別添資料６

本件調査開始に当たって
環境・水省が関係諸機関に宛てて発出したレター類

Estado Plurinacional de Bolivia

Ministerio de Planificación del Desarrollo

Viceministerio de Inversión Pública y Financiamiento Externo

La Paz, 13 FEB 2015

MPD/VIPFE/DGGFE/UOF-000392/2015

001131

AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON
JICA CORRESPONDENCIA RECIBIDA
No Registro: .....
Recibido : ..... Entregado :
LA PAZ - BOLIVIA

Señora
Mika Yamamoto
REPRESENTANTE RESIDENTE
AGENCIA DE COOPERACIÓN INTERNACIONAL DEL JAPÓN
Presente.

Ref.: ***ESTUDIO DE FACTIBILIDAD PARA LA EXTENSIÓN DE LA VIDA ÚTIL DEL POZO UTILIZANDO TECNOLOGÍA DE DIAGNÓSTICO DE POZOS***

Señora Representante:

Hago referencia a las notas CAR/MMAYA/VAPSB/DGAPAS/UTAPS N° 1309/2014 y CAR/MMAYA/VAPSB/0281/2014 remitidas a esta Cartera de Estado por el Viceministerio de Agua Potable y Saneamiento Básico (VAPSB) dependiente del Ministerio de Medio Ambiente y Agua (MMAyA), con el fin de remitir información y hacer conocer la priorización sectorial para participar en el estudio de factibilidad en el Estado Plurinacional de Bolivia, para realizar un diagnóstico mediante endoscopia de pozos.

Al respecto, tengo a bien comunicar que una vez realizado el análisis correspondiente de la información proporcionada por el VAPSB, se manifiesta el interés del Gobierno de Bolivia, para participar en el estudio que será realizado por el equipo de investigación Raax Co. Ltd. contratado por la Agencia de Cooperación Internacional de Japón (JICA) – Casa Matriz.

En este sentido, agradeceré a usted realizar las gestiones pertinentes para viabilizar el estudio en Bolivia en coordinación con el Ministerio cabeza de sector.

Con este motivo, saludo a usted muy atentamente.

ESTADO PLURINACIONAL DE BOLIVIA

Ministerio de Medio Ambiente y Agua
Viceministerio de Agua Potable y Saneamiento Básico

MMAyA

La Paz, 15 de enero de 2015
CAR:MMAyA/VAPSB/0281/2014
MMAYA/2014-45641

Señor
Harley Rodriguez
VICEMINISTRO DE INVERSION PÚBLICA
Y FINANCIAMIENTO EXTERNO
Presente

REF.: **INFORME DE PRIORIZACION ESTUDIO DE FACTIBILIDAD PARA LA EXTENSION DE LA VIDA UTIL DEL POZO UTILIZANDO TECNOLOGIAS DE DIAGONOSTICO DE POZOS JICA**

De mi consideración:

Para su conocimiento y fines consiguientes, tengo a bien enviar adjunto a la presente el Informe Técnico INF. MMAYA/VAPSB/DGAPAS/UTAPS N° 838/2015. referente a la priorización del Estudio de Factibilidad para la extensión de la vida útil del pozo utilizando tecnologías de diagnostico de pozos JICA.

Con este motivo. saludo a usted atentamente.

Ing. Ruben Mendez Estrada
VICEMINISTRO DE AGUA POTABLE
Y SANEAMIENTO BÁSICO
MINISTERIO DE MEDIO AMBIENTE Y AGUA

Adj. Lo indicado
cc. arch
RMB/enrique

M0000272

Calle Capitán Castro N° 434, Teléfono 231567, Fax 230502, La Paz - Bolivia
www.mmaya.gob.bo

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Estado Plurinacional de Bolivia

MMAyA
Ministerio de Medio Ambiente y Agua

INFORME
INF/MMAYA/VAPSB/DGAPAS/UTAPS N 0838/2015
MMAYA/2015-45641

A: Ing. Rúbén Mendez Estrada
VICEMINISTRO DE AGUA POTABLE Y SANEAMIENTO BASICO

VIA: Ing. Luis Arratia Quisbert
DIRECTOR GENERAL DE AGUA POTABLE
Y ALCANTARILLADO SANITARIO

De: Ing. Pamela Flores Ayaviri
PROFESIONAL 1 - AGUA POTABLE Y SANEAMIENTO

Ref.: Informe de Priorización – Estudio de Factibilidad para la extensión de la vida útil del pozo utilizando tecnologías de diagnóstico de pozos, JICA

Fecha: La Paz, 14 de enero de 2015

Señor Viceministro:

Como es de su conocimiento, el VAPSB se encuentra en gestiones para inicio del "**Estudio de Factibilidad para la extensión de la vida útil de pozos utilizando tecnologías de diagnóstico de pozos**" con recursos de la Cooperación Japonesa JICA. Para lo cual se presenta el informe de priorización sectorial al perfil de Estudio elaborado de manera conjunta entre el VAPSB y JICA; a fin de que pueda ser presentado al Viceministerio de Inversión Pública y Financiamiento Externo (VIPFE) del Ministerio de Planificación del Desarrollo (MPD) para su consideración y fines consiguientes.

1. ANTECEDENTES

Mediante nota CAR/MMAYA/VAPSB/DGAPAS/UTAPS Nº 0519/2014 de fecha 27 de mayo de 2014, el Viceministerio de Agua Potable y Saneamiento Básico (VAPSB) manifesta al Representante de JICA en Bolivia, el interés de realizar diagnósticos que permitan la rehabilitación de pozos de agua para consumo humano, garantizando la predisposición del Sector a cooperar en la recopilación de datos, selección de lugares de intervención, soporte de operaciones, evaluación y documentación que corresponda para concretar el Proyecto.

Al respecto, en el mes de noviembre de 2014 el Director de JICA Sr. Satoshi Iwakiri hace conocer al VAPSB que se ha puesto en marcha un nuevo esquema de ayuda oficial al desarrollo (AOD), en el que Pequeñas y Medianas Empresas japonesas (PYME) llevan a cabo la encuesta de viabilidad en virtud de la AOD de Japón con el fin de utilizar sus productos y tecnologías para el desarrollo social y económico en los países en desarrollo.

Asimismo, manifiestan que un equipo de investigación de RaaX Co., Ltd., ha sido designado en éste esquema como exitoso y cualificado, el cual está programado para llevar a cabo el estudio de viabilidad en el Estado Plurinacional de Bolivia, para realizar un diagnóstico mediante endoscopia de pozos.

En este sentido, inicialmente y a manera de demostración piloto, el VAPSB ha recomendado realizar trabajos en el campo de pozos Tilata ubicado en el Municipio de El Alto del Departamento de La Paz, para que posteriormente se realice la limpieza, rehabilitación y se inicie las gestiones para un Programa a nivel Nacional.

En fecha 16 de diciembre de 2014, mediante nota CAR/MMAYA/VAPSB/DGAPAS/UTAPS N 1309/2014, el VAPSB hace conocer al VIPFE y a las instituciones involucradas el Proyecto, nota de aceptación por parte de JICA para trabajar con el Proyecto y el cronograma de actividades correspondiente.

Sin embargo, para dar curso al Programa, se ha elaborado un perfil de Proyecto para realizar el "Estudio de Factibilidad para la Extensión de la Vida Útil del Pozo utilizando tecnologías de diagnóstico de Pozos" a fin de cumplir con requisitos establecidos por el VIPFE.

2. ANALISIS Y CONSIDERACIONES

2.1. Objetivo general del Programa

En Bolivia, la tasa de cobertura de agua sigue siendo baja en el área rural. El agua subterránea es ampliamente utilizada como fuente de agua, pero la mayoría de los pozos de agua se han deteriorado y sus tasas de bombeo han disminuido debido al mantenimiento y la gestión inadecuada. La razón principal es que así es la instalación construida bajo tierra y por lo general es difícil de comprobar el estado de una observación directa. Sólo de forma indirecta se aplica para el diagnóstico de pozo mediante el control de los datos básicos, tales como el nivel de las aguas subterráneas o la velocidad de bombeo.

Por esta razón, la situación y causas del deterioro funcional no son identificadas y en muchos casos no se toman medidas o se toman medidas equivocadas, que no sólo reduce la eficiencia del mantenimiento, sino también acorta la vida útil del pozo.

2.3. Entidades Involucradas en el Programa

Las entidades involucradas para la ejecución del programa son las siguientes:

1. Viceministerio de Agua Potable y Saneamiento Básico.
2. Agencia de Cooperación Internacional del Japón (JICA)
3. Gobernaciones de Oruro, La Paz y Santa Cruz.
4. Empresa Pública y Social de Agua y Saneamiento EPSAS

2.4. Tecnología Propuesta

Con el fin de mejorar la capacidad de diagnóstico bien antes mencionada, el producto Raax Co., Ltd. (*cámara pozo de sondeo i-Do300F*), que el Japón viene trabajando. Como se muestra en la figura-1, identifica la causa de los problemas como un endoscopio en médico.

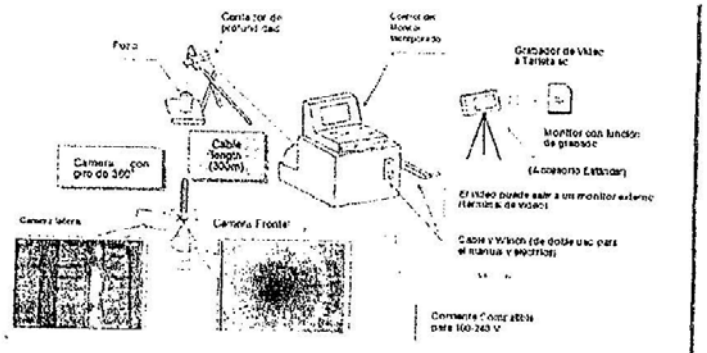

Figura - 1 Figura conceptual del diagnóstico de pozos utilizando la cámara de pozo

Este producto es capaz de diagnosticar pozos profundos. Se cambia la cámara desde la parte delantera a la parte lateral o desde el lado a la parte delantera en cualquier momento, y horizontalmente gira en cualquier dirección. Entonces se puede adquirir información detallada sobre el interior del pozo mediante la adopción de la imagen-video desde todos los ángulos. Aunque hay otros productos similares, nuestro producto es superior a los productos de otros fabricantes en términos de medición de profundidad, operatividad y la nitidez de la imagen. En muchos países desarrollados, nuestros productos se han introducido en muchos campos. A modo de ejemplo, el Servicio Geológico de Estados Unidos (USGS) los haya adoptado formalmente por el equipo de la encuesta.

2.5. Duración y fases del Programa

En el primer estudio sobre el terreno de noviembre a diciembre de 2014, en primer lugar, los objetivos de la encuesta serán explicados y la cooperación para la encuesta se solicitará a las contrapartes. Entonces situación y desafíos de sistema de mantenimiento de los pozos existentes actual serán estudiadas por el análisis de los materiales recogidos y por entrevistas con las partes interesadas. Además de ellos, los pozos candidatos para demostración en la segunda etapa de estudio de campo serán comprobados por reconocimiento del lugar, y subcontratistas de obras de rehabilitación, el bombeo de pruebas y video de promoción durante la manifestación serán seleccionados.

En el segundo estudio de campo de febrero a marzo de 2015, la promoción de la cámara de pozo propuesta se llevará a cabo mediante dos pozos existentes en la ciudad de El Alto. Durante el periodo de la promoción, las obras de rehabilitación por el método de transporte aéreo y los ensayos de bombeo se llevarán a cabo para verificar el efecto de las obras de rehabilitación mediante el uso de la cámara de pozo. El estado de la obra será grabada en video. Aparte de estas actividades, se planificarán los posibles proyectos de la AOD y consultamos a autoridades de la JICA, y se iniciará la preparación del Seminario de tecnolcgia en la tercera etapa de estudio de campo.

En el tercer estudio de campo en abril de 2015, el seminario de tecnología se llevará a cabo en tres ciudades: La Paz, Santa Cruz de la Sierra y Oruro. En el seminario, los méritos de la cámara y para ejemplos de pozos propuestos en otros países se introducirán por Power Point y el video promocional grabado durante la manifestación.

(*) Es importante hacer notar que la programación es preliminar y está en procesos de ajuste de fechas para su inicio.

3. CONCLUSIONES Y RECOMENDACIONES

El Viceministerio de Agua Potable y Saneamiento Básico ha elaborado un perfil de Programa de manera conjunta con la Cooperación Japonesa para dar inicio al "Estudio de Factibilidad para la extensión de la vida útil de pozos utilizando tecnologías de diagnóstico de pozos", aprobado por JICA el mes de noviembre de 2014 y bajo un nuevo esquema de ayuda oficial al desarrollo (AOD).

En este sentido, dado que el Perfil de Estudio, se encuentra enmarcado en el PSD-SB y la estrategia de intervención del sector a través del Enfoque Programático en Áreas Periurbanas de manera inicial y en áreas rurales en un futuro, se considera prioritario para el Sector agilizar los trámites que correspondan a fin de que se inicien los estudios piloto.

Asimismo, dado que inicialmente se realizará los trabajos piloto en el campo de pozos Tilata ubicado en el Municipio de El Alto del Departamento de La Paz y cuyos resultados tiene previsto alcanzar a un Programa a nivel nacional, será favorable para la habilitación de nuevas fuentes de agua y correspondientemente al incremento porcentual de coberturas de agua a nivel nacional.

Por tanto, se recomienda remitir el presente informe al Viceministerio de Inversión Pública y Financiamiento Externo (VIPFE) del Ministerio de Planificación del Desarrollo (MPD).

Es cuanto se informa para fines consiguientes.

cc.Arch.
RME/LAQ/pta

JICA

Estado Plurinacional de Bolivia

MMAyA
Ministerio de Medio Ambiente y Agua

Jueves, 11 de Diciembre de 2014
CAR/MMAYA/VAPSB/DGAPAS/UTAPS N 1309/2014

Viceministerio de Inversión Pública y Financiamiento Externo
RECIBIDO
16 DIC. 2014
VIPFE
La Paz - Bolivia

Señor
Harley Rodríguez
Viceministro de Inversión Pública y Financiamiento Externo
MINISTERIO DE PLANIFICACIÓN DEL DESARROLLO
La Paz

Ref.: Cooperación Diagnostico y rehabilitación de pozos para consumo de Agua Potable - JICA

De mi consideración:

Mediante nota CAR/MMAYA/VAPSB/DGAPAS/UTAPS Nº 0519/2014 de fecha 27 de mayo de 2014, el Viceministerio de Agua Potable y Saneamiento Básico (VAPSB) manifesta al Representante de JICA en Bolivia, el interés de realizar diagnósticos que permitan la rehabilitación de pozos de agua para consumo humano, garantizando la predisposición del Sector a cooperar en la recopilación de datos, selección de lugares de intervención, soporte de operaciones, evaluación y documentación que corresponda para concretar el Proyecto.

Al respecto, en el mes de noviembre de 2014 el Director de JICA Sr. Satoshi Iwakiri hace conocer al VAPSB que se ha puesto en marcha un nuevo esquema de ayuda oficial el desarrollo (AOD), en el que Pequeñas y Medianas Empresas japonesas (PYME) llevan a cabo la encuesta de viabilidad en virtud de la AOD de Japón con el fin de utilizar sus productos y tecnologías para el desarrollo social y económico en los países en desarrollo.

Asimismo, manifiestan que un equipo de investigación de RaaX Co., Ltd., ha sido designado en éste esquema como exitoso y cualificado, el cual está programado para llevar a cabo el estudio de viabilidad en el Estado Plurinacional de Bolivia, para realizar un diagnóstico mediante endoscopia de pozos.

En este sentido, ponemos a su conocimiento que inicialmente y a manera de demostración piloto, el VAPSB ha recomendado realizar trabajos en el campo de pozos Tilata ubicado en el Municipio de El Alto del Departamento de La Paz, para que posteriormente se realice la limpieza, rehabilitación de los mismos y se inicie las gestiones para un Programa a nivel Nacional.

Por tanto, remito a Ud. el documento "Estudio de Factibilidad para la Extensión de la Vida Útil del Pozo utilizando tecnologías de diagnóstico de Pozos", nota de aceptación para trabajar con el Proyecto y el cronograma de actividades para su conocimiento.

Sin otro particular, saludo a usted con las consideraciones más distinguidas.

Atentamente,

Ing. Rubén Méndez Estrada
VICEMINISTRO DE AGUA POTABLE
Y SANEAMIENTO BÁSICO
MINISTERIO DE MEDIO AMBIENTE Y AGUA

c.c. Archivo
Adj. Lo indicado
RME/OPM/pfa

JICA

Estado Plurinacional de Bolivia

MMAyA
Ministerio de Medio Ambiente y Agua

Jueves, 11 de Diciembre de 2014
CAR/MMAYAA/VAPSB/DGAPAS/UTAPS N 1310/2014

GOBIERNO AUTÓNOMO DEPARTAMENTAL DE LA PAZ
EMPRESA PUBLICA DEPARTAMENTAL
ESTRATEGICA DE AGUAS LA PAZ - EDALP
RECIBIDO
26 DIC. 2014
Nº 1150/13
HORA 11:50 FIRMA
OBS.

Señor
Ing. Venencio Tazola
Gerente General Empresa Pública
Departamental Estratégica de Aguas (EDALP)
GOBIERNO AUTÓNOMO DEPARTAMENTAL DE LA PAZ
Presente

Ref.: Ejecución del Proyecto "Diagnostico y rehabilitación de pozos para consumo de Agua Potable" - JICA

De mi consideración:

Pongo a su conocimiento que el mes de mayo de 2014, el Viceministerio de Agua Potable y Saneamiento Básico (VAPSB) manifesta al Representante de JICA en Bolivia, el interés de realizar diagnósticos que permitan la rehabilitación de pozos de agua para consumo humano, garantizando la predisposición del Sector a cooperar en la recopilación de datos, selección de lugares de intervención, soporte de operaciones, evaluación y documentación que corresponda para concretar el Proyecto.

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Asimismo, manifiestan que un equipo de investigación de RaaX Co., Ltd., ha sido designado en éste esquema como exitoso y cualificado, el cual está programado para llevar a cabo el estudio de viabilidad en el Estado Plurinacional de Bolivia, para realizar un diagnóstico mediante endoscopía de pozos.

En este sentido, el VAPSB ha recomendado realizar trabajos en el campo de pozos Tilata ubicado en el Municipio de El Alto del Departamento de La Paz, para que posteriormente se realice la limpieza y correspondiente rehabilitación de los mismos e iniciar un Programa a nivel Nacional.

Por tanto, remito a Ud. el documento "Estudio de Factibilidad para la Extensión de la Vida Útil del Pozo utilizando tecnologías de diagnóstico de Pozos", nota de aceptación para trabajar con el Proyecto y el cronograma de actividades a realizarse con el Proyecto, con el objeto de que su Institución pueda participar en el Proceso de capacitación del Proyecto conforme a cronograma establecido.

Sin otro particular, saludo a usted con las consideraciones más distinguidas.

Atentamente,

Ing. Rubén Méndez Estrado
VICEMINISTRO DE AGUA POTABLE
Y SANEAMIENTO BÁSICO
MINISTERIO DE MEDIO AMBIENTE Y AGUA

c.c. Archivo
Adj. Lo indicado
RME/OPM/pfa

Estado Plurinacional de Bolivia

MMAyA
Ministerio de Medio Ambiente y Agua

Jueves, 11 de Diciembre de 2014
CAR/MMAYA/VAPSB/DGAPAS/UTAPS N 1310/2014

Señor
Ing. Oscar Copa
Jefe de la Unidad de Saneamiento Básico y Vivienda
GOBIERNO AUTÓNOMO DEPARTAMENTAL DE ORURO
Oruro

Ref.: Ejecución del Proyecto "Diagnostico y rehabilitación de pozos para consumo de Agua Potable" - JICA

De mi consideración:

Pongo a su conocimiento que el mes de mayo de 2014, el Viceministerio de Agua Potable y Saneamiento Básico (VAPSB) manifesta al Representante de JICA en Bolivia, el interés de realizar diagnósticos que permitan la rehabilitación de pozos de agua para consumo humano, garantizando la predisposición del Sector a cooperar en la recopilación de datos, selección de lugares de intervención, soporte de operaciones, evaluación y documentación que corresponda para concretar el Proyecto.

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Sin otro particular, saludo a usted con las consideraciones más distinguidas.

Atentamente,

Milton Mamani Coc ario
UNIBOL COURIER
CEL 73539236

Ing. Rubén Méndez Estrada
VICEMINISTRO DE AGUA POTABLE
Y SANEAMIENTO BÁSICO
MINISTERIO DE MEDIO AMBIENTE Y AGUA

c.c. Archivo
Adj. Lo indicado
RME/OPM/pfa

Estado Plurinacional de Bolivia

MMAyA
Ministerio de Medio Ambiente y Agua

La Paz, 27 de Mayo de 2014
CAR/MMAYA/VAPSB/DGAPAS/UTAPS N° 0519/2014

Señor
Oscar Saucedo
Director de Aguas
GOBIERNO AUTÓNOMO DEPARTAMENTAL DE SANTA CRUZ
Santa Cruz

Ref.: Ejecución del Proyecto "Diagnostico y rehabilitación de pozos para consumo de Agua Potable" - JICA

De mi consideración:

Pongo a su conocimiento que el mes de mayo de 2014, el Viceministerio de Agua Potable y Saneamiento Básico (VAPSB) manifesta al Representante de JICA en Bolivia, el interés de realizar diagnósticos que permitan la rehabilitación de pozos de agua para consumo humano, garantizando la predisposición del Sector a cooperar en la recopilación de datos, selección de lugares de intervención, soporte de operaciones, evaluación y documentación que corresponda para concretar el Proyecto.

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Sin otro particular, saludo a usted con las consideraciones más distinguidas.

Atentamente,

Milton Mamani Coc
UNIBOL COURIER
CEL 73538236

c.c. Archivo
Adj. Lo indicado
RME/OPM/pfa

Ing. Rubén Méndez Estrada
VICEMINISTRO DE AGUA POTABLE
Y SANEAMIENTO BÁSICO
MINISTERIO DE MEDIO AMBIENTE Y AGUA

Estado Plurinacional de Bolivia

EMPRESA PÚBLICA SOCIAL DE AGUA Y SANEAMIENTO - INTERV
EPSAS No. VE. .....
16 DIC 2014
La recepción de este documento no significa la aceptación de su contenido
8964

MMAyA
Ministerio de Medio Ambiente y Agua

Jueves, 11 de Diciembre de 2014
CAR/MMAYAVAPSB/DGAPAS/UTAPS N 1310/2014

Señor
Ing. Marcel Humberto Claure Q.
Interventor
EMPRESA PÚBLICA SOCIAL DE AGUA Y SANEAMIENTO – INTERV.
La Paz

Ref.: Ejecución del Proyecto "Diagnostico y rehabilitación de pozos para consumo de Agua Potable" - JICA

De mi consideración:

Pongo a su conocimiento que el mes de mayo de 2014, el Viceministerio de Agua Potable y Saneamiento Básico (VAPSB) manifesta al Representante de JICA en Bolivia, el interés de realizar diagnósticos que permitan la rehabilitación de pozos de agua para consumo humano, garantizando la predisposición del Sector a cooperar en la recopilación de datos, selección de lugares de intervención, soporte de operaciones, evaluación y documentación que corresponda para concretar el Proyecto.

Al respecto, en el mes de noviembre de 2014 el Director de JICA Sr. Satoshi Iwakiri hace conocer al VAPSB que se ha puesto en marcha un nuevo esquema de ayuda oficial al desarrollo (AOD), en el que Pequeñas y Medianas Empresas japonesas (PYME) llevan a cabo la encuesta de viabilidad en virtud de la AOD de Japón con el fin de utilizar sus productos y tecnologías para el desarrollo social y económico en los países en desarrollo.

Asimismo, manifiestan que un equipo de investigación de RaaX Co., Ltd., ha sido designado en éste esquema como exitoso y cualificado, el cual está programado para llevar a cabo el estudio de viabilidad en el Estado Plurinacional de Bolivia, para realizar un diagnóstico mediante endoscopía de pozos.

En este sentido, como es de su conocimiento inicialmente y a manera de demostración piloto, el VAPSB ha recomendado realizar trabajos en el campo de pozos Tilata ubicado en el Municipio de El Alto del Departamento de La Paz, para que posteriormente se realice la limpieza y correspondiente rehabilitación de los mismos.

Por tanto, remito a Ud. el documento "Estudio de Factibilidad para la Extensión de la Vida Útil del Pozo utilizando tecnologías de diagnóstico de Pozos", nota de aceptación para trabajar con el Proyecto y el cronograma de actividades a realizarse con el Proyecto, con el objeto de que su Institución pueda coadyuvar a la ejecución del mismo.

Sin otro particular, saludo a usted con las consideraciones más distinguidas.

Atentamente,

Ing. Ruben Mendez Estrada
VICEMINISTRO DE AGUA POTABLE
Y SANEAMIENTO BÁSICO
MINISTERIO DE MEDIO AMBIENTE Y AGUA

V°B° O.P.M. U.E.P. VAPSB

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RME/OPM/pfa

Summary

1. Current Situation of Water Supply Sector in Bolivia

1) Development challenges of water supply sector

In Plurinational State of Bolivia (hereinafter, referred to as Bolivia), the rate of population who can access safe water is 88% across the country (in 2010), and the rate of 78.5% which is targeted for by the Millennium Development Goal has been achieved (source: Japan's ODA policy with Bolivia, June 2012). However, the rate is still low in rural area and water supply services have been underdeveloped in urban fringe areas where the population influx from rural area is dense.

In order to cooperate with the Government of Bolivia to cope with the challenges, the Government of Japan has provided well drilling equipment and technological transfer through the Grant Aid scheme and carried out "The Project for Water of Life (Phase1 and Phase 2)" from the year 2005 until 2011 through the technical cooperation project scheme to strengthen capacities of related organizations and facilities maintenance. As a result, about 2,000 wells were constructed across the country. Although about 40% of these wells have passed more than 10 years, diagnoses of functional deterioration have scarcely been carried out. Malfunction due to aging of wells is one of major factors which cause stagnation of water supply rate.

Data do not seem to have been monitored for the above wells on degradation of the pumping capacities. Only occasional monitoring data on water level and pumping rate for 30 wells at Tilata area in El Alto City were obtained. Therefore it was not possible to clarify the regional characteristics of the functional degradation of wells in Bolivia through the existing data.

Regarding the wells at Tilata area, about 25 years have elapsed without rehabilitation after the construction by the Japan's Grant Aid projec. As functional degradation was significant, the pumping rates of the wells were reduced roughly to 3lit./s. Totally 22 wells (73%) were abandoned after 20 to 24 years from the construciton, and 21 wells were newly constructed in each of the same site.

2) Organization structure of water supply operators

Water supply in Bolivia is controlled by VAPSB of MMAyA and supported by UNASBVIs at prefectural level and UTIMs at municipal level. Area is classified into two areas in Bolivia; urban area which has population of 2,000 or more and rural area which has population under 2,000. In general, urban water supply is operated and managed by public water corporation or cooperative under the supervision of municipality and rural water supply is by CAPyS organized by rural residents. Although municipality is originally responsible for supporting CAPyS according to decentralization, national and prefectural governments support CAPyS at present because of the financial and technical shortage of

small and medium-sized municipality. Organizational structures of water supply operators in urban area and rural area are shown in Figure-1 and Figure-2 respectively.

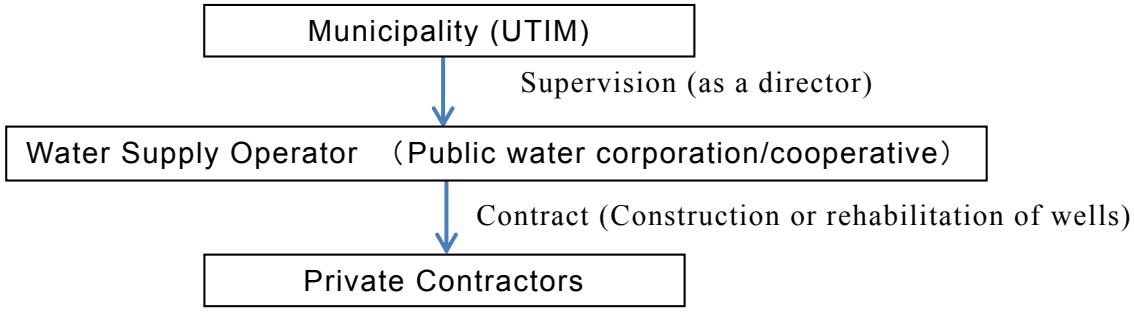


Figure-1 Organization Structure of Urban Water Supply Operators

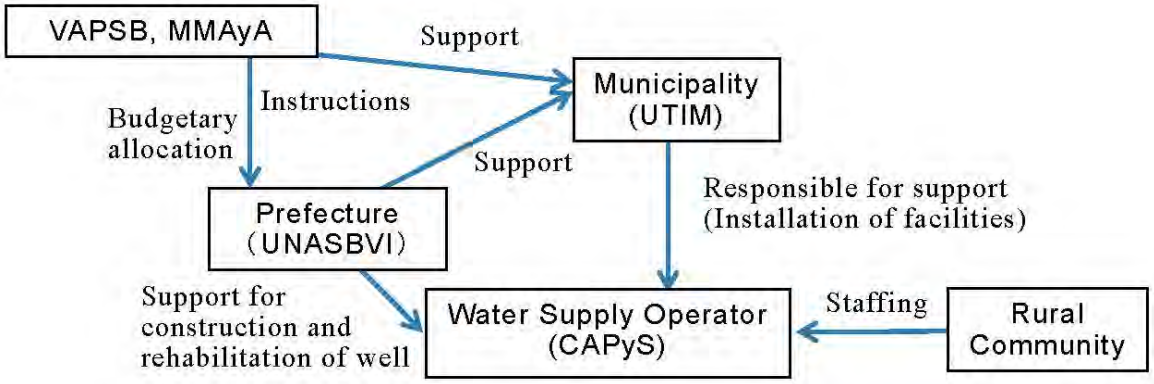


Figure-2 Organization Structure of Rural Water Supply Operators

2. Features of Raax's Co., Ltd. and its Products/Technologies to be utilized

The proposer, Raax Co., Ltd., has been developing, producing, selling and renting out the latest survey tools including BIP (Borehole Image Processing) Series since it was founded in 1988, and also been providing consulting services based on advanced geological information acquired by the tools.

The product to be utilized is "Bore hole camera i-Do300FII" which was developed as a well camera in 2002 from BIP Series. As shown in Figure-3, it thoroughly photographs the inside of well and identify the cause of problems or malfunction like an endoscope in medical test. It is equipped with dual camera system which can be switched from the front to the side or from the side to the front at any time, and horizontally rotates in any direction. Then it is able to acquire detailed information about the inside of the well by taking the video-images from every angle.

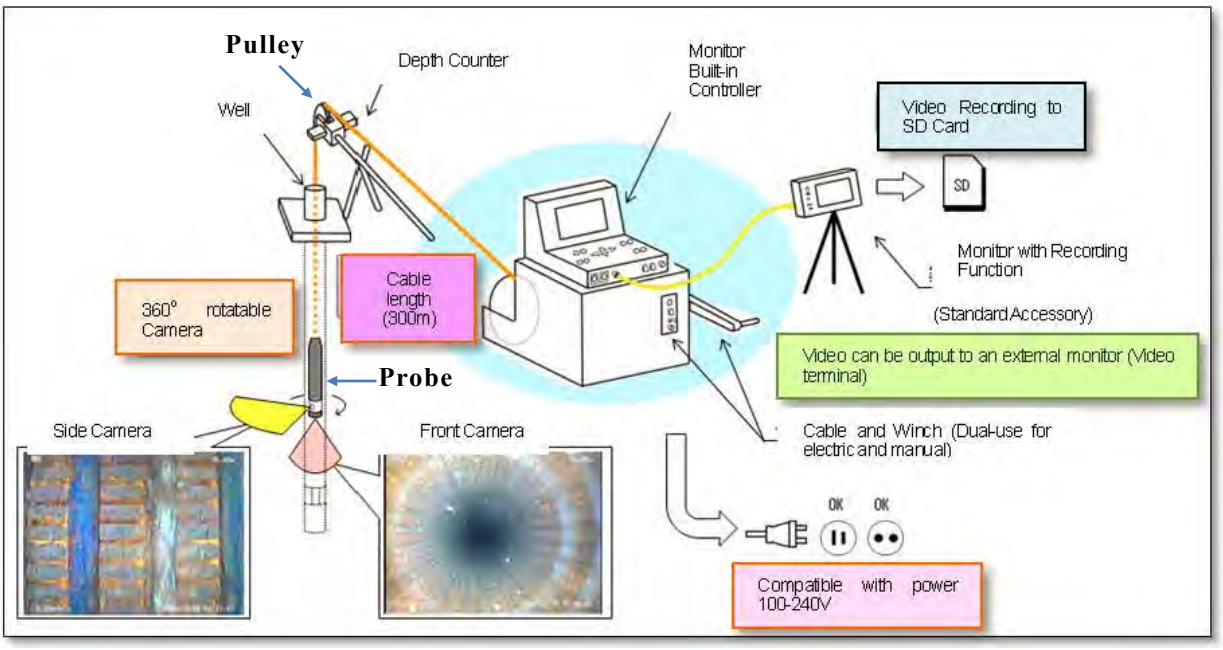


Figure-3 Conceptual Figure of Well Diagnosis using the Well Camera

3. Verification of Adaptability of the Raax's Products/Technologies to Bolivia

1) Verification activities for the Raax's products/technologies

In the 1st field survey (December 2014), an interview survey to officials in charge of water supply was carried out to clarify who will purchase well camera and how it is purchased. As a result, UNASBVI is likely to make an additional budget for procurement of well camera and to purchase well camera by putting the procurement out to general competitive bidding through a domestic ordering system "SICOES".

In addition, as UNASBVI has already organized a rehabilitatin team that is dispatched in response to a request from CAPyS and has also capable staff who are familiar with operation and maintenance of equipment for survey, monitoring or drilling, it will be able to establish a system for diagnosis and rehabilitation of well. Then UNASBVI is a likely organization as a counterpart for the project to verify and disseminate the proposed products and technologies.

In the 2nd field survey (from February to March 2015), an demonstration of well diagnosis using the products for existing two EPSAS's wells located at Tilata in El Alto City. One is named "A8" which has passed 25 years without rehabilitation since it was constructed in 1990 and been malfunctioning, and the other is named "A9-II" which has

passed 5 years since it was constructed next to the old well "A9" in 2010. Water supply stakeholders including counterpart organizations were invited to the demonstration. Specifications of the wells, methods used for rehabilitation, and pumping rates and water levels before/after the rehabilitation are shown in Table-1.

Table-1 Specifications of Wells and Results of Demonstration

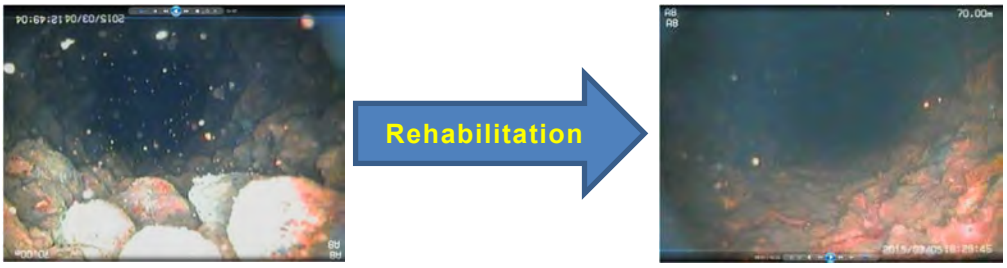
Well Name/Number	A8	A9-Ⅱ
Depth	90m	123m
Diameter of casing pipe	250mm (10in.)	200mm (8in.)
Type of screen　Width of slot	Johnson　0.3 ㎜	Johnson　1.0 ㎜
Initial pumping rate	11.7 ℓ/s (year 1990)	18 ℓ/s (year 2010)
Initial static water level	-12.90m (year 1990)	-11.95m (year 2010)
Initial dynamic water level	-25.40m (year 1990)	-29.47m (year 2010)
Pumping rate before rehabilitation	3.1 ℓ/s	9.7 ℓ/s
Static water level before rehabilitation	-19.60m	-19.98m
Dynamic water level before rehabilitation	-47.45m	-29.87m
Methods used for rehabilitation	Brushing (vertical direction), Jetting、Airlifting	Brushing, Shock wave (Nitrogen gas), Airlifting
Pumping rate after rehabilitation	3.0 ℓ/s	16.0 ℓ/s
Static water level after rehabilitation	-20.17m	-16.40m
Dynamic water level after rehabilitation	-36.74m	-27.24m

As shown in Photo-1, scale adhered so thickly that the screen was not sighted in the well A8. General methods could only scratch the surface scale and hardly improve the clogged screen. The result of demonstration made it clear that the aging well without rehabilitation for 25 years cannot recover its function unless some special techniques are applied.

On the other hand, sacle adhered not so thickly in the well A9-II compared with the well A8 as shown in Photo-2. As screen was sighted to some extent, it was expected that the well would recover its function. In fact, the well A9-II recovered its function significantly by rehabilitation work.

It was demonstrated that the proposed well camera is able to provide clear images inside of the well which directly recognize the situation of clogging and the possibility/effect of rehabilitation. Thus, it was realized to gather the attention of the Bolivian stakeholders.

Front camera image (before rehabilitation)　　Front camera image (after rehabilitation)



Side camera image (before rehabilitation)　　Side camera image (after rehabilitation)

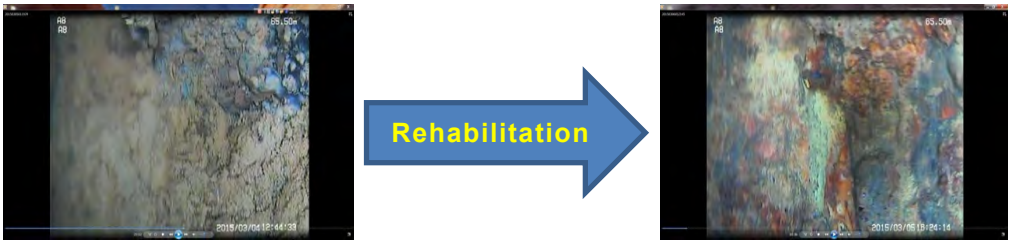


Photo-1 Demonstration of Diagnosis and Rehabilitation using the Well Camera (Well A8)

Side camera image (before rehabilitation)　　Side camera image (after rehabilitation)

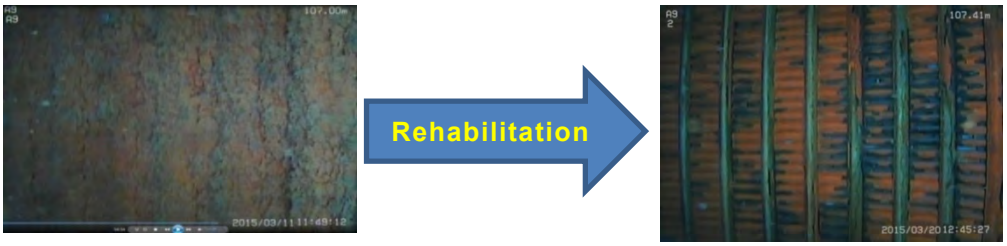


Photo-2 Demonstration of Diagnosis and Rehabilitation using the Well Camera (Well A9-II)

In the 3rd field survey (April 2015), technology seminars were held in the form of cooperation with JICA, MMAyA and three prefectures of La Paz, Oruro and Santa Cruz in each prefectural capital. Stakeholders such as MMAyA, UNASBVIs, public water supply corporation, international donors, universities or private contractors were invited to the seminars.

At the seminars, the results of the demonstration were reported and the aspects of cost-effectiveness of well rehabilitation were explained to the participants. Through discussions at the seminars, it was recognized that the Bolivian stakeholders have high

interest in overall technology from well diagnosis to rehabilitation and the well camera is likely to be accepted in Bolivia.

2) Verification for the Raax's products and technologies

In Bolivia there are general rehabilitation techniques such as airlift or brushing and special techniques such as high-pressure jetting or shock wave method. Although UNASBVIs and many private contractors have the technique and equipment of airlift, the problem is that well diagnosis technology has not been established or disseminated yet in Bolivia. The well diagnosis technology is needed to understand what a cause of malfunction of the well is, to decide whether the well should be rehabilitated or not, or to decide which techniques should be applied.

On the other hand, it is recognized that there is a private contractor who is equipped with well camera and providing well rehabilitation services using the camera and there are urban water supply corporations who are using the services or plan to use the services. Judging from this background, the well diagnosis technology using a well camera seems to be acceptable in Bolivia.

3) Confirmation of the needs of products and technologies

The results of the field survey made it clear through the interview surveys, the demonstration activities and the technology seminar that water supply managers are aware that the well diagnosis using camera is effective technology and the cost-effectiveness of proper rehabilitation may be higher than that of construction of new well.

In order to ensure stable water source for increasing water supply rate, there is a growing need for the diagnostic techniques to inspect malfunction of well, techniques to select appropriate rehabilitation method based on the diagnosis and techniques to carry out it.

As for rural water supply, UNASBVI supports maintenance of water supply facilities according to request of CAPyS. Therefore UNASBVI is likely to purchase the well camera and use it for diagnosis and rehabilitation of rural wells. During the field survey period, there were requests for detailed specifications and price quotation from MMAyA, La Paz Prefecture, Chuquisaca Prefecture and SeLA. There seems to be high and urgent demand.

Judging from the budget scales of MMAyA and UNASBVIs shown in Table-2, these organizations seem to carry out the well diagnosis using the proposed well camera at the cost of USD903 per operation. Considering the scales of general budgets, some of the organizations may not purchase the proposed well camera at the price of USD66,366. However, regarding procurement of equipment, these organizations request each government to add the special budget for procurement to the next year's general budget,

and they are able to purchase the equipment in the next year if the additional budget is approved. In this way, the UNASBVI of Chuquisaca procured the proposed well camera this year, and MMAyA plans to procure the camera next year. It would be possible for other UNASBVIs to do it the same way as the Chuquisaca's case.

Table-2 Annual Regular Budget for major Administrative Organizations of Water Supply Sector (year 2011)

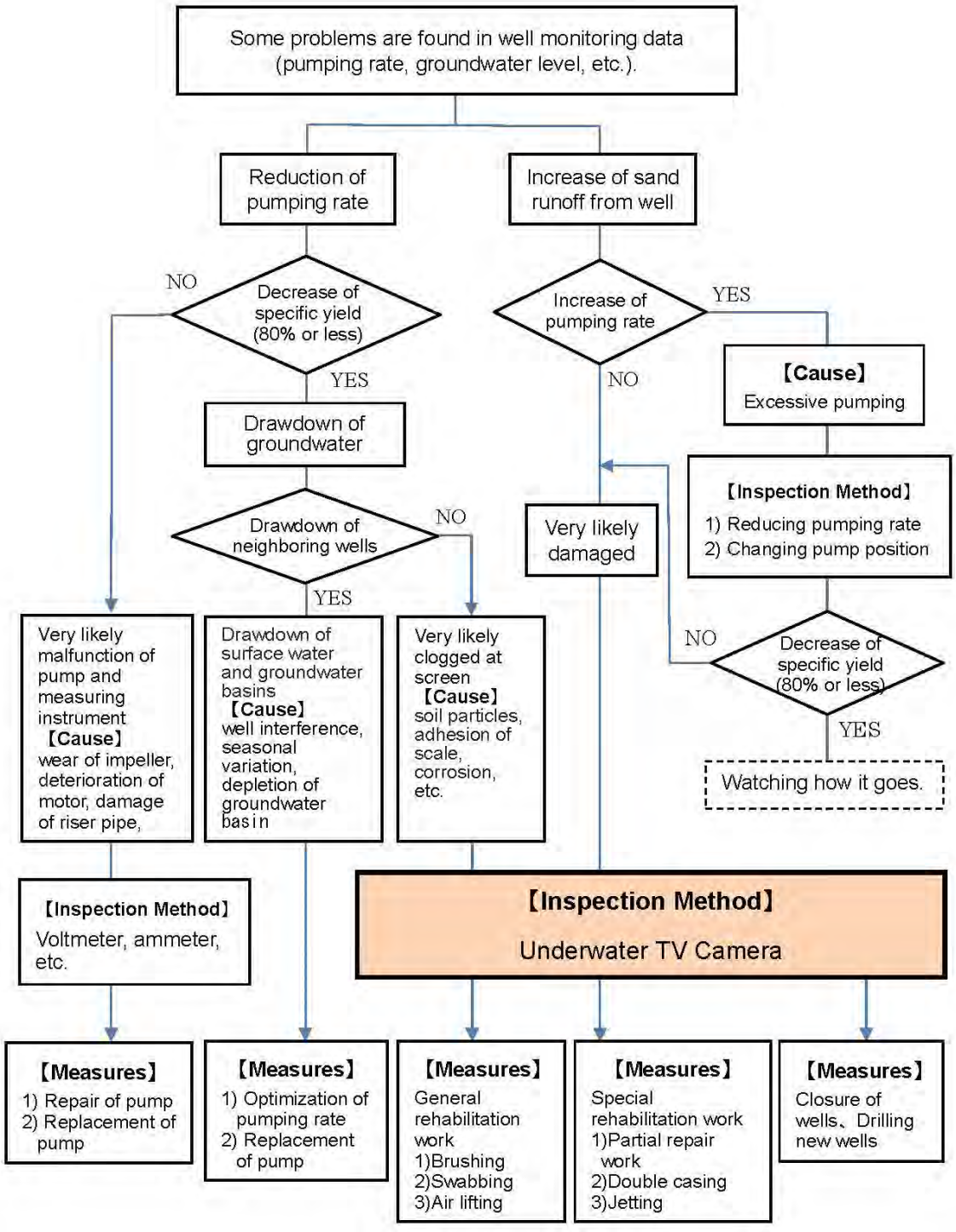
Names of Organizations	Annual Budget (USD/yr.)
Ministry of Environment and Water（MMAyA）	40,327,219
JICA Groundwater Project, Santa Cruz Prefecture (PROASU-JICA)	78,651,685
Department of Basins and Water Resources, Chuquisaca Prefecture（DACRH)	505,618
Department of Water and Basic Sanitation, Tarija Prefecture（UNASBVI)	505,618
Departme of Water, Basic Sanitation and Living, Oruro Prefecture (UNASBVI)	159,551
Department of Water, Basic Sanitation and Living, La Paz Prefecture (UNASBVI)	174,157
Department of Water, Basic Sanitation and Living, Potosi Prefecture (UNASBVI)	95,506
Department of Water, Basic Sanitation and Living, Beni Prefecture（UNASBVI)	112,360
Department of Water, Basic Sanitation and Living, Pando Prefecture（UNASBVI)	151,685
Department of Water, Basic Sanitation and Living, Cochabamba Prefecture (UNASBVI)	28,090

（source：VAPSB/MMAyA and UNASBVIs）

4) Validity with the product/technology and consistency with the development challenges

As shown in Figure-4, countermeasures against functional degaradation of well include removal of clogging of screen, repair and replacement of water pump, and repair of casing pipe. Among them, the well diagnosis by the camera is effective for removal of clogging of screen and repair of casing pipe. As repair of casing pipe such as a double casing technique is scarcely applied in Bolivia, well diagnosis by the well camera is effective only for removal of clogging of screen.

In the following, validity with the product/technology and consistency with development challenges are considered.



(source : "Technical manual for management of wells", Japan Water Works Association, 1999)

Figure-4 Diagnostic Flowchart of Deep Wells

a. Diagnosis cost by well camera

Unit cost for the well diagnosis using the proposed well camera in Bolivia is estimated as follows. Net two days is needed for the well diagnosis, as one day is for well observation before rehabilitation work and the other day for completion inspection after the rehabilitation work. Usually the same engineer/technicians work for both diagnosis and rehabilitation and it takes about 10 days to complete the whole work including mobilization and demobilization. As sites are remote villages in general, they stay with equipment at the sites throughout the work period. Then a total number of working days for well camera is assumed as 10 days per operation when users share the costs such as maintenance costs or depreciation costs.

Diagnosis cost = Depreciation cost + Operation cost + Maintenance cost

= USD903 per operation

b. Rehabilitation costs of existing Well

Average costs to remove clogging of screen are shown in Table-3. In general, cause of clogging is different where geological condition is different, and proper rehabilitation technique is also different. Then rehabilitation cost differs by region.

Table-3 Average Unit Costs for Rehabilitation of Existing Well (100m class)

Area	Western Area (Cities of La Paz and El Alto (EPSAS))	Eastern Area (Santa Cruz Prefecture)
Average unit rehabilitation cost for a well and once (USD)	11,110 General method such as Airlift, Swabbing or Brushing, special methods such as High-pressure Jetting or Shock Wave method and the combination are included	2,381 General method such as Airlift, Swabbing, or Brushing and the combination are included

(source : The data for cities of La Paz & El Alto are provided by EPSAS, and the data for the eastern area are from interview survey to private contractors in Santa Cruz Prefecture)

Note: Except for diagnosis costs by well camera, all costs such as equipment rent, personnel labor costs or fuel costs are included.

Rehabilitation costs by technique are shown in Table-4. By introducing the camera for a well diagnosis to select an appropriate rehabilitation technique(s), rehabilitation costs rise to some extent (+USD903). However, the cost of proper rehabilitation technique(s) based on the diagnosis by the well camera may be lower than that of multiple techniques combined by trial and error when the cause of clogging is not identified due to the lack of information by diagnosis.

In Bolivia, it is not unusual that the actual position/depth of the screen is different from the drawing because no completion inspection of newly constructed well is done. In this case, cleaning may be done for other part than screen, no effect may be obtained and

money may be wasted even if the rehabilitation techniques are proper.

Table-4 Unit Costs for Rehabilitation of Existing Well (100m class) by Technique

Rehabilitation technique	Unit cost (USD)
Airlift	2,857
Jetting	1,429
High-pressure Jetting	2,857
Swabbing	1,607
Brushing	4,286
Washing with chemicals	762
Shock wave	5,655

(source : EPSAS and well contractors in Santa Cruz Prefecture)

Note: Except for diagnosis costs by well camera, all costs such as equipment rent, personnel labor costs or fuel costs are included.

c. Construction costs of new well

Construction costs of a new well are shown in Table-5. As well as costs of rehabilitation, the construction costs differ by region.

The propotions of the construction costs of new well to the rehabilitation costs (shown in Table-3) are 3.6 times in the western area and 7.5 times in the eastern area. According to a simple comparison of the unit costs, it is possible to rehabilitate a well three times in the western area and seven times in the eastern area using the budget for construction of a new well.

Table-5 Unit Costs for Construction of New Well (100m class)

Area	Western Area (Cities of La Paz and El Alto)	Eastern Area (Santa Cruz Prefecture)
Construction cost for a new well (USD)	40,179	17,857

(source: The data for cities of La Paz & El Alto are provided by EPSAS, and the data for the eastern area are from interview survey to private contractors in Santa Cruz Prefecture)

d. Functional degradation of well

In Bolivia, wells do not seem to have been periodically monitored or data do not have been recorded on degradation of the pumping capacities. It was not possible in this survey to clarify the regional characteristics of the functional degradation of wells in Bolivia through the existing data. Only occasional monitoring data on water level and pumping rate for 30 wells at Tilata area in El Alto City were obtained.

Therefore, based on the above-mentioned data of wells at Tilata, functional degradation of the well A9-Ⅱ as a model well, is simulated using the following formula.

$$Q_n = Q_0 \times d^{(n-1990)}$$

here, Q_n : Pumping capacity in the year "n"
Q_0 : Pumping capacity at the initial stage (1990)
d : Average annual functional degradation rate

The pumping capacity of the well A9-Ⅱ was 18ℓ/s at the initial stage (in 2010) and has been reduced to 9.7ℓ/s in 2015 after five years. When these values are inputted into the above formula, the average annual functional degradation rate (d) of 88.4%/yr. is obtained.

Since there is no data on degradation of the well A9-Ⅱ well after the sixth year, the value of 95%/yr. is used as "d" after the sixth year. The value is estimated by the above formula using the data on degradation of old wells of A-line and B-line at Tirata from the year 1990 to 2008. And the model well is abandoned at the 25th year after the construction in the same way as most wells of A-line and B-line

e. Effects of countermeasures against functional degradation

Effects of construction of new well and effects of rehabilitation to remove clogging of screen are compared and discussed as follows. As mentioned above, judging from simple comparison of both costs, rehabilitation of existing well seems to be more advantageous than construction of new well. However, the effects of construction of new well and those of rehabilitation of existing well should be compared in order to evaluate the effects of well life extension.

Total amount of water rate income earned from the 25th year to the 50th year by the newly constructed well (Case 1)and the amount of increase of water rate income earned from the 10th year to the 50th year by the rehabilitation in twice (Case 2) are estimated and compared. And cost-effectiveness for each case is calculated dividing the total amount by the cost and compared.

Case 1: The old well was constructed 50 years ago and abandoned in the 25th year because no rehabilitation was performed and the pumping capacity

significantly reduced after 24 years. A new well with the same capacity was constructed right after the abandonment and abandoned without any rehabilitation in the 49th year

Case 2: The existing well was constructed 50 years ago and rehabilitated twice, in the 10th year and the 20th year. The well has extended the life and has continued its operation until the 50th year

Firstly, in Case 1, the curve of functional degaradation described above in d. is applied to the model well every time a new well is constructed. This concept is shown in Figure-5.

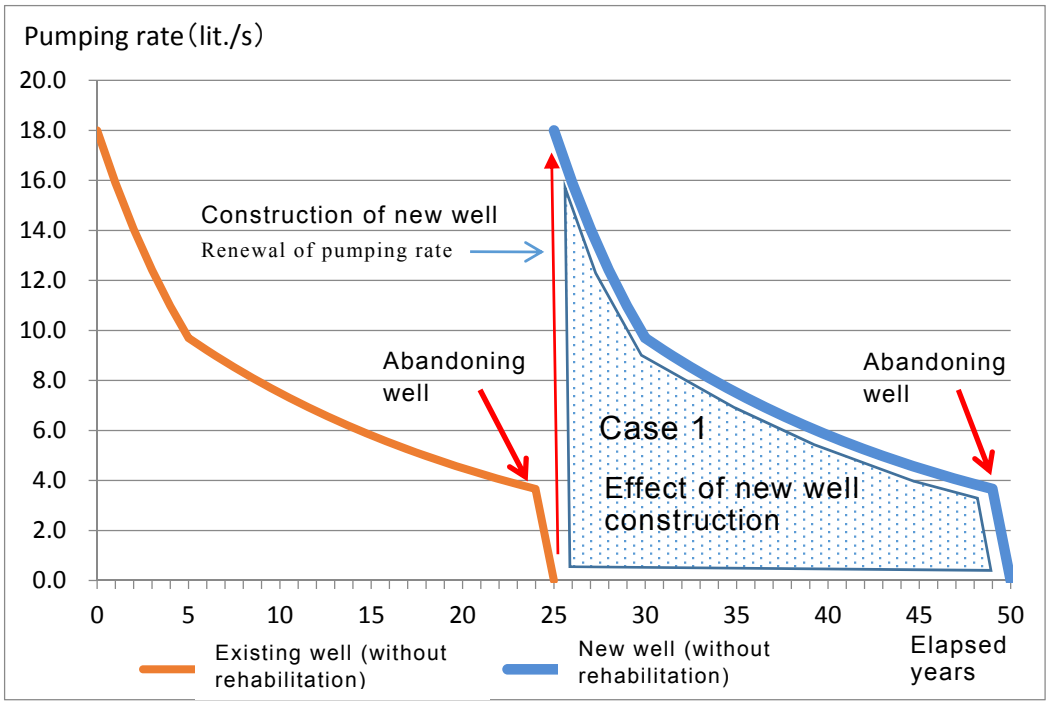


Figure-5 Conceptual Figure of the Effect by Construction of New Well

Secondly, in Case 2, the existing well could extend the life until the 50th year recovering the pumping capacity to certain extent in the 10th year and in the 20th year

Regarding the extent of recovery by rehabilitation, as data do not seem to have been recorded or anallized in Bolivia, the data obtained by the demonstration in this survey are applied to the model well. The recovery rate of 75.9% is applied to an advanced rehabilitation techniques and the recovery rate of 38.0%, a half of advanced technique, is applied to general techniques.

Based on above-mentioned assumptions, the concept of functional degaradation and recovery through twice rehabilitation by advanced technique is shown in Figure-6. The effect of the rehabilitation is total increase of water production from the 10th year to the 50th year.

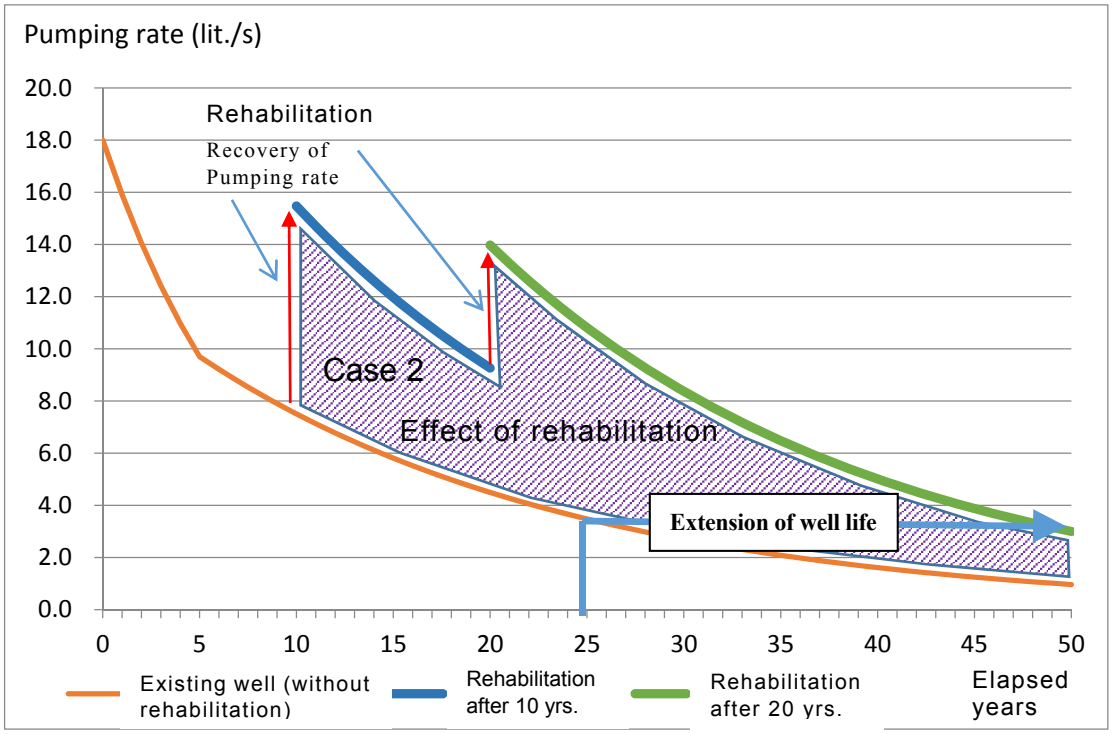


Figure-6 Conceptual Figure of the Effect by Rehabilitation

Neglecting inflation, fluctuations in water rate and costs of abandoning well, the water production volume-based effect can be translated into monetary value (turnover), by multiplying it, the unit water rate (45 cents/m3) and the water rate collection rate (60%). And cost effectiveness is estimated by dividing the turnover by the total cost.

The results of estimates of effects, costs and cost-effectiveness of the countermeasures are summarized in Table-6.

It is evaluated that rehabilitation of well is more cost-effective than construction of new well. Even if the existing well is rehabilitated by the advanced technique based on the diagnosis by the well camera, the cost-effectiveness of the rehabilitation is 137% higher than that of the new well construction in the western area. In the eastern area, the cost-effectiveness of the rehabilitation by general technique plus the diagnosis by the well camera is 25% higher than that of the new well construction.

Table-6 Comparison of Costs and Effects of Countermeasures against Malfunction of Well (one well)

Countermeasures against malfunction of existing well	Effect		Total Cost (USD)		Cost-effectiveness	
	Water Production (m^3/50years)	Turnover (USD/50years) (@USD0.45/m^3)	Western Area	Eastern Area	Western Area	Eastern Area
Construction of new well	5,891,386	1,590,674	40,179	17,857	39.6	89.1
Twice rehabilitation (advanced method) Recovery rate: 76%	6,544,701	1,767,069	18,830	—	93.8	—
Twice rehabilitation (general method) Recovery rate: 38%	3,091,970	834,832	—	7,520	—	111.0
Ratio (rehabilitation versus construction of new well)	Rehabilitation (advanced) : 1.11 Rehabilitation (general) : 0.52		0.47	0.42	2.37	1.25

Effect: Increase in total volume/amount of drinking water production that was obtained by the countermeasures (3 ways: new well construction, rehabilitation (advanced) and rehabilitation (general)) in the 50 years

Total cost: Total of the costs that were spent on the countermesures against the malfunction of the well in the 50 years. The costs of rehabilitation include the cost of well diagnosis and inspection by the well camera.

Cost-effectiveness: effect (turnover) ÷ cost

Rehabilitation (advanced): Rehabilitation by the combination of shock wave method and airlift. The costs of rehabilitation include the cost of well diagnosis and completion inspection by the well camera.

Rehabilitation (general): Rehabilitation by airlift method. The costs of rehabilitation include the cost of well diagnosis and completion inspection by the well camera.

f. Validity with the product/technology and consistency with the development challenges

As described above, since the diagnosis cost by the well camera increase the rehabilitation costs by about 20-60%, the well camera may be unnecessary where cause of screen logging and countermeasures are clear. However, such case is rare and types of clogging are various. Furthermore it seems that position or depth of a screen sometimes differs from the drawings in Bolivia, which makes effects of well rehabilitation more uncertain. Due to the uncertain effects of rehabilitation, new wells generally have been constructed next to the existing wells as an alternative to recover pumping rate.

As shown in the above evaluation for the effect of rehabilitating existing well to remove

the clogging of the screen, extension of existing well life is more cost-effective than construction of new well if an appropriate rehabilitation method is selected and performed depending on the characteristics of the well. It means that well life extension by rehabilitating existing well plays an important role under a limited budget and availability of water resources in order to effectively secure water resources and increase the rate of accessing safe water especially in the rural and peri-urban areas which is the challenge for development. And to select an appropriate rehabilitation method in advance, it must be valid that well camera, such as the proposed product that provides clear image inside well, and diagnostic technology are applied and disseminated.

Low success rate is one of major challenges when a new well is developed in an area on a bedrock. Low success rate makes the water resources development more uncertain and makes the construction cost of the well expensive. On the other hand, it is more likely that the pumping capacity of the well will be recovered by rehabilitation. As a countermeasure in such area, rehabilitation of existing well is securer than construction of new well.

Overexploitation of well often abandon old wells without proper treatment. Through those wells, contaminants may infiltrate down through the ground and cause water contamination of underground aquifer. It must be a risk of reducing potential of the entire groundwater resources. From the viewpoint of water resources management, it should be important that rehabilitation of existing wells are emphasized more.

It is essential to construct a good quality well and to use it as long as possible maintaining properly, in order to presserve limited groundwater resources and sustain the effective use. For that purpose, it will contribute to capacity development of the integrated water resources management that improper construction of wells should be excluded by completion inspection using well camera, rehabilitation techniques of existing wells should be improved by disseminating well diagnosis technology and lives of wells should be extended.

5) Study on feasibility

a. Feasibility in ODA projects

One of the major problems in well maintenance is that there are no clear grounds for making decides whether an old well should be abandoned and a new well should be constructed instead, whether rehabilitation should be applied to recover the function of the well, or which method should be applied for rehabilitation.

To solve the problem, important things are to inspect the inside of well, to understand the situation of malfunction and to select measures suitable for each situation. In particular,

basic data such as water level and pumping capacity of wells should be recorded properly, aging of wells should be analyzed, and appropriate measures should be applied by observing the inside of wells by well camera. A series of the above activities is an important system. In order to establish this system in Bolivia, it will be effective to provide necessary equipment and guidance/transfer of related technology through Japan's ODA. Especially, it is effective to guide and transfer technologies combining well diagnosis with selection of rehabilitation. ,

Fortunately, for many years, Japan has implemented grant aid and technical cooperation projects in water supply sector across the country in Bolivia. As human resources and network developed through those projects remain, it would be easy to get cooperation and supports from nationwide water supply organizations including MMAyA.

b. Feasibility in business development

At the initial stage, we aim to sell the i-Do300FII to national and prefectural water supply organizations such as MMAyA and UNASBVIs who are aware of the importance of well rehabilitation and diagnosis. If they purchase some cameras and their effectiveness is widely known, following them, public water supply corporations in urban areas would apply the well diagnosis technology, and private contractors would purchase cameras to meet the requirements of the public corporations. Thus, the well diagnosis technology using well camera would disseminate across the country.

In fact, Chuquisaca Prefecture purchased our product by competitive bidding in May this year (2015). This is the first case that the governmental organization recognized the effectiveness and advantage of our well camera and purchased it. It can be said that our product was able to jump over the initial high hurdle. It is expected that UNASBVIs of other prefectures and MMAyA follow Chuquisaca Prefecture. Dissemination of well camera would be accelerated if the prices of products and technical services are reduced.

Because experience of operation and maintenance of the well camera such as operability and the points to be noted for the maintenance will be recorded and stored, more adaptable specifications to Bolivia would be materialized. If the experience can reduce the price of the camera simplifying or modifying the original specifications, it is not only advantageous in price competition with the competitors but also able to reduce the fee for well contractors' technical services such as well diagnosis. It is considered that it would accelerate the introduction and dissemination of the well camera.

4. Proposal for Formulating ODA Projects

1) Overview of ODA projects

Concerning ODA projects that utilize the proposed product, possibilities of three schemes

of the verification survey with the private sector for disseminating Japanese Technologies, the follow-up cooperation and the technical cooperation project are considered. As the follow-up cooperation is only once project with the maximum budget of USD200,000, it is not likely that a single project can carry out enough demonstration and dissemination activities. As for the technical cooperation project, a pure water supply sector is not included in the JICA's projects list in Bolivia and it seems difficult to materialize the projects.

On the other hand, there is high needs of the Bolivian side for the verification survey for disseminating Japanese Technologies. Through JICA's cooperation performance so far, it may be easy to get cooperation of the counterpart and information on the project area is enough. Therefore the verification survey disseminating Japanese Technologies is possible to be realized. It is considered effective that the verification survey disseminating Japanese Technologies precedes other schemes and other possible schemes follow it.

Since the verification survey with the private sector for disseminating Japanese Technologies is most likely to materialize, the specific contents are proposed as follows. Regarding other possible scheme, training program can be combined with the verification survey. Utilizing the training program, well administrators or operators of neighboring countries such as Peru or Paraguay are invited to workshop in Bolivia and exchange opinions and information related to operation and maintenance of wells at the final stage of the verification survey. At the workshop, the results of the verification survey are reported and the well diagnosis technology using the proposed well camera is introduced to the neighboring countries.

2) Concrete plan and development effects

a. Project title : The project for well life extension utilizing effective well diagnosis and rehabilitation technologies

b. Goal

Overall goal: Stable water supply to meet the demand through well life extension of existing wells by fixing and disseminating proper diagnosis and rehabilitation technology

Project purpose: It is verified across the country that well diagnosis and selection of rehabilitation method using the proposed product are valid in Bolivia, and the technologies are transferred to the Bolivian well administrators.

c. Activities

① 1st Year

- Two sets of well camera and one set of well rehabilitation equipment including common equipment such as air compressor and high pressure pump which constitute a system of well diagnosis and rehabilitation will be procured and assembled in Japan. After that, they will be transported to Bolivia and the remaining other equipment such as boring rods will be procured in Bolivia. Finally, the equipment will be mounted on a track with crane and put into the project as an onboard-type portable system.
- During the 1st Year, for personnel of C/P agencies in charge of well operation and maintenance, a technical guidance by lectures for well diagnosis, selection of rehabilitation methods and rehabilitation technology will be carried out. In addition, a guidance by lectures for planning technique of well life extension including budgetary measures and essential monitoring/analyzing techniques of aging of well function will be carried out.

② 2nd Year

- Detailed survey on functional degradation of wells in the candidate areas for the demonstration will be carried out by interviewing administrators of the wells. Candidate wells for the demonstration will be selected based on the reslts of the survey.
- Preliminary diagnosis of the candidate wells will be carried out and target wells will be finalized using two sets of well camera procured in the 1st Year. In addition, OJT on well diagnosis technology will be implemented for the counterpart officials who maintain the wells.
- Moving to the demonstration sites with the onboard-type portable system of well diagnosis and rehabilitation, a series of operation work will be carried out starting from well diagnosis operation followed by selection of proper rehabilitation method and rehabilitation. And the results of demonstration will be reported to the respective local officials as a part of verification activities. In addition, OJT on a series of well maintenance technologies including well diagnosis, rehabilitation work and maintenance of well camera will be carried out mainly to officials of UNASBVIs. The demonstration activities will be performed at all target sites.

③ 3rd Year

- Based on the results of the demonstration in the 2nd Year, well diagnosis, selection of proper rehabilitation method and rehabilitation work by region and well structure wll be summarized in the form of well diagnosis and rehabilitation menu/manual.

- Based on the menu/manual and results of the demonstration, technology seminars will be held at the western and the eastern activity bases (Oruro City and Santa Cruz De La Sierra City) for the purpose of improvement and dessemination of technologies of well diagnosis and rehabilitation.

d. Outputs

① Diagnostic technology using the proposed well camera is verified in various areas in Bolivia.

② Techniques of selecting proper rehabilitation method and effects of the rehabilitation are verified in various areas in Bolivia.

③ A series of above-mentioned technologies from well diagnosis to rehabilitaiton are transferred to Bolivian officials who are in charge of operation and maintenance of wells.

e. Indicators

With respect to the output ①

Indicator ①: Demonstration of diagnostic technology using well camera is carried out for existing wells in three areas that represent various topographical, climatorogical and geological conditions in Bolivia.

With respect to the output ②

Indicator ②: Based on the results of above demonstrations in three areas, rehabilitation methods are selected and carried out, and the effects are verified.

With respect to the output ③

Indicator ③-1: During the demonstration in three areas, a series of technological OJT for counterpart officials is carried out every time.

Indicator ③-2: After the demonstration, results briefing will be held in each region in order to discuss the effects of the well diagnosis and rehabilitation with the Bolivian counterpart officials in chrge of maintenance of wells.

Indicator ③-3: After the demonstration, all results are summarized in the form of menu/manual of well diagnosis and rehabilitation.

Indicator ③-4: Technological seminars are held at two operating bases at the end of the project widely inviting well administrators in charge of operation and maintenance.

f. Inputs

Japanese side

① Japanese Engineers/Technicians
Team Leader, Chief Adviser, Well Diagnosis Technician, Well Rehabilitation Technician, Expert of Training and Manual, Coordinator

② Materials and equipment
Well diagnosis and rehabilitation system (Well camera, Rehabilitation equipment, Air compressor, High pressure pump, Generator, other equipment)

③ Direct costs
Travel expenses, Transportation expense, Local activities expense

Bolivian side

① Arrangement of the counterpart personnel

② Facilities and equipment necessary for the project operation
Preparing/providing the target wells, training and briefing venues, Work sites for demonstration activities, Support vehicle/equipment, Electricity and Water

③ Storage and maintenance of equipment that are inputted by the Japanese side

④ Ensuring budget necessary for cooperation with the survey

⑤ Necessary procedures for the project operation
- Temporary removal and re-installation of existing facilities/devices
- Acquisition of permission for demonstration
- Consideration to the surrounding residents
- Request for cooperation of stakeholders
- Tax exemption from customs duties which may be imposed in Bolivia with respect to the import of the well diagnosis and rehabilitation system and local purchase of products and services
- Providing available data/information

g. Counterpart organizations

① VAPSB/MMAyA

② UNASBVIs (Oruro, Santa Cruz, Chuquisaca perfectures)

③ Municipal water supply corporations as sub-counterpart (SeLA (Oruro City), COSMOL（Montero City）)

h. Consultation with counterpart organizations

Although VAPSB of MMAyA was preparing a request to the Government of Japan for technical cooperation project that is carried out across the country combining well diagnosis and rehabilitation, we informed that a technical cooperation project of pure water supply sector is not included in JICA's project list in Bolivia and it would be

difficult to accept the request. Instead of it, we presented and explained the outline of the project planned for the next stage, the verification survey with the private sector for disseminating Japanese Technologies for disseminating Japanese technologies, to VAPSB, and requested VAPSB to cooperate with the project if the proposal is granted for the survey scheme by JICA. We also informed that a certain technical guidance and technology transfer related to well diagnosis and rehabilitation will be possible through the above verification survey, and we have been occasionally exchanging views on the survey with the staff of VAPSB. As a result, the Vice Minister of VAPSB expressed their approval of our proposal for the project in the next stage and told us that VAPSB was willing to cooperate with and support us to drive the project.

At the demonstration and the technology seminar, the scheme of the verification survey with the private sector for disseminating Japanese Technologies and the outline of the project were explained to the level of well administrators such as UNASBVI or public water supply corporation, and we have kept exchanging the views on the project even after the field survey was finished. As a result, it was agreed that they will cooperate with us to verify the effect of diagnosis further more through the verification survey. At the same time, they requested us to include the technical guidance and technology transfer of proper selection of possible rehabilitation technique(s) and rehabilitation work in the verification survey.

i. Implementation system and schedule

As shown in Figure-7, implementation system of the project to be proposed for “the verification survey with the private sector for disseminating Japanese Technologies” is on the basis of the same system as this survey and rehabilitation technology is added to the project.

In addition, as natural conditions such as geology, topography and climate vary in Bolivia, the implementation system will enable the project team to carry out the demonstration activities in a wide range of areas such as the western highlands, the eastern tropical plains and semiarid zone (Gran Chaco) in order to try well diagnosis and rehabilitation corresponding to the difference of natural conditions.

In particular, a Japanese well contractor who has developed an advanced rehabilitation technique is added to the supporting group and equipment which copes with a series of techniques from well diagnosis to rehabilitation is prepared. Specifically, the Japanese well contractor nominated so far is Eath Trust Engineering Co., Ltd. which is headquartered in Sapporo City as well as the project proposer, Raax Co., Ltd., and has a track record not only in the rehabilitation of water well but also in the rehabilitation of hot spring well that scale tends to adhere to more severly than water well.

Regarding the Bolivian counterparts, MMAyA plays a leading role of the counterpart

team, prefectural UNASBVIs practically cooperate with the Japanese Team in carrying out demonstration and water corporations in urban areas prepare wells for demonstration as sub-counterpart.

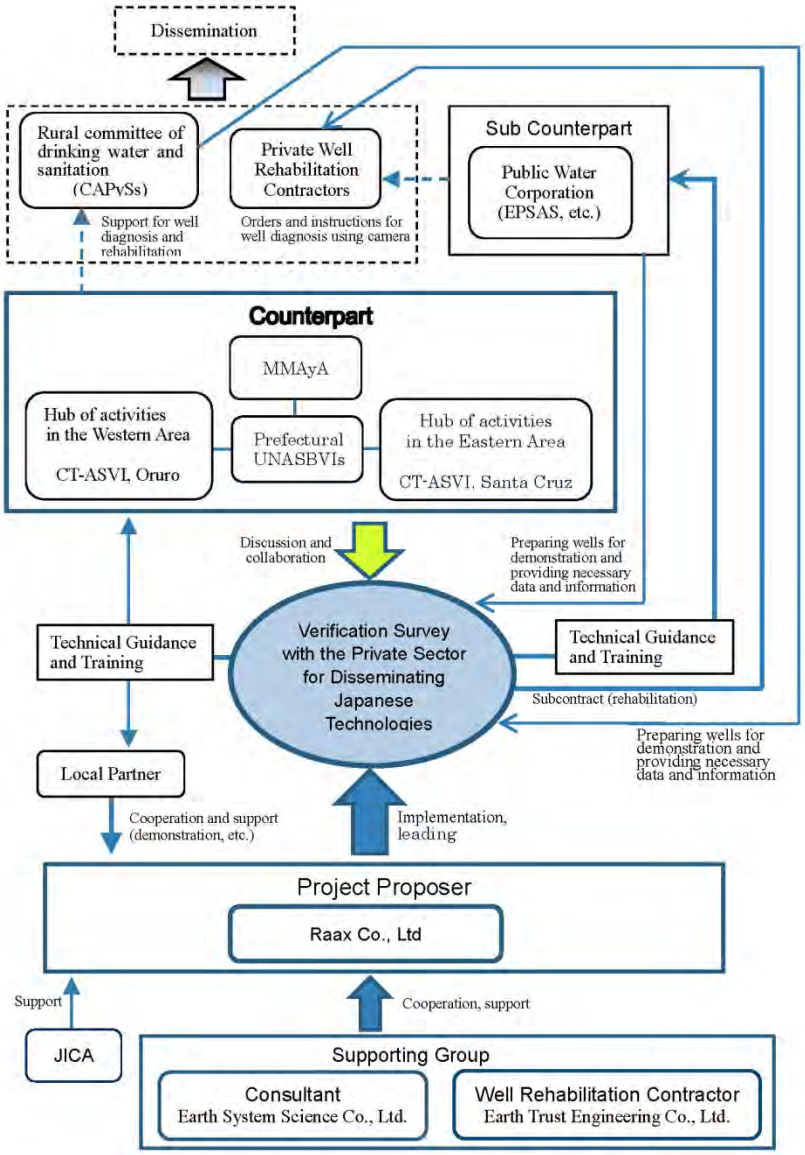


Figure-7 Implementation System of the Verification Survey with the Private Sector for Disseminating Japanese Technologies

Implementation schedule is as shown in Table-7. By dividing the entire project period into three Years, the 1st Year is mainly equipment procurement period to manufacture, purchase, assemble and transport the equipment necessary for the project, the 2nd Year is

demonstration activities period to carry out demonstration of well diagnosis and rehabilitation, and the 3rd Year is organizing and reporting period to create a manual and hold technology seminars. The entire project period is 28 months from the commencement in March 2016 until the submission of the final report in June 2018.

Table-7 Time Schedule of Verification Survey with the Private Sector for Disseminating Japanese Technologies

Project Year	Activities	Year / Month	year 2016												year 2017												yers : 2018					
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
1	Deciding specifications of rehabilitation equipment																															
	Procurement of equipment																															
	Assembling system for diagnosis and rehabilitation of well																															
	Transportation and customs clearance																															
	Guidance by lectures for planning technique of well life extension																															
2	Selection of candidate wells for demonstration																															
	Preliminary diagnosis of candidate wells using well camera																															
	Deciding wells for demonstration, Preparation for demonstration																															
	Implementation pf demonstration of diagnosis and rehabilitation of wells																															
3	Creating menu/manual for diagnosis and rehabilitation of wells																															
	Technology seminar in Bolivia																															
	Reporting																															

Legend : activities in Bolivia activities in Japan

j. Estimated amount of project costs

Total amount of the proposed verification survey with the private sector for disseminating Japanese Technologies costs is estimated to be 100,000 thousand yen.

k. Specific development effect

Demonstration activities in the verification survey with the private sector for disseminating Japanese Technologies will clarify the methodology of well diagnosis using well camera and appropriate rehabilitation method according to the results of diagnosis.

It will provide clear grounds for selecting possible measures against malfunction including abandonment of old well and construction of new well though it has been done blindly. As a result, a well operator can avoid useless spending such as abandoning recoverable well or waste of expenses by trial and error, and it becomes easier to rehabilitate well.

As the demonstration activities become widespread, regional features of well diagnosis and rehabilitation become clear, and it becomes a trigger for the technologies to disseminate.

Activities of the verification survey include technical guidance for planning method of well life extension, periodical monitoring of functional deterioration of well inevitable for the planning, analysis of the monitored data, and so on. When rehabilitation techniques applicable in Bolivia are properly selected and periodical monitoring of well function and planning method of well life extension is taken root, the effective way to secure water supply with limited budget according to water demand can be planned by comparing cost-effectiveness of well rehabilitation and new well construction. Water supply rate and quality of water supply services will be improved especially in rural areas where UNASBVIs assist in operating and maintaining wells.

3) Target areas and surrounding situation

As target areas of the demonstration activities, three cities have been nominated at present. They are Oruro City (Oruro Prefecture), Montero City (Santa Cruz Prefecture), Machareti City (Chuquisaca Prefecture) that represent the western highlands, the eastern tropical plains, and semiarid zone (Gran Chaco), respectively.

4) Challenges in ODA project formulation

Although the needs for functional recovery of wells are high in Bolivia, only establishment and dissemination of diagnosis by well camera is insufficient. The results of this survey have made it clear that a series of technologies including proper selection of rehabilitation method and effective rehabilitation should be established and disseminated. Therefore, in the verification survey with the private sector for disseminating Japanese Technologies, selection and carrying out of rehabilitation methods currently applied in Bolivia will be demonstrated, and an advanced Japanese technique will be introduced and applied to the wells that general rehabilitation methods could not recover the function.

In Bolivia, as natural conditions such as topography, geology and climate are various, quality of groundwater and features of functional deterioration are also various.
Therefore, diagnosis by well camera may not be disseminated unless demonstration activities are carried out on a nationwide scale to some extent.

It is essential to construct a good quality well and to use it as long as possible maintaining properly, in order to presserve quantity and quality of limited groundwater resources and sustain the effective use. For that purpose, it will be a part of an integrated water resources management that improper construction of wells should be excluded by completion inspection using well camera, rehabilitation techniques of existing wells should be improved by disseminating well diagnosis technology and lives of wells should be extended.

5) Correspondence relating to environmental and social considerations

Taking the effects of demonstration into account, wells located in urban areas are nominated. As heavy machines such as air compressor or high pressure pump cause noise and muddy water, the wells where houses are densely constructed around are excluded from candidates. Although consent of local residents will be asked to counterparts and taken in advance, the well are excluded from candidates if the consent is not taken.

5. Plan for the Raax's Business Development

1) Results of market analysis

As competing products, European and American manufacturers' products are generally known in Bolivia. Although sales agent was not confirmed, prices of the products are USD25,000 – 30,000 on the internet. According to the interview survey, only one Cochabamba-based private well contractor, HIDRO DRILL, has a well camera and provides technical services of well diagnosis.

The water supply department of Santa Cruz Prefecture (PROASU-JICA) intends to make use of the technical services of well diagnosis using camera, but it has not been realized yet due to high price of the services. On the other hand, EPSAS of La Paz-El Alto cities entrusts a private contractor, HIDRO DRILL, with the technical services including well diagnosis using camera and rehabilitation. There is a little difference in outsourcing by region, but the intension that water operators utilize such technocal services has been born.

It should be UNASBVIs of nationwide nine prefectures who purchase the well cameras and assist rural water supply systems in carrying out well diagnosis and rehabilitation. And it should be private well contractors who purchase the well cameras and are entrusted with well diagnosis and rehabilitation by water supply companies in urban areas.

As actual working days are considered as 250 days/yr. taking holidays into account, the number of times that a well camera is annually used for well diagnosis and inspection is estimated to be 25 as it takes about 10 days to carry out both well diagnosis and rehabilitation. If well diagnosis and rehabilitation is carried out every 10 years, at least 11 cameras are necessary to carry out the work for 2,600 deep wells.

Including MMAyA that is in a position to manage and supervise the nationwide water supply services, there should be 10 organizations who are able to own the camera. If each organization owns a camera and is flexible to each other, it would be almost possible to carry out well diagnosis and rehabilitation for 2,600 wells every 10 years. If the organizations need a spare camera, it can be expected to sell 20 units for these ten organizations.

On the other hand, private well contractors are not entrusted with well diagnosis and rehabilitation by the above organizations. Well contractors will still need well camera even if the above organizations own their cameras. Water supply companies in urban areas would require of the well contractors for well diagnosis using camera if UNASBVIs often carry out the diagnosis for rural wells. The needs of well contractors for well camera would be boosted if diagnosis, verification of rehabilitation and completion inspection of new well are required by guideline or regulation. Activities to request MMAyA to issue the guideline or regulation should be continued.

As there are about 150 well contractors across the country, it might be possible to sell about 50 cameras if 30% of them start the technical services using well camera. Then it should be a mid- and long-term target to sell and disseminate 50 well cameras to the well contractors.

2) Assumed business plan and development effect

a. Implementation system to expand assumed overseas business

Basically, consignment through local sales agent is assumed, and new investment such as building a sales network by our own capital is not considered at this stage. For the time being we intend to proceed with business targeting public water supply organizations at national and prefectural level, and would like to actively participate in the bidding through the local sales agent.

b. Time schedule for dissemination of the product

＜year 2015～2018＞

Firstly, the sales system is developed with a formal sales agency agreement with a local partner. Within the year 2015, after-sales service system is established by training local partner for maintenance and inspection technology. Secondly specifications of the proposed product, i-Do300FII, are reviewed to lower the price in order to win the price competition with competing products, the design is changed and prototype is completed by around mid-2016.

Through 2016 to 2018, the proposal is submitted to JICA for the verification survey with the private sector for disseminating Japanese Technologies and the project is commenced when JICA entrusts implementation of the project to us. In this period, the sales of well camera are proceeded mainly to counterpart organizations like UNASBVIs. As the minimum number of well camera to inspect and diagnose about 2,500 wells across the country, two sets for each prefecture and for MMAyA, totally 20 sets of camera seem to be necessary. Thus, this should be the minimum sales target.

＜year 2019～＞

Based on the effectiveness and our achievements of a series of technological system from diagnosis to rehabilitation verified by the ODA project, sales to well maintenance sections of UNASBVIs who support rural water supply and sales to private contractors who have been awarded the sole contract for the maintenance of wells in urban areas by public water supply corporations will be emphasized

In parallel, sales to public sector and private sector (factories, farms, mines, construction companies, etc.) who use deep wells or carry out survey boring will be developed aiming the sales of other type of bore hole camera. Furthermore, sales channel will be developed toward the neighboring countries such as Peru or Paraguay.

c. Assumed development effect

The utilization of the proposed product will urge the well operators or administrators to carry out detailed functional diagnosis of wells and to integrate the experience in a manual, which helps them properly consider and plan the range/timing/method/cost of measures.

To exactly understand situation of well by diagnosis and inspection and to make it clear which measures should be taken including abandonment of well would make it possible to secure necessary volume of water even if the budget is limited and to realize proper maintenance of groundwater resources considering overdevelopment of groundwater. Especially, rural water supply services would be improved by the support of UNASBVI.

d. Prospect of local partners

As a local partner that acts as a sales agent, SUIGEN SRL headquartered in Santa Cruz de la Sierra City has been selected. SUIGEN SRL has originally engaged in the business of drilling and maintaining wells and facility construction. It employs 58 persons including full-time base eight engineers, three mechanics, five office clerks and other project-contract base staff. SUIGEN SRL is familiar with groundwater development and maintenance and has a network of the various agencies and private contractors related to the water supply business. SUIGEN SRL has business relations with some Japanese companies and served as a sales agent of the geological survey equipment. SUIGEN SRL is trusted by these Japanese companies.

In this survey period, SUIGEN SRL purchased a well camera and preparing for technical services of well diagnosis and rehabilitation using the camera. It is expected that they will get familiar with operation and maintenance of the well camera by using practically and they will become more reliable as a sales agent who is able to cope with minor repair at least.

3) Risks and Challenges in business development

Recent economic trends tend to raise import tariffs on machinery, which is also a risk of pushing up import prices. Leaving only essential functions as well camera, specifications will be reviewed to lower the current price to the extent that beat the price competition with other products.

For the response to equipment failure, the proposed product has been evolving through the years from the development in 2002, very small equipment failure occurs. Although the risk seems to be lower as far as the well camera is normally used and maintained, it should be considered to let the staff of the sales agent receive the training program and to build the local repair system to cope with failure to some extent in Bolivia.

Feasibility Survey with the Private Sector for Utilizing Japanese Technologies in ODA Projects
Bolivia, Well Life Extension Survey Utilizing Well Diagnosis Technologies

SMEs and Counterpart Organization

- Name of SME: Raax Co., Ltd.
- Location of SME: Sapporo City, Hokkaido, Japan
- Survey Site/Counterpart Organization: Prefectures of La Paz, Santa Cruz and Oruro / Ministry of Environment and Water, Prefectural units for water, basic sanitation and housing (UNASBVIs) and Social public enterprise for water and sanitation (EPSAS) of La Paz and El Alto



Concerned Development Issues

- Insufficient water supply and improper maintenance and management of facilities which has reduced the functions of wells
- Inadequate water supply services in peri-urban areas due to intense influx of population from rural areas
- Bolivia is susceptible to climate change due to its complex terrain and it has become difficult to secure water sources in many areas due to retreat and disappearance of glaciers, which need urgent measures on effective use of water sources.

Products and Technologies of SMEs

"Borehole Camera"

- To diagnose inside of well observing image or video
- To identify clogging or damaged parts and cause of dysfunction of well
- To confirm the effect of repair work to the eye
- In terms of measurable depth, operability and image quality, it is superior to other products.
- High technical reliability is certified by the fact that It has been adopted in various fields of many countries.

Proposed ODA Projects and Expected Impact

- Through the Verification Survey with the Private Sector for Disseminating Japanese Technologies , effectiveness of well diagnosis using well camera and selection of rehabilitation method based on the diagnosis is demonstrated and the techniques are transferred to the well administrators across the country in Bolivia.
- Through the Verification Survey with the Private Sector Disseminating Japanese Technologies , a series of techniques of well diagnosis → selection of rehabilitation method → rehabilitation is integrated in a manual and transferred to the Bolivian side, which becomes a trigger for dissemination of the proposed product.

Future Business Development of SMEs

Based on the verification by ODA projects, the sales will be strengthened to nationwide water supply authorities and water supply operators and private contractors. In parallel, the sales will be expanded to other sectors (factories, farms, mines, etc.) in Bolivia and to neighboring countries (Peru, Paraguay, etc.).