Republic of Mali

Ex-Post Evaluation of Japanese Grant Aid Project

"The Water Supply Project in Region of Kayes, Segou and Mopti"

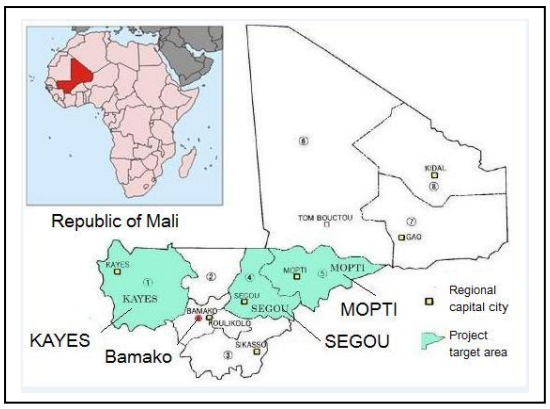
External Evaluator: Machi KANEKO, Earth and Human Corporation

0. Summary

This grant aid project has found that its relevance is high both at the time of the appraisal and the ex-post evaluation, as it is consistent with the National Development Strategy of the Republic of Mali and its development needs as well as Japan's ODA Policy. Although the operating rates of the constructed facilities are lower than expected, unable to achieve a target population of water supply, improved access to safe water by this project has some positive impacts on enhancing sanitation for people in the target village, including reducing infantile diarrhea. As for project efficiency, it is high since both the cost and implementation period of the project were as planned. Furthermore, the ex-post evaluation study has found that the project sustainability is fair. Although there have been observed some problems in the operation and maintenance of the project facilities in terms of its management, technical skills and financial resources, it is expected that the Government of Mali would make further efforts to cope with those challenges.

In light of the above, although having certain problems in effectiveness and sustainability, this project is evaluated to be satisfactory.

1. Project Description



Project locations

The project borehole with a hand pump

1.1 Background

As of 2003, when the Basic Design Study of this grant aid project was undertaken, the proportion of the population having access to safe water was 65%. Of this population, the rate of water supply in rural areas was as low as 57%, while that of urban areas was 87%. Thus those residents with no source of safe water in rural areas depend on draw wells, rivers and ponds, and this has often caused

waterborne infectious disease particularly for infants. Furthermore, water-drawing labor has deprived women and school age children of their opportunities for schooling or pursuing productive activities to gain income.

Given these problems associated with water scarcity, the Government of Mali has developed a policy of improving water supply with provision of at least one safe water source for each village.

As a part of such effort, this grant aid project was requested by the Government of Mali in order to increase a reliable supply of safe drinking water, targeting rural communities in the respective Region of Kayes, Segou and Mopti where water service coverage remains particularly limited.

1.2 Project Outline

The objective of this project is to ensure a reliable supply of safe water in Region of Kayes, Segou and Mopti by providing water supply facilities.

Grant Limit / Actual Grant Amount	1,493 million yen / 1,473 million yen (1st phase: 227 million yen/ 220 million yen) (2nd phase: 1,266 million yen/ 1,253 million yen)
Exchange of Notes Date	1st phase: December, 2003 2nd phase: May, 2004
Implementing Agency	National Water Department (DNH) at the Ministry of Mines, Energy and Water
Project Completion Date	1st phase: March, 2005 2nd phase: March, 2005 (Term 1) : March, 2006 (Term 2) : March, 2007 (Term 3)
Main Contractor(s)	Urban Tone Corporation
Main Consultant(s)	Sumiko Consultants, Co.Ltd., Sanyu Consultants, Inc. (JV)
Basic Design	August, 2003
Related Projects (if any)	Grant aid of JICA: "Water Supply Project in Kati, Koulikoro and Kangaba Cercles" (1999-2000) "Drinking Water Supply Project in the Southern Mali" (2008-2010) Project by other international organizations and aid agencies: "Technical advisor for the advisory team of DNH on installing drinking water supply facilities" (1994-2010, KfW, AFD and UNICEF) "Water Supply Project in Rural Communities in the Region of Kayes" (1998-2008, UNICEF) "Water Supply Project in Rural Communities in the Region of Mopti and Tombouctou" (1998-2004, Islamic Development Bank)

	"Water Supply Project in Rural Communities in the Region of Kayes and Koulikoro" (1998-2004, Islamic Development Bank) "Water Supply Project in Rural Communities in the Region of Kayes, Koulikoro, Sikkaso and Segou" (2001-2004, World Bank) "Water Supply Project in Rural Communities in the Region of Sikkaso, Segou and Tombouctou" (2000-2005, AFD) "Water Supply Project in the Region of Kayes" (2003-2005, KfW)

2. Outline of the Evaluation Study

2.1 External Evaluator

Machi KANEKO, Earth and Human Corporation, Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was undertaken on the following schedule.

Duration of the Study: October, 2010 –October, 2011

Duration of the Field Study: February 26, 2011 – March 18, 2011 and May 2, 2011–May 15, 2011
July 21, 2011–August 6, 2011

2.3 Constraints during the Evaluation Study

Not found.

3. Results of the Evaluation (Overall Rating: B[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Policy of the Republic of Mali

In a planning phase of this project, the governmental policy in water supply sector was developed upon the "Water Resources Development Plan (1999-2001)"[3] and the "Infrastructure Development Plan in Rural Areas (1998-2002)."[4] These plans revealed objectives to improve access to safe water in rural areas by providing at least one safe water source facility in every village. Also, the "Five-Year Plan (2000-2005)" that comprises those two development plans had set goals of achieving a safe water supply rate of 80% and eradicating waterborne infectious diseases which account for 60% of the total diseases in the country. Furthermore, the "National Programme for Access to Drinking Water (2004)" targets providing at least 75% of the necessary and safe water supply by 2015, which is

[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, and D: Unsatisfactory

[2] ③: High, ②:Fair, ①: Low

[3] The "Water Resources Development Plan (1992-2001)" was developed in cooperation of UNDP.

[4] The "Infrastructure Development Plan in Rural Areas (1998-2002)" was developed in 1997 in cooperation with the World Bank and other agencies.

also promised in the Millennium Development Goals (MDGs).

The project was designed to ensure sustainable and safe drinking water sources in Region of Kayes, Segou and Mopti where water service coverage remains particularly limited. It can be said that its objective is to respond to such needs, thereby consistent with the above-mentioned water sector policy and the national development plan of Mali.

The ex-post evaluation study further examined the relevance of the project after the project completion. The "Development and Poverty Reduction Strategy" revised in 2006 addresses to achieve the target 7 of the MDGs to "reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation." The above-mentioned "National Programme for Access to Drinking Water," moreover, was revised in 2009 as the "Action Programme for Access to Drinking Water." This targets at least 75% of the population having improved access to safe water by 2012, bringing the target year forward three years.

Given these policy backgrounds, the project objectives to provide improved safe water sources have been consistent with the development policy of Mali at the time of the project appraisal, thereby the relevance of the project is high. Also after the project completion, its ex-post evaluation has found that the project objectives and directions remain consistent with the "Development and Poverty Reduction Strategy" currently under implementation. In addition, the project continues to be relevant since urgent needs for improving access to safe water are addressed such policy as the "Action Programme for Access to Drinking Water."

3.1.2 Relevance with the Development Needs of Mali

Since the late 1970s, the Government of Mali, with a help of aid agencies, has committed to construct safe water facilities in order to improve severe water scarcity in rural communities. Accordingly, at the time of the Basic Design Study of this project, the availability of water sources seemed to be gradually increasing. At the same time, however, the water supply rate in rural areas in Mali was as low as 57%, and poor sanitation had been prevalent in many of the villages.

According to DNH, as of the ex-post evaluation study in 2011, the proportion of the population having access to safe water in Mali was increased to 75.5%, compared to 65% at the time of the project appraisal. However, the proportion of the rural population having such access remains 73.9%, while that of urban cities was 79.3%. Availability of water sources also varies depending on regions and districts (cercles), and people in rural communities, in particular, continue to face water scarcity.

For this reason, improving water supply in those rural areas is an urgent need which Mali is expected to make consistent efforts to meet.

3.1.3 Relevance with Japan's ODA Policy

In Mali, the Government has made efforts for poverty reduction, undertaking decentralization and privatization of state-owned enterprises. In planning this project, it was considered to be highly

significant for Japan's Official Development Assistance (ODA) to support such efforts of Mali in achieving sustainable development and poverty reduction that were underpinned in the ODA Charter (1992-2002). More concretely, the project was consistent with Japan's aid priorities in meeting basic human needs including infrastructure as well as in promoting primary education, water supply and agriculture, by employing grant aid projects.

In the light of all these policy directions, this project has been highly relevant with Mali's development plan, development needs as well as Japan's ODA policy, and therefore its relevance is high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

The project outputs are indicated in the Table 1, showing no major differences in the planned and actual outputs. In the respective regions of Kayes, Segou and Mopti, a total of 233 boreholes with hand pumps and 3 small water facilities have been provided as planned. On the other hand, there have been minor changes in specifications of the facilities.

Table 1 The planned and actual project outputs

Facility	Planned	Actual
(1) Boreholes with hand pumps	Kayes: 89 hand pumps (India-Mali Mark II)	Kayes: The number of hand pumps and the specification as planned
	Segou: 81 hand pumps (India-Mali Mark II)	Segou: The number of hand pumps and the specification as planned
	Mopti: 38 hand pumps (India-Mali Mark II) 25 stepping pumps (Vergnet Hydropump 100)	Mopti: 63 hand pumps (India-Mali Mark II: 61) (Hydro-India 60: 2) The number of pumps as planned The specifications made the following changes; 1) 25 hand pumps were installed instead of 25 stepping pumps. 2) Two of the above hand pumps installed iron-removal equipment with higher spout type pump.
(2) Small water facilities	Kayes: 1 village (6 common faucets) Segou: 1 village (13 common faucets) Mopti: 1 village (7 common faucets)	Kayes: mostly as planned Allocation of piping lines was change in order to bypass main roads under pavement work. Segou: as planned Mopti: as planned

The changes in outputs are primarily due to the following reasons.

1) Change in specification from “stepping pump” to “hand pump”

The initial project plan in Mopti suggested that a borehole with drilling depth of more than 60 meters employ stepping pump instead of hand pump. In the following Detailed Design Study, however, the National Water Department (DNH) requested that it should be avoided women draw drinking water with foot as it is of sacred nature.

Accordingly, all the 63 project sites in Mopti have installed boreholes with hand pumps, regardless of the drilling depth. Taking such a local practice into consideration, the Government of Japan agreed with that of Mali upon this change in specification, which is considered to be a reasonable adjustment.

On the other hand, the field study during the ex-post evaluation has found many of hand pumps out of order. The malfunction of the facilities seems more likely to occur in the project sites where stepping pumps were substituted with hand pumps for the above-mentioned reason (About 12 out of the 18 sites have facility failure). This indicates that the installed facilities need more appropriate maintenance, and the details are further discussed in the following section of “3.5 Sustainability.”

2) Installation of iron-removal equipment with hand pumps

Iron-removal equipment installed along with a borehole with a hand pump (Woroyesso village in Mopti)

The initial plan suggested that if a selected project site had any problem in water quality, then an alternative village should be reselected. In Mopti, it was found groundwater in some villages tend to include iron. Accordingly, two target villages in the region were subject to this problem, but it was turned out to be difficult to select alternative villages in the surrounding areas having water sources without iron. Moreover, these two villages faced particularly severe water scarcity due to an increasing population. Despite the high level of iron contained in water, the result of drilling showed abundant water sources there. The residents, facing a growing need of a new water facility, strongly desired an installation of iron-removal equipment in boreholes. Accordingly, based on an official request of design changes submitted by DNH, the Government of Japan approved providing iron-removal equipment and an alternative hand pump with a higher spout. Changing specifications was considered relevant as it was carefully decided upon a cost comparison between installing iron-removal equipment and undertaking new drilling in other villages.

After all, however, the field study during the ex-post evaluation has found in two project sites hand pumps with iron-removal equipment were not properly working. Again, this indicates that the installed facilities need more appropriate maintenance, and the details are further discussed in the following section of “3.5 Sustainability.”

(3) Change in water piping of the small water facility in Kayes

Piping to install a small water facility was initially designed to cross under main roads between

Bamako and Kayes. However, its pavement work previously planned was completed before this piping installation was started, and as a result, the allocation of water pipe was reassigned to run through culvert laying 173 meters in west of the water source. This change was considered necessary to complete the piping work, and therefore it was a reasonable decision.

3.2.2 Input

3.2.2.1 Project Cost

While the Government of Japan had estimated the grant limit of 1,493 million yen (227 million yen for 1st phase and 1,266 million yen for 2nd phase), the actual grant amount disbursed was 1,473 million yen (220 million yen for 1st phase and 1,253 million yen for 2nd phase). Therefore, the project cost was lower than planned (99%).

As for the Government of Mali, the actual cost disbursed was 90,000,000 FCFA, compared to the planned cost of 95,064,000 FCFA, therefore it was mostly as planned.

3.2.2.2 Project Period

The actual project period was mostly as planned, taking 38 months (100%) from the Detailed Design Study in February 2004 to completion in March 2007.

In the light of these, both the project cost and the project period were mostly as planned, therefore efficiency of the project is high.

3.3 Effectiveness (Rating: ②)

3.3.1 Quantitative Effects

(1) Increase in population of water supply realized by the project

Population and operating rate by region and those by water facility are indicated in the Table 2 below.

As of 2009, the actual total population of water supply covered by this project was 100,791, and it is 35,000 less than the target value of 2007 estimated to be 135,047 at the time of the Basic Design Study of this project (achieving only 75% of the planned value).[5] This is primarily because some of the water facilities are not fully operating.

In accordance with results of defect inspection conducted one year after a transfer of the completed facilities, [6] any malfunctioning facilities have been repaired. As indicated in the Table 2, however, a facility survey[7] pursued during the ex-post evaluation found facilities in project sites were still not in

[5] The output values of 2009 is estimated by DNH according to data of the National Census 2009, and any data prior to 2008 is a provisional estimation based on the previous data set of population. Therefore, a comparison between the end target and output in the same particular year is not applicable here.

[6] The constructed water facilities were officially transferred to the Government of Mali respectively from January to March 2005 in Segou, March 2006 in Mopti, and March 2006 and March 2007 in Kayes.

[7] This facility survey, conducted from March through May in 2011, examined operating status of the project boreholes with hand pumps on 34 out of 81 sites in Kayes, 56 out of 63 sites in Mopti, and 34 out of 81 sites in Segou. Those project sites in which pump renewals were completed by other donors were excluded from the survey targets. (There are one site in Segou

full operation. The number of the facilities under operation[8] by region was respectively 27 out of 38 in Kayes (71.1%), 22 out of 34 in Segou (64.7%), and 33 out of 56 in Mopti (58.9%). The result shows some residents remain unable to use the project facilities.

According to the results of defect inspection, moreover, the operating rates one year after the transfer of the facilities are respectively 97.8% in Kayes, 82.7% in Segou, and 87.3% in Mopti, as indicated in the Table 2. It suggests that the maintenance of the facilities varies depending on the regions as of a year from the transfer.

It should be noted that the project initially expected to achieve its target population (135,047 as of 2007), assuming that provided facilities would maintain the full operation rate. On the other hand, Mali's national development strategy on potable water aims about 70 to 80% of the operating rate of boreholes with hand pumps.[9] From this, it is recommended that a similar project in the future needs to carefully estimate an end target including population, by considering a realistic operating rate a few years after the project completion.

As for small water facilities, although there have been observed some parts failures in Mopti, water pumps are functioning. The population of water supply has reached 13,030 totaled in three regions, achieving more than the end target.

Table 2 Comparison of population of water supply before and after the project implementation and the operating rates of the facilities

Indicator (person)		End target (2007)	Output (2009)	Operating rate of facilities	
				As of a facility survey between Mar.-May, 2011	After defect inspection (prior to repairs) (A year after the transfer of the project facilities)
Increase in population of water supply by this project (person)					
Kayes		46,032	37,200		
Segou		56,975	39,247		
Mopti		32,040	24,343		
Total		135,047	100,791		
Type of water facility	【Boreholes with hand pumps】				
	Kayes: 89 villages	43,791	34,750	71.1%	97.8%
	Segou: 81 villages	51,764	32,062	64.7%	82.7%
	Mopti: 63 villages	29,239	20,948	58.9%	87.3%
	Total	124,764	87,761		
	【Small water facilities】				
	Kayes: 1 village	2,241	2,450	100.0%	100.0%
	Segou: 1 village	5,211	7,185	100.0%	100.0%
	Mopti: 1 village	2,801	3,395	100.0%	100.0%
	Total	10,253	13,030		

Source: The Basic Design Study Report, data provided by DNH and Regional Water Departments, the results of the facility survey, and the Defect Inspection Report

and 7 sites in Mopti.)

[8] Being "under operation" refers to a project facility in a good condition of pumping, observed by a surveyor on the site, and the operating rates are provided based on the number of such facilities. In other cases, an operating rate may be calculated by way of monitoring a facility for a certain period of time, for instance, from downtime to recovery of a hand pump.

[9] It is not indicated such operating rate should be sustained over how many years after the facility completion.

The facility survey conducted along with the ex-post evaluation included a water quality survey.[10] It examined safety of water sources by drawing water from either small water facilities or boreholes with hand pumps, both that were provided by the project. The test results found neither general bacteria nor coliform, and therefore the water sources in the project sites were concluded to be very clean compared with draw wells and large-diameter wells (The detailed outcomes of the water quality survey will be discussed in the section of "Impact.") Accordingly, it suggests that using water facilities provided by the project ensures access to safer water which is not contaminated with general bacteria or coliform.

(2) Population and rate of water supply by region

The population and the rate of water supply in respective regions are indicated in the Table 3 as below.

As of 2009, the population of water supply in the three regions was 3,849,325, significantly above the end target of 2,132,780 in 2007. This increase is presumably due to the effects of projects implemented by donors other than Japan such as Germany, France and UNICEF supporting the water supply sector in Mali. Aside from this, it should be noted that the end target in 2007 and the actual output in 2009 were estimated based on the national census[11] with different survey methods, and therefore these two values are not in fact applicable to a practical comparison.

As for the rate of water supply by region, the output value was 70.9% in Kayes, and 58.1% in Mopti, achieving the end target of 59% and 48% respectively. In Segou, on the other hand, the output value was 53.5% or approximately 10% lower than the end target estimated to be 64%. This is primarily due to its largest population among the three target regions. Also, people in Segou generally have more access to draw wells in their villages, and the Government of Mali and other donors had tended to prioritize other regions in assisting borehole construction.

[10] The water quality survey used a simple test kit to examine coliform, general bacteria, pH, nitrous nitrogen (NO_2), nitrate nitrogen (NO_3), and iron (Fe). Although detecting coliform or general bacteria in water does not necessarily pose a danger, there is a possibility of contamination, for instance, by animal excreta.

[11] The national census in 2009, applying a new survey method, is the latest official data on the population in Mali. Unlike the previous census in 1998, the new method employed a large number of survey workers, directly hearing household. The population data prior to 2008, which has been widely used, is estimated based on the census in 1998, and therefore the National Bureau of Statistics points out it cannot be compared with data after 2009.

Table 3 Population and rate of water supply by region, and national rate of water supply

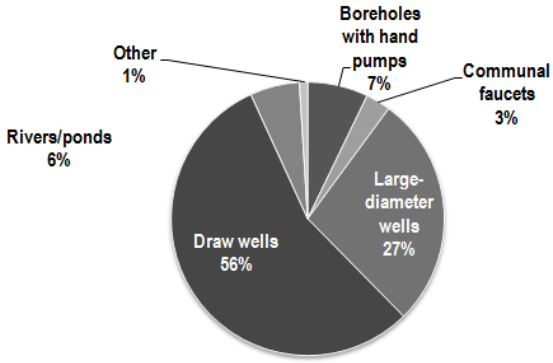
Indicator (unit of measure)	Baseline (2002)	End target* (2007)	Output** (2009)	Reference data
Population of water supply by region (person)	1,997,733	2,132,780	3,849,325	
Kayes	622,908	668,940	1,415,740	(Population by region based on National Census 2009)**
Segou	790,310	847,285	1,249,896	Kayes: 1,996,812
Mopti	584,515	616,555	1,183,689	Segou: 2,336,255
				Mopti: 2,037,330
Rate of water supply by region (%)	55%	59%	70.9%	(Rate of water supply by region estimated for 2010)***
Kayes	60%	64%	53.5%	73.3%
Segou	45%	48%	58.1%	58.7%
Mopti				65.2%
National rate of water supply (%)	65%		73.1%	75.5%
Urban areas	87%		77.4%	79.3%
Rural areas	57%		71.4%	73.9%

* End target in 2007 adds a baseline value in 2002 on increased population of water supply realized by this project.
** Population and rate of water supply in 2009 are officially estimated output provided by DNH using data of the National Census 2009.
*** Rate of water supply in 2010 is provisional estimation by DNH based on the National Census 2009, Mid-term budget framework, construction and rehabilitation plans of water supply facilities.

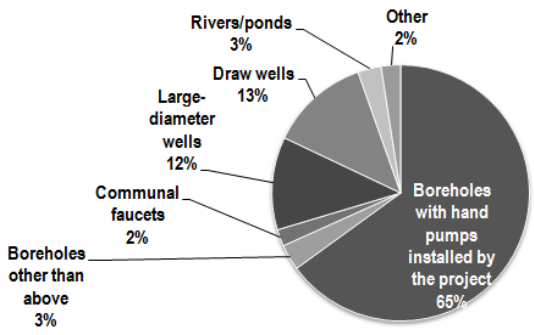
3.3.2 Qualitative Effects

(1) Status of utilization

During the ex-post evaluation study, a social survey was conducted over 630 households in 26 villages who have access to boreholes provided by this project. Selection of the target villages has taken into account of their population size. The Graph 1 and 2 below indicates primary sources of drinking water before and after the project implementation. Five years ago when the project was not yet under implementation, the proportion of the households having access to boreholes was 7%, and now 65% of the households use water for drinking and cooking from boreholes installed by the project.

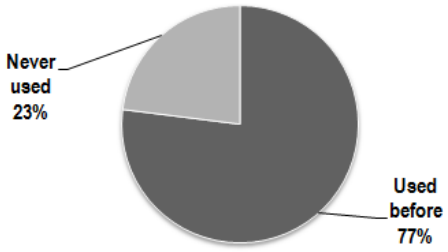


Graph 1: Primary water sources of drinking water 5 years ago
(n=630 households, of this 16 households with non-response)

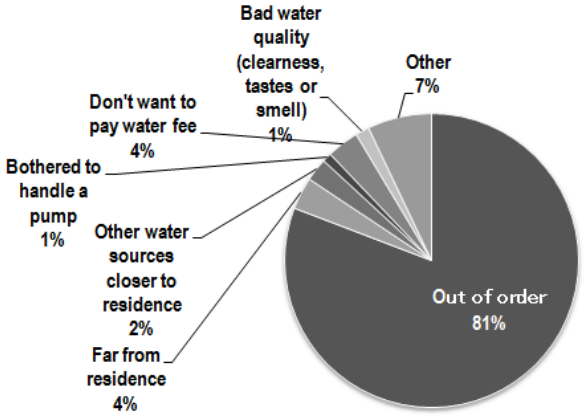


Graph 2: Primary water sources of drinking water at present
(n=630 households, of this 16 households with non-response)

About 193 households said that they were not currently using the project boreholes to drinking or cooking water, although about 80% of them answered that they used to do in the past (Graph 3). Of these households, 81% pointed out facility malfunction for its reason (Graph 4). It suggests that the poor operating condition has partly a negative effect on the project objective to "ensure the reliable supply of safe water."



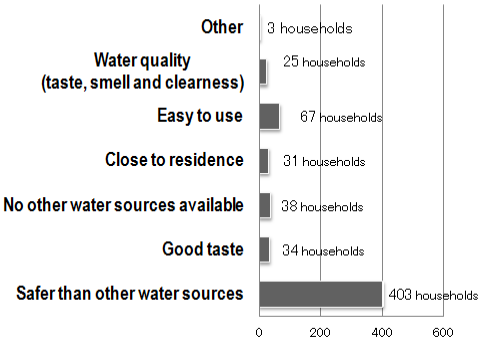
Graph 3: Of non-users, the proportion of the households with experiences using project boreholes in the past
(n=193 households, of this 6 households with non-response)



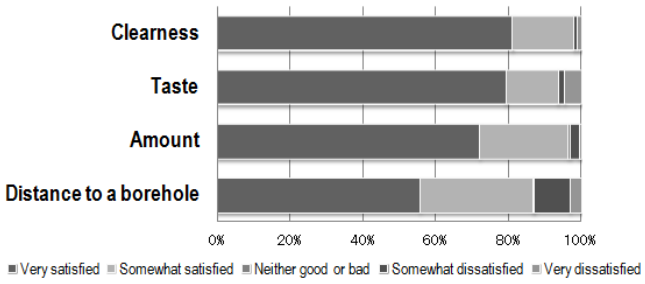
Graph 4: Reasons for not using the project boreholes (multiple answers allowed)
(n=193 households, of this 6 households with non-response)

(2) Water quality and facility site

As indicated in the Graph 5, among 425 households using the project boreholes for drinking water, about 90% said its water quality is safer than that of other water sources such as draw wells. Furthermore, 97% of the borehole users were satisfied with water they use in term of its quantity. Also, 94% of them are satisfied with its taste, while 98% are satisfied with its clearness (Graph 6). Therefore, the residents in the project sites are highly satisfactory in overall water quality.



Graph 5: Reasons for using the project borehole (multiple answers allowed)
(n=425 households)



Graph 6: Satisfaction with water quality of the project boreholes (clearness, taste, quantity and distance)
(n=425 households)

Recognizing a safety of water of the project boreholes, almost all of the households said that a

quality of drinking water is a key determinant of health. From the hearing of the field study, it was found some cases children drinking water of the project boreholes were less likely to have diarrheal diseases. It suggests that residents have somehow experienced improvement of water quality and basic sanitation compared to before the project implementation.

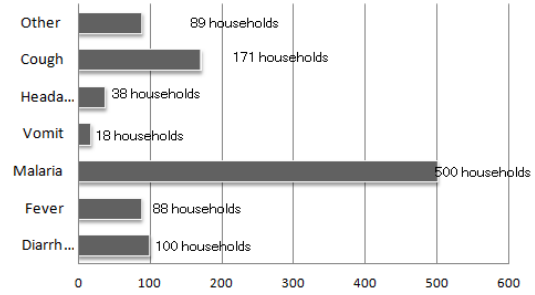
In the light of these outcomes, although observing some qualitative effects, the project has not achieved the target population of water supply, and therefore the overall effectiveness is evaluated to be fair.

3.4 Impact

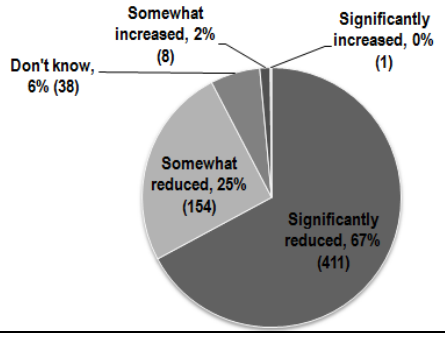
3.4.1 Intended Impacts

(1) Occurrence of diarrheal diseases

According to the results of the social survey, while 500 out of 630 households pointed to malaria as the most common disease of children, 100 households said diarrhea is the second frequent disease (see Graph 7). As the Graph 8 shows, the project has contributed to a reduction of children's diarrheal diseases, with 92% of the households responding a frequency of their children's diarrheal diseases have been "significantly reduced" or "somewhat reduced" compared to five years ago (2005).



Graph 7: The most common disease of children (multiple answers allowed)
(n=630 households)



Graph 8: Change in frequency of children's diarrheal diseases compared to 5 years ago
(n=630 households, of this 18 households with non-response)

Furthermore, as in the Table 4[12] and 5, the water quality survey over the project boreholes provides evidence that residents now have access to safe water. The water found neither general bacteria nor coliform that cause diarrhea, while other large-diameter wells and draw wells detected contaminations of those bacteria. In addition, the project has significant outcomes in increasing access to safe water for residents in rural areas, remote from the regional capital cities or central villages.

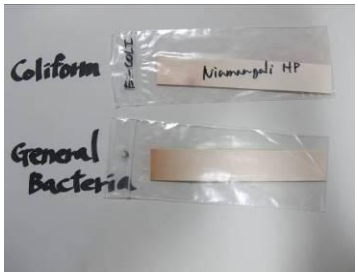
[12] The water quality survey used a simple test kit to examine coliform, general bacteria, pH, nitrous nitrogen (NO_2), nitrate nitrogen (NO_3), and iron (Fe).

Table 4　Results of the water quality survey conducted in the ex-post evaluation study (the number of the sites with bacteria detection)

Testing site	Kayes (of 27 sites)	Segou (of 22 sites)	Mopti (of 33 sites)	River	Draw wells	Large-diameter wells
General bacteria	0	0	0	detected	detected	detected
Coliform	0	0	0	detected	detected	detected
pH	0	0	0	0	0	0
NO_2	0	0	0	0	0	0
NO_3	0	0	0	0	0	0
Fe (iron)	0	0	0	0	0	0

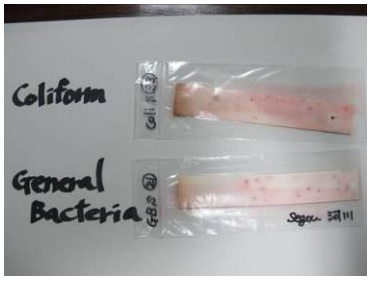
Note: Details on test items including their criteria and descriptions are provided in the Table 6 below.

Table 5 Test results of coliform and general bacteria* (culture time of 24 hours+)



Borehole with hand pump in the project site (Niangari Village in Mopti)

Draw well (Aboudouma Village in Mopti)



Niger River (Segou)

Large-diameter well (manual drawing with a bucket) (Bankass in Mopti)

* The test used examination papers for bacteria detection. Generally, after soaking papers in test liquid for 24 hours, it counts the number of colonies appeared on the papers. The water quality survey in this ex-post evaluation study recorded any visible colonies as "detected" without using detection equipment, therefore the accurate number of colonies are not provided in the Table 5. Accordingly, as in the above photographs, changes in colors from light yellow to red purple on the tested papers show colonies of coliform and general bacteria found in Niger River, draw well and large-diameter well.

Table 6 General criteria of water safety by test items and the descriptions

Test item	WHO Standard (allowable range)	Description
General bacteria	Less than 100 colonies in 1 ml of water	Although many of general bacteria detected are not pathogenic germ, they are more likely to be found in contaminated water. Thus the number of general bacteria indicates degree of contamination and safety of drinking water.
Coliform	Not detection	Although coliform is not generally pathogenic, some of them cause diarrhea and bowel inflammation, called "Escherichia coliform."
pH	Between 6.5 and 8.5 (Between 6.5 and 9.2)	Although a neutral pH is desirable in terms of preventing corrosion of water pipes, there is no evidence-based specific range of pH in drinking water that possibly affects health.
NO_2 (nitrite nitrogen)	Less than 0.5mg/L (Less than 3mg/L)	A health effect is that nitrate nitrogen rapidly reduced to nitrite nitrogen in the body reacts with haemoglobin in the blood, causing methemoglobinemia. In particular, babies under 6 months are subject to this symptom. Nitrate nitrogen widely exists in soil, water and plants including vegetables, while nitrite nitrogen is also included in very low concentration. Those found in water come from wastewater, factory disposal, human waste, fertilizer, carcass and garbage. These two elements are used as an indicator of contamination.
NO_3 (nitrate nitrogen)	Less than 50mg/L (Less than 50mg/L)	
Fe (iron)	Less than 0.3mg/L (Less than 1.0mg/L)	Iron generally detected in drinking water has no harm on health, but it causes color (red) or unusual taste and smell (metallic odor and bitterness).

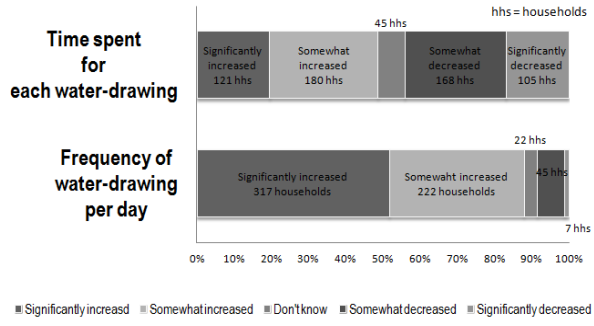
(2) Reducing burden of drawing water

The result of the social survey indicates that in more than 60% of the households women are responsible for drawing water. It also reveals that more girls than boys engage in such work. This tendency has hardly changed compared to five years ago in the target villages and elsewhere.

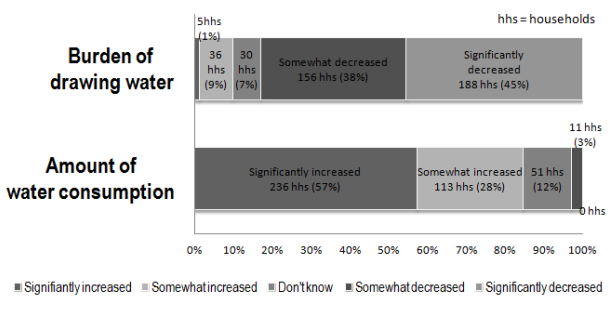
For some household, as observed in the field study, using the project boreholes instead of the nearest water sources such as draw wells has increased a walking distance from their residence areas. Compared to five years ago, about a half of the households said it takes more time per water drawing, while the rest answering spending less time (see Graph 9). Furthermore, more than 90% of the households said that a frequency of drawing water per day has increased compared to five years ago, with 36% of twice a day, 17% either once a day or three times a day.

In addition to the above, 85% of the households using the project boreholes said they use more amount of water on a daily basis compared to five years ago (see Graph 10).

Given these survey results, while burdens of drawing water have seemingly increased, 83% of the households responded that it has actually decreased, as shown in the Graph 10.



Graph 9: Changes in water drawing time and frequency compared to 5 years ago (n=630 households)



Graph 10: Change in the consumption of water and in burden of drawing water compared to 5 years ago (n=425 households)

The results indicate that, along with an increasing frequency of water drawing and more water consumption, time spending in water-drawing work has actually increased. Nonetheless, many households feel water-drawing work less burdened than before. The major reason of this outcome is an installation of hand pumps with the boreholes.

For women and children in villages, large-diameter wells and draw wells impose them hard work, repeatedly drawing up and down a hanging rope with a rubber bag. Five years ago, about 60% of the households relied on those types of wells, but hand pumps installed by the project have enabled women and children to easily draw water with less time as shown in the photo below in the right. This has led those users to feel less burdened in water-drawing work. Besides, an availability of new water source has an effect on the increase of water consumption per household, contributing to improved living environment with more access to water.

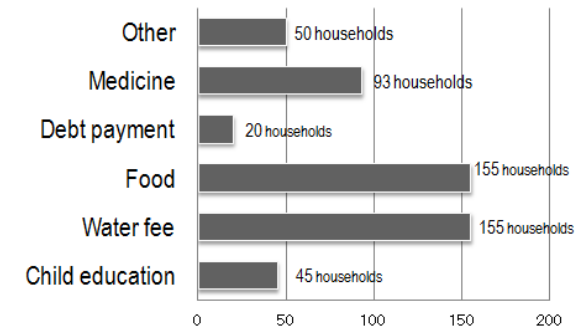
A girl drawing water out of a draw well (about 80 meters in depth)
(She handles the rope with a rubber bag, repeating ups and downs about seven times to fill a bucket with water. It takes a lot of time and efforts.)

A borehole with a hand pump provided by the project
(For women bringing their babies to water drawing, pumps enabling one-hand operation is easier for the mothers as well as safer for their babies.

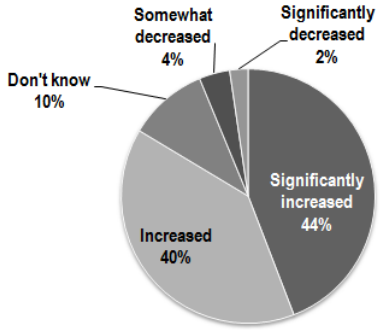
On the other hand, 86% of the households said that it takes up to 30 minutes of walk to a project borehole from their residence. A location of a borehole should be carefully determined so that its accessibility increases facility users, allowing them less time and effort required in water-drawing work.

(3) Women engaging in income-generating activities and productive activities

According to results of the social survey, the proportion of the women engaging in productive or income-generating activities in the target villages is about 40% (262 out of 630 households). With this income earned, they pay for water, food, medicine and other provisions (Graph 11). About 84% of the household said, compared to five years ago, they are more likely to be involved in productive or income-generating activities (Graph 12). Furthermore, 91% of the households said their family incomes have been increased by such activities. Behind this, they have presumably become able to spend more time in productive activities partly as a result of reduced labor in drawing water. According to a local NGO helping rural development, furthermore, women increasingly need to make up for family incomes by productive activities including agriculture, as more men leave their villages for Bamako or neighboring countries as migrant workers.

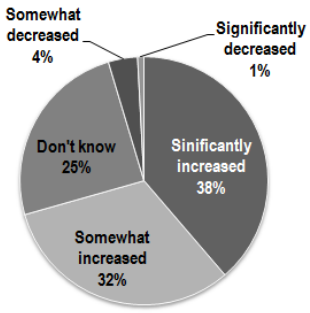


Graph 11: Items paid with incomes gained from productive and income-generating activities (multiple answers allowed)
(n=262 households)

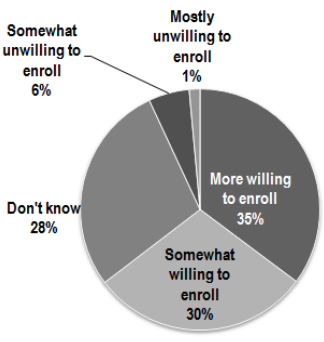


Graph 12: Change in opportunities to engage in productive and income-generating activities compared to five years ago
（n=262 households）

As shown in the Graph 13, 70% of the households said that their children go to school more regularly than five years ago, indicating more parents encourage them to obtain education. In addition to an increasing number of schools constructed in rural areas, children of school age who used to engage in domestic work such as water drawing are allowed to have more time for attending school. Also, Graph 14 indicates 65% of the household answering they have become more willing to enroll their children in school.



Graph 13: Number of days attending school of children (n=630 households)



Graph 14: Change in parents' attitude toward schooling of their children compared to five years ago (n=630 households)

While women's involvement in income-generating activities and children's schooling opportunity have increased compared to five years ago, such impact is also largely attributed to other factors including increasing migrant male workers and school construction. Actually, the social survey has found non-target villages are also experiencing the similar improvement of livelihood for women and children.[13] Nonetheless, given the slightly higher impact over the target villages, it can be said that the project has contributed to inducing positive outcomes mentioned above.

[13] The social survey conducted inquiries in non-target eight villages in Mopti in order to compare counterfactual outcomes of no project intervention. These villages initially selected for project sites during the Basic Design Study found no viable water sources in the process of drilling, and thereby the project has not been implemented.

BOX 1　Results of Project Impact Analysis with Statistical Social Survey

The ex-post evaluation study attempted to apply quantitative effect measurement method in order to assess the project achievement and impact in more detail. The summary of the analysis is as follows.

Objective

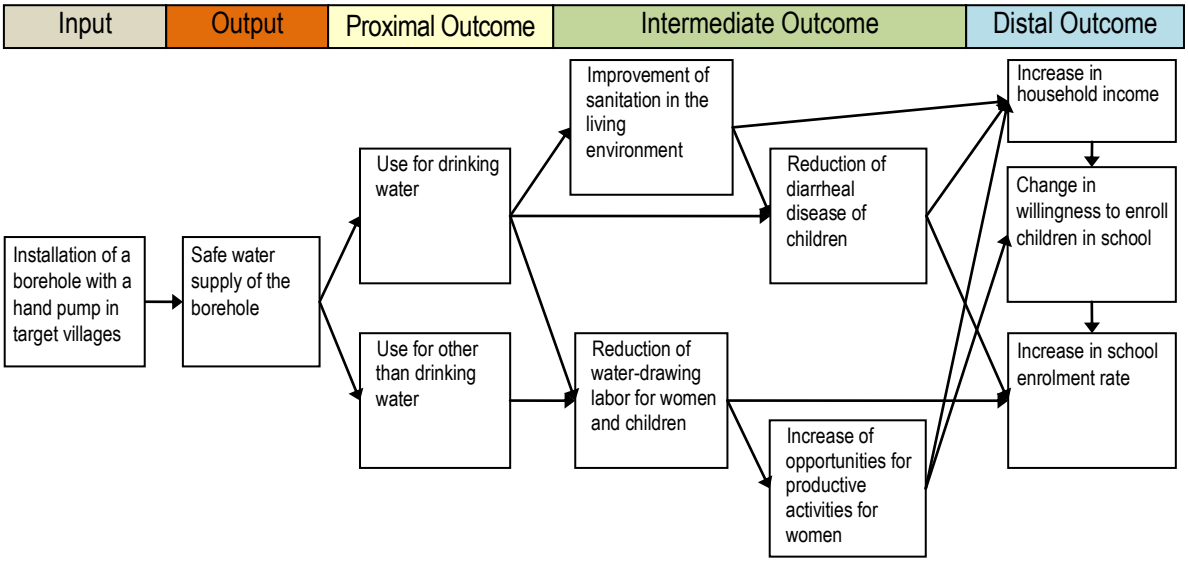


Diagram 1　A theoretical model (an assumed causal chain from “input” to “distal outcome” of this project)

Diagram 1 shows a theoretical model drawing on the ex-ante evaluation sheet of this grant aid project and previous experiences of similar projects.　It represents a causal relation in three sequential stages responding to proximal, intermediate and distal outcomes.　For instance, the model above suggests that installing a borehole with a hand pump leads to an increase in consumption of safe water, which in turn results in reducing diarrheal diseases of children.　In addition, it indicates another causal link that drawing-water labor is reduced as a result of installing a borehole with a hand pump, and this increases opportunities for women’s productive activities and children’s schooling.

The objective of this measurement method is to define causal relations among variables selected from data obtained from the social survey.

Method

After selecting 26 out of 63 villages in Mopti taking account of the population size, a social survey was conducted with a questionnaire over 630 households selected from those 26 villages in accordance with their population size. In addition, another set of 100 households in non-target villages was also surveyed. The survey questionnaire applies ordinal scale whenever possible to enable statistical analysis, asking about water supply of the project borehole, use for drinking water, drawing-work labor, sanitation, health, education, household income, facility maintenance and so on.

Statistical analysis is undertaken by performing Structural Equation Modeling (SEM) with SPSS19.0 and Amos19.0.

The procedure of the analysis is as follows.

(1)　With SPSS, database was created using data obtained from the social survey.

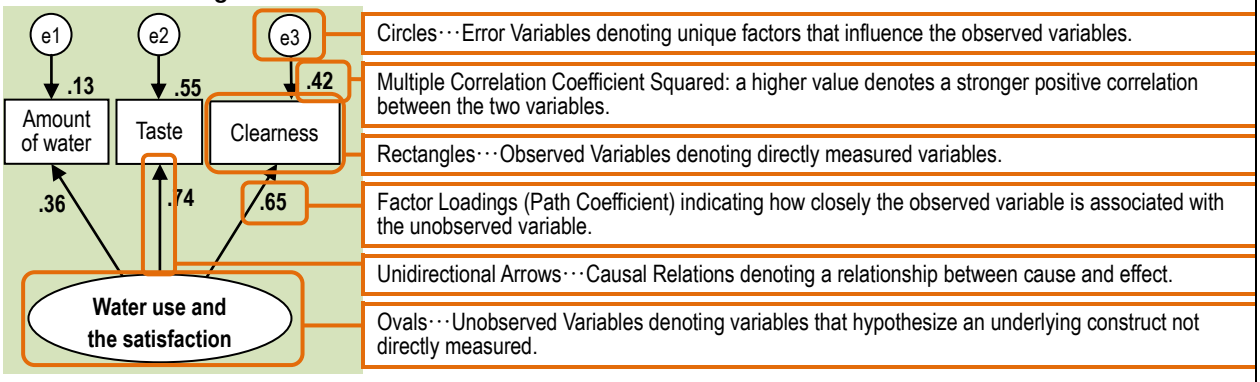
(2)　Based on a cross tabulation of the hypothesized model, a revised model was defined, selecting 29

variables.

(3) As a result of performing a factor analysis of these 29 variables, a set of 19 variables and five factors was selected. These five factors include “water use and the satisfaction,” “improvement of women’s domestic work conditions,” “improvement of health,” “economic situation,” and “increase in schooling opportunity.”

(4) Using the above five factors, a model of their observed response was illustrated in a pass diagram, and then a pass analysis was performed.

≪Basic Path Diagram≫



Results

Diagram 2 shows results of pass analysis. The chi square value (χ^2) is 248.29,with degree of freedom of 98, and p<0.001. Goodness of fit index of the models is CFI=0.924, IFI=0.925, and RMSEA=0.060.

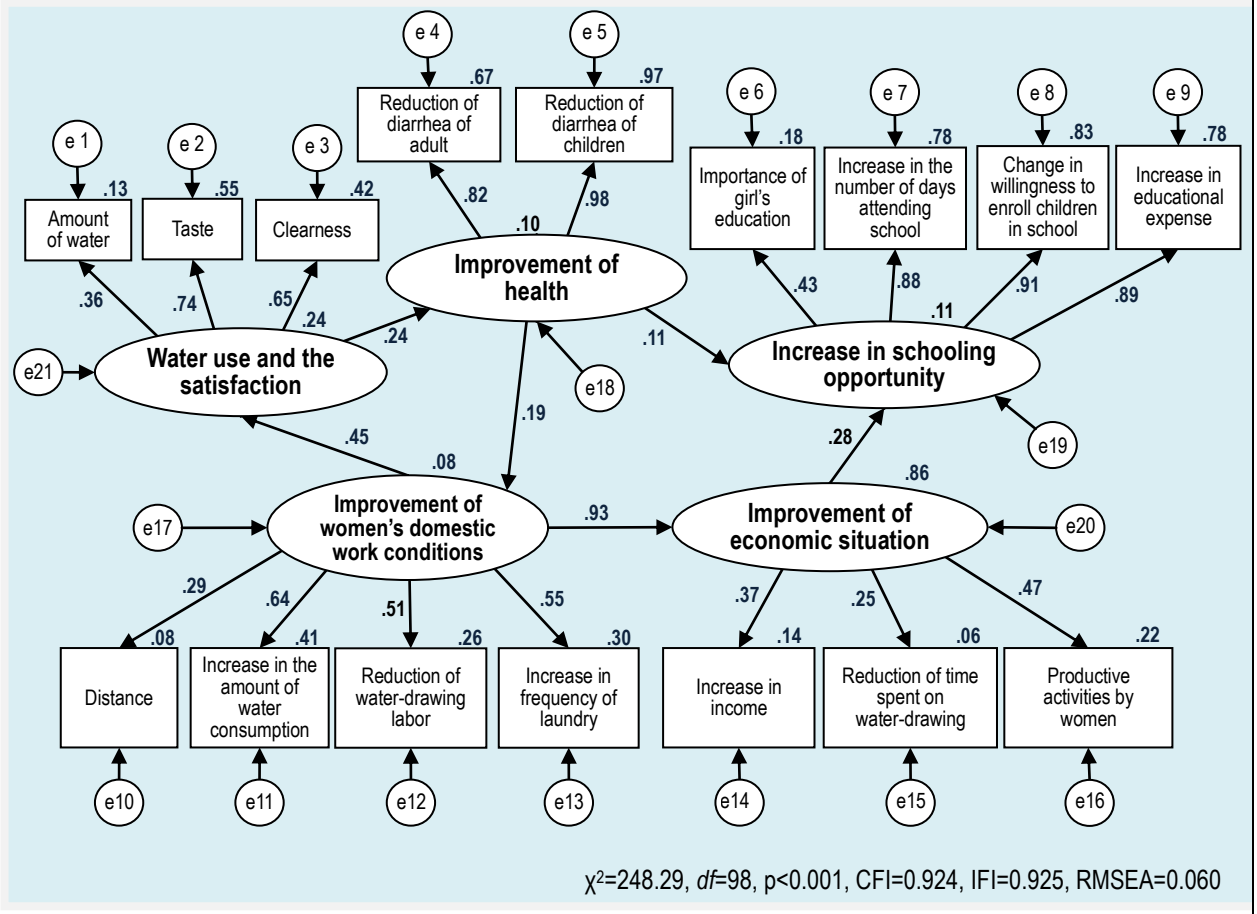


Diagram 2 Results of the pass analysis of households using the project boreholes

Conclusion

According to the results of the pass analysis above, causal interpretations are primarily as follows;

Users of the project boreholes are satisfied particularly with taste and clearness of water, leading to an increase in users. This increase has in turn improved domestic work conditions for women as well as overall sanitation in households, and moreover, access to safe water has brought about improved health.

Regarding improved domestic work conditions for women, in particular, they have felt water-drawing work less burdened than before as a result of enhanced usability of a hand pump, and an increased availability of water has obviously led to more frequent laundry. Furthermore, using safe water for drinking, cooking and washing of cooking utensil has contributed to improved sanitation in the living environment.

As for improvement of health, the respondents particularly feel that diarrheal diseases of children and family members have been significantly reduced by their using water of the project boreholes, which actually indicates strong correlation.

The improvement of economic situation is strongly related to that of women's domestic work conditions. Easier water-drawing work associated with the hand pump has led to reduced domestic work load. This has enabled women to engage in more productive activities, contributing to improved economic situation of their households.

On the other hand, an increase in schooling opportunity in the model has observed less correlation with using the project boreholes. This suggests that some critical factors other than an availability of the project boreholes have led to promotion of school enrollment. It should be mentioned that a growing number of school construction projects in the country have resulted in an increase in the gross enrollment rate from 66 percent in 2005 to 82 percent in 2009, although having not yet achieved a target value of 95 percent in 2010. In addition to school construction, furthermore, an increase in the enrollment rate generally requires associated efforts in enhancing parents' understanding of formal education for their children and in improving overall school management. These various factors are more likely to affect an increase in schooling opportunity, and as a result, the use of the project boreholes by itself has found to be less strongly correlated with promotion of school enrollment.

This SEM, indicating the CFI over 0.9, appears to be valid. On the other hand, its RMSEA is slightly over, and it is necessary to reproduce another model of good fit. Although data obtained from the questionnaires is unable to develop the above model to test further relationships, the outcomes of this pass analysis provide useful lessons for similar projects in the future. In particular, improving how to ask questions in a questionnaire will help conduct more efficient social survey.

3.4.2 Other Impacts

(Any project benefits on the target villages and the residents, impact on the environment, land acquisition and resettlement)

1. Impacts on the natural environment

According to a hearing of DNH, no impact on the natural environment has been particularly found.

2. Land Acquisition and Resettlement

No land acquisition or resettlement has been undertaken.

3. Unintended Positive/Negative Impact

No particular impact has been found.

To conclude, the project has given a positive impact over the target villages, contributed to improved access to safe water and basic sanitation including reduction of diarrheal diseases of children. Moreover, by improving water supply facilities (installing hand pumps and communal faucets), it has helped to reduce burden of water-drawing work for women and children. DNH and respective Regional Water Department stated that the project has given significant impacts in rural and remote areas facing with severe water scarcity. On the other hand, no negative impact has been found.

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

(1) Boreholes with hand pumps

Prior to decentralization started in 2006, the National Water Department (DNH), with financial support of UNICEF, had undertaken repairs of damaged pumps, replacement of parts and training of local repair workers. Since then, respective communes, as owners of water supply facilities, have assumed a responsibility of operation and maintenance. However, because it is practically difficult for them to pursue all the necessary tasks the government had used to assume, a Water Management Committee (CGE) constituted of community members takes charge of overall maintenance. Apart from this, the facility operation and maintenance largely depend on geographical conditions of villages and their organizational capacities including financial resources. In many cases, these factors cause to prolong downtime.

The project had constructed water supply facilities in the process of which the Government of Mali had promoted decentralization mentioned above.

Moreover, the Basic Design Study of this project states that “DNH will be in charge of establishing CGEs, directing the target villages over operation and maintenance of the constructed facilities. Thus it is not necessary for the project to include component of strengthening local facility management.” Accordingly, the Government of Mali set up a CGE in each target village after the transfer of the project facilities.

Table 7 shows an organizational structure of a CGE and its primary roles as well as related parties in

maintenance work.

According to the results of the survey, the proportion of the existing CGEs is respectively 83% in Kayes, 97% in Segou and 82% in Mopti, and therefore the structure for operation and maintenance is generally sustained as expected. In the villages where CGEs are no longer functioning, their village chiefs or elders assume instead the responsibility in facility maintenance. This suggests maintenance work has been somehow carried on regardless of existence of CGEs.

Nonetheless, as discussed in the following sections of 3.5.3 and 3.5.4, there have been observed some problems in water fee collection and operating rates of the project facilities. Supposedly they resulted in part from failing to foster residents' participation in facility management in the process from CGE set up through a facility transfer.

Table 7 Organizational structure of the CGE, its primary roles and related parties in maintenance work

Structure of CGE	Major roles of CGE defined in the Committee Rules	Parties related to maintenance of CGE
-President -Vice president -Secretary -Accountant -Auditor -Organization coordinator -Facilitator -Guardian on pumps -Sanitation and drainage	＊Responsible for regular maintenance ＊Call for a repairer when overhaul is needed ＊Collect water fees from users ＊Make a reserve for renewing pumps ＊Report on a regular basis to a commune and a village committee as to technical problems and financial conditions	Commune: As an owner of water supply facilities, a commune is responsible for its overall management including repair, inspection and renewal of the facility. Pump repairer: A repairer is a qualified technician having completed a training provided by donors and import agents of parts supply. In some cases he is a retail store owner of spare parts. Private company supporting maintenance work: Supported by NGOs, a private company contracts with villages to pursue operation and maintenance. Regional Water Department in respective regions: Monitoring

(2) Small water facilities

In Mali, maintenance of small water facilities are guided under the framework called "STEFI" (Technical and Financial Follow-up in Drinking Water Conveyance System)[14] constituted of a

[14] "STEFI or Technical and Financial Follow-up in Drinking Water Conveyance System" (Suivi Technique et Financier des Systemes d'Adduction d'Eau Potable) contracts out maintenance work to two private maintenance companies called "2AEP" and "GCSAEP." Outsourcing of the maintenance work is allowed only for public water supply facilities provided the government and aid agencies, and several maintenance companies operate other water supply business run by the private sector. 2AEP undertakes maintenance in Zone 1 (Kayes), while GCSAEP is in charge of Zone 2 (Koulikoro, Sikkaso and Segou) and Zone 3 (Mopti, Tombouctou, Gao and Kida).

commune, a private maintenance company and an association of water users (AUE). STEFI was developed in support of Germany (KfW and GTZ) and France (AFD) in 2004. Until 2010, in accordance with that framework, DNH had been primarily in charge of managing small water facilities in respective villages through a consigning contract with private maintenance companies. In the process of decentralization, however, DNH withdrew from this framework in November 2011, and those three parties of a commune, a private maintenance company and an AUE are expected to share a responsibility for facility maintenance. It is currently at the stage of undertaking a procedure in making necessary changes in contract.

Among the three target regions, Mopti and Segou have established maintenance system in accordance with the government policy guidance, contracting with a private maintenance company called GCSAEP. In Kayes, on the other hand, making a contract with "2AEP" or a private company in charge of region-wide facility maintenance has been unsuccessful. This was due to a difficulty to obtain an agreement from residents of Same Plantation village over the STEFI framework. Thus, the commune, AUE and the village committee are working together for facility maintenance, and no particular problem has been so far reported in that cooperation. In accordance with the provisions of the STEFI framework, however, it is desirable to establish a reliable maintenance system, making a contract with a private maintenance company such as 2AEP.

As described above, operation and maintenance structure on small water facilities are mostly functioning as expected in the project appraisal.

3.5.2 Technical Aspects of Operation and Maintenance

(1) Boreholes with hand pumps

While CGEs are in charge of regular maintenance of boreholes with hand pumps, a repairer is ultimately responsible for fixing any damages.

Pump repairers working in the target villages have so far enough technical skills, experiences and tools, having completed or repeated a training provided by UNICEF and parts supply shops. On the other hand, sending such a skilled repairer to remote areas is often difficult. According to a Regional Water Department, an inexperienced pump repairer is more likely to complicate troubleshooting as a result of taking on a challenging task.

Given that the number of pump repairers and the level of their skills are almost identical, the reason for prolonged downtime, respective Regional Water Department said, was actually due to CGEs' organizational capacities and financial resources. As described above, operating rates of the project boreholes with hand pumps vary depending on the regions. To foster CGEs' functions, the Regional Water Departments need to implement measures such as a provision of retraining of its members.

(2) Small water facility

Over small water facilities in Mopti and Segou, as noted above, contracted private maintenance companies provide regular monitoring once a half year as well as technical guidance for electricians

and plumbers. Any problems in parts and equipment inspected during the monitoring are reported to the village meeting in attendance of the Regional Water Department. However, in some cases villages do not always respond to those suggestions of a maintenance company, since there is no regulatory mechanism to assure compliance.[15] This needs to be improved by taking appropriate measures.

In general, electricians in charge of maintaining major components (a power generator and pumps) are supposed to be those who are selected within a village in accordance with a direction of a private maintenance company. Then they are required to go through a technical training before a transfer of project facilities is completed. On the other hand, AUEs in this project were organized after the project completion, and they assigned electricians with no consultation of private companies. As a result, in Madiama village in Mopti, for instance, it was reported low technical abilities of an electrician has worsened problems in pumping function.

In Kayes, although a private maintenance company is not involved in operation of the project facilities, electricians and plumbers with general technical skills have been selected from AUEs, finding so far no particular problems in their abilities.

	
Same Plantation village in Kayes Small water facility constructed by this project (a water tower and an electric room)	Madiama village in Mopti Small water facility constructed by this project (communal faucets)

3.5.3 Financial Aspects of Operation and Maintenance

(1) Boreholes with hand pumps

Any cost of maintaining a constructed borehole is shared by their users in a village. To cover an unexpected expense for a repair or replacement of parts such as rubber seals, they are asked for making a reserve deposit by paying water fees for the amount they use.

According to findings of the facility survey, the collection rates of the water fees are respectively 49% in Kayes, 57% in Segou and 67% in Mopti. Of the villages which never collected fees, about 60% said it is difficult to obtain an agreement on payment from the residents. In Mopti, about a half of the target villages preferred paying cost of repair on an as-needed basis. Given this, it is practically difficult to implement such a planned maintenance cycle in every target village that a CGE collects and reserves water fees to cover expense for a repair or replacement of parts, and renewal of

[15] For instance, after a regular monitoring in Mopti, AUE's disregarding an engineer's direction to repair abnormal sound resulted in serious breakdown later on.

pumps.

Both DNH and Regional Water Departments point out a major reason for failing water fee collection is that it was not accompanied with a sufficient explanation for residents on the purpose of payment. For them, water is generally considered free of charge, and the project should have fostered in its initial stage the residents' understanding of cost of facility maintenance. In particular, AUEs were established after the project completion. Ideally they should have started working for developing a maintenance framework in respective villages prior to a transfer of the completed water facilities. Those residents made no advance reserve deposit before start using water facilities, and this has in part undermined an idea of sharing cost of operating a facility among users.

Currently, necessary expense for repair is collected from users on a case-by-case basis, which is more acceptable for them in responding to repair needs. On the other hand, relying on such countermeasure instead of a reserve deposit may possibly cause prolonged downtime.

The results of the facility survey indicate while the operating rate of the water facilities is higher in Kayes despite its lowest water fee collection rate, that rate in Mopti is low regardless of its highest fee collection rate. Based on a discussion with DNH, the major reasons for this contradiction are suggested as below;

- In Kayes having a traditionally high proportion of emigrants to France, a part of their remittance is reserved for necessary expenses including a repair of water facilities.
- Using the above remittance, residents in Kayes have experiences in constructing water facilities across the region. This has developed a local ownership, preventing prolonged downtime.
- Kayes is a mountainous area with severe water scarcity, making its access by car most difficult among three target regions. Such condition has led its residents to call immediately for a repairer on any malfunction of water facilities, preventing a complete breakdown.
- While respective three target regions have parts suppliers, only a shop in Kayes can provide spare parts of an India-Mali hand pump installed in the project boreholes. It as well as almost the other necessary parts.

These factors imply that collecting water fees does not necessarily ensure a higher operating rate or reduced downtime. Rather, further efforts are needed to develop a regional maintenance framework, including improvements of AUE's functions, repairers' skills, and sales network of spare parts supply. To realize these, DNH and respective Regional Water Departments confirmed to strengthen AUEs in the target villages.

(2) Small water facilities

As in the case of boreholes, any cost of maintaining constructed small water facilities is shared by their users. Water fee collectors allocated each communal faucet ask for its users to pay at a metered rate. In case the meters indicate significant difference with water charge, some CGEs suspend the faucets temporarily to penalize possible fraud.

According to an account book of each target village, Madiama village in Mopti are running surplus, sufficiently covering necessary cost of operation and maintenance including a contract payment and fuels. In Samine village in Segou, although the balance of revenue fell below expense, it recovered in 2010. Same Plantation village in Kayes had maintained a quite steady surplus until 2008, and yet a soaring fuel price since 2009 has led to a decreasing profit, unable to reflect it over water fees. Table 8 shows an annual balance of payment in 2010.

It should be noted that in Samine in Segou and Madaima in Mopti a private maintenance company called GCSAEP undertakes a regular monitoring over technical and financial conditions related to water facilities. The monitoring outcomes are reported by a monthly accounting statement, employing its own accounting system. This system enables to consolidate information on accounts of all the clients, and therefore GCSAEP can make a quick comparison of financial situations or good practice among the target sites.

Table 8 Current water fees and annual balance of payment in 2010

Name of region	Kayes	Segou	Mopti
Name of village	Same Plantation	Samine	Madiama
The number of communal faucets	6	13	8
Water fee			
20 liters	10 FCFA	15 FCFA	15 FCFA
75 liters	100 FCFA		
200 liters			125 FCFA
1000 liters	375 FCFA		
Balance of payment in 2010			
Total expense for operation	2,043,560 FCFA	155,735 FCFA	4,574,365 FCFA
Total revenue	2,686,835 FCFA	184,145 FCFA	5,557,319 FCFA
Total balance	643,275 FCFA	28,410 FCFA	982,954 FCFA

To conclude, although operation and maintenance of boreholes with hand pumps has some financial problems of failing water fee collection and a reserve deposit, it is expected that the Government of Mali will direct an improvement by strengthening functions of CGEs. As for small water facilities, currently favorable balance of payment needs to be sustained by managing cost against an increasing fuel price, while expecting future replacement of parts and facilities.

3.5.4 Current Status of Operation and Maintenance

(1) Boreholes with hand pumps

The facility survey on the project boreholes with hand pumps revealed varying working conditions and maintenance, as observed in operating rates of 71.1% in Kayes, 64.7% in Segou and 58.9% in Mopti

respectively. Moreover, a supply and quality of spare parts also differ depending on regions. A parts supplier in Kayes, contracting with SETRA, has more sufficient availability of parts including India-Mali hand pumps than in Segou and Mopti. Parts suppliers in these two regions, albeit contracting with SETRA, mostly rely for specialized parts on SETRA in Bamako, making orders on an as-needed basis.

In the target sites where the project appraisal initially planned stepping pump installation, 12 out of 18 boreholes with India-Mali hand pumps are not properly working. The Regional Water Department in Mopti points out that the problem is supposedly related to a drilling depth. As discussed above, stepping pumps were substituted with hand pumps, as a result of taking account of local practice of Mali. However, the low operation rate above suggests that facility specifications essentially need to meet environmental conditions, which in turn is more likely to increase the operating rate. On the other hand, it should be noted that although durable in quality, a Vergnet Hydropump (a stepping pump) selected in the Basic Design Study and its associated spare parts are not available in parts suppliers in Mopti. There are also no repairers who are able to fix problems. Installing Vergnet Hydropump therefore needs a careful consideration in terms of sustainable operation and maintenance (which was discussed at the time of the Basic Design Study).

In Mopti, other donors such as Belgium have installed boreholes with stepping pumps, but currently they account for a small portion of the total pumps in water facilities. This is partly because an India-Mali Mark II hand pump is unified specification in Mali in order to ensure parts supply and repairs. Thus the availability of their spare parts is higher than that of stepping pumps.

(2) Small water facilities

The small water facility in Kayes is calling for a repair in troubled cables in chlorination apparatus. In Mopti, a diesel generator in an electric room is under repair (which is taking time to obtain spare parts), and alternatively a power pump is used in drawing water. The small water facility in Segou is operating in a fairly good condition.

Maintenance conditions including cleaning frequency in pump rooms vary in the three target villages. While respective pump facilities installed identical equipment, electricians' skills and technical assistance by external agencies seem to cause a difference in maintenance.

In conclusion, the sustainability of the project is fair due to some problems observed in terms of maintenance, technical abilities and financial resources. In particular, it was found problematic in inadequate functions of CGEs in maintaining the boreholes with hand pumps as well as in lacking technical support in small water facilities.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This grant aid project has found that its relevance is high both at the time of the appraisal and ex-post evaluation, as it is consistent with the National Development Strategy of the Republic of Mali and its

development needs as well as Japan's ODA Policy. While the operating rates of the constructed facilities are lower than expected, unable to achieve a target population of water supply, improved access to safe water by this project has some positive impacts on enhancing basic sanitation for people in the project sites, including reducing infantile diarrhea. As for project efficiency, it is high since both the cost and implementation period of the project were as planned. Furthermore, the ex-post evaluation study has found that the project sustainability is fair. Although there have been observed some problems in the operation and maintenance of the project facilities in terms of its management, technical skills and financial resources, it is expected that the Government of Mali would make efforts to cope with those challenges.

In light of the above, although having certain problems in effectiveness and sustainability, this project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations on the Implementing Agency

1) While respective pump facilities have been installed with identical equipment, maintenance conditions including cleaning frequency in pump rooms slightly vary in the three target villages. This is primarily due to technical disparities among electricians. It is thus suggested that the Regional Water Departments and AUEs in the target sites organize a seminar, for instance, to learn technical aspects in facility maintenance of each site.
2) On small water facilities, a regular monitoring is conducted by private maintenance companies, and necessary measures are suggested to communes and AUEs. However, a private maintenance company points out that some of the AUEs often worsen facility problems, not immediately responding to those recommendations to prevent a potential large-scale damage. It is suggested that respective Regional Water Departments supervise AUEs in the target villages to assure carrying out suggested repairs on their water facilities.
3) A range of information over the past project experiences should be provided to donor agencies. In selecting water facility types best suitable in locality, it is essential to examine beforehand an availability of parts suppliers and a record of repairer trainings. This will help decide appropriate specifications that endure environmental and geographical conditions (such as areas requiring deep drilling), which in turn will enable better control of maintenance of constructed facilities.
4) In order to increase operating rates of installed boreholes with hand pumps, it is recommended to implement some kind of activities to foster users' ownership as well as to strengthen functions of CGEs.
5) Regarding boreholes with hand pumps, technical capacities of repairers should be further enhanced. Also, by cooperating with parts suppliers, it is desirable to review and expand a reliable supply network.

4.2.2 Recommendation on JICA

While the water quality survey has assured safety of water sources provided by this project, it found water in rivers and traditional draw wells cause waterborne infectious diseases. As of the third field study in August 2011, a cholera epidemic was observed in delta area in Mopti, leading to an increasing concern of its outbreak to other regions. According to DNH, this area has a high risk of a cholera outbreak due to a particularly severe scarcity of safe water. This is partly because donors tend to avoid a borehole construction there. For transporting a drilling rig by track is possible only in a limited period of the dry season, which makes borehole drilling an extreme difficult task to complete.

Generally, in order to complete a project within a planned period, it is quite challenging to target such area. And yet, it is desirable to inclusively address people's needs of sustainable access to safe water.

4.3 Lessons Learned

To assess quantitative effects, the project set indicators focusing on an increase in the water supply population and the rate of water supply. To achieve end target values estimated based on those indicators, it requires a full operating rate to be sustained during five years after the project completion. On the other hand, the national development strategy of Mali on potable water assumes the operating rates of boreholes with hand pumps between 70 to 80%. Based on more realistic prospect on the operating rates, end targets such as the increased water supply population or water supply rate need to be estimated carefully. Moreover, project indicators did not include target operating rates or potential downtime, both of which are supposedly important indicators to assess project effects. It is expected that a project design in the future will fully examine essential and relevant indicators.

Developed in 2004, the STEFI framework on small water facility maintenance marks five years since its implementation in 2005. Currently, in the process of decentralization, the maintenance framework is undergoing a structural change, demanding more community-based management involving communes, private maintenance companies and AUEs. Similar projects in other countries are considering applying this particular mode of maintenance involving private companies. However, its sustainable expansion after the project completion is challenging, given a limited participation of private sector as of today. Nonetheless, despite its problem in technical aspects, the STEFI framework has been partly successful in enhancing financial sustainability in facility maintenance. Given that the accounting systems developed by 2AEP and GCSAEP are well functioning, it provides a helpful example for a similar project in the future.

Just as the design of this project had foreseen as its indirect effects, reduction of waterborne infectious disease, enhancement of women's participation in social and economic activities, and increase in children's schooling opportunity are frequently used indicators to assess impact of a rural water supply project. The outcomes of the statistical analysis that draws on the detailed social survey indicate that users of the project

boreholes have strongly felt the diarrheal diseases have been reduced to a significant degree compared to before. It suggests that they understand that the safety of drinking water is an important factor in such reduction of infectious diarrhea.

In addition, a strong correlation has been observed between "improvement of women's domestic work conditions" and "improvement of economic situation" at the household level, which is particularly affected by increasing women's engagement in income-generating activities. In other words, water-drawing labor has been one of the factors preventing women in rural Mali from engaging in productive activities to earn their incomes. On the other hand, it has been found that "use of water in the project borehole" and "increase in schooling opportunity" are less correlated than expected, as the latter is more likely to be affected by various other factors.

This provides a lesson that more careful consideration will need to be made in prospecting indirect impact of similar projects in the future.

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