanitation sector was established with a central focus on ARD, but it is insufficient in terms of accumulation of information. In addition, it is recommended to activate further the platform for the water and sanitation sector at Regional level from a view point of leadership for concrete policy publications at Regional level.

12. 3 Conclusions (Hygiene and Sanitation)

The main reason for high morbidity of water-born disease in the target area are lack of water supply facilities through development of safe and stable drinking water, as well as lack of safe and adequate sanitation facilities as barriers within transmission route of sickness. Furthermore, since target population insufficient "knowledge" on hygiene and sanitation issues, so that unfavorable behavior such as inadequate treatment of human excreta and to contaminate their water sources is continuously conducted. Also lack of information on quality improvement of the sanitation facilities obstruct to secure their family health in each household.

12.4 Recommendation (Sanitation)

Concerning rural hygiene and sanitation issues in Senegal, there are 5 ministries as stakeholders; Ministry of Urbanization and Sanitation, Ministry of Health and Prevention, Ministry of Public Health and Life Environment, Ministry of Decentralization and Local Autonomy, and Ministry of Education. Measures to establish the stronger body within 5 ministries for harmonization and smooth cooperation.

(1) Strengthen the corporation body
In order to make smooth share of data and information that concerns; the planned, the executing and the executed project, those accessibility for safe and adequate sanitation facilities in certain areas, and some actual condition of sanitation and hygiene in certain areas, the existing body (such as Hygiene and sanitation control committee, Sanitation plat-form at semi-urban areas, and Water and sanitation Plat form at regional levels) is necessary to be strengthen and to be activated.

(2) Information Compilation System for sanitation facilities
Together with the straightening those corporation bodies, it is recommended to establish the information compilation system for sanitation facilities at national level. At the present circumstance, to grasp all the information and data related to those sanitation facilities installed by each 5 ministries stated above are very hard. Spread of adequate sanitation facilities will be considered with the important factor of continuous use of those facilities. As in project monitoring index of PEPAM, continuous use of facilities are also stated.

However, the inventory for the rural sanitation facilities in household installed by project has not been prepared before, so that it is hardly know the exact number of the installations or those accurate conditions at the central government of Senegal. This absence of inventory or system seriously affect on future project planning, so avoiding the difficulties, a technical cooperation that can support and accelerate for developing Information Compilation System for sanitation facilities at the central level.

(3) Technical Cooperation for introducing the public health service (Assainissement Collectif)
In target area, as previously stated (in Chapter 2, 2.7(3) and in Chapter 8, 8.2(2)), there are some villages where urgently need to introduce the public health service, but numbers of village are very few. But to settle those regulations concerning the norm of sewerage and the waste disposal, as well as the excrement treatment at the central government is a prerequisite for planning for and commencement of the public health service project. Further important thing before starting the technical support, is to reconsider the definition of continuously developing "semi-urban area" or "huge central village" located in rural areas (the 5 cities out of Dakar where ONAS provides the service).

In accordance with "Code de l'Assainissement (Code of Public health)" that has been waited for the official announcement for renovation, it is strongly recommended to send an expert in central government in order to settle on the contents of the public health service in rural semi-urban area and establish the service providers with the technical transfer approach. Continual examination for contents of the technical cooperation is desired.

(4) Standard for rural sanitation facilities

Concerning type of toilettes which constructed in rural areas, a standard is needed to settle with leadership of Senegal, through mutual concessions between various executors of the project. At this moment, each executor gropes with their own policy but it is reported in PEPAM 2010 annual report that VIP/TCM type become a main stream (through 4 out of 5 project the VIP/TCM has been constructed as main type and urine diversion toilettes (VIET) as supplement, one project takes DLV type as sanitation facilities.) But, two monitoring and evaluation studies were conducted in 2010 with the intention of harmonization and make standard for toilettes. With CTB's funds, the evaluation study for PEPAM-BA project was executed, and Eau Vive conducted also evaluation study for every type of rural toilette those installed by various executors in all over the Senegal. Based on those results of two studies, the PEPAM annual report for 2010 recommends not limiting the toilettes type, but encouraging the construction those toilettes that meet DAR's recommendation. As for reach the object to improve the accessibility of sanitation facilities, the study and analyze for toilette type and standardization, including study on improving of CLTS's approach are required continuously.

Furthermore, DAR decided to execute the study for "National Sanitation Strategy Revue in Senegal" with PEPAM-BAD Phase 2. The result of this study will be elaborated in the end of year 2011.

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