Table 11.2 **Summary of Environmental Assessment in the Groundwater Development Project**

		HYDROGEOLOGIC UNIT				
INFLUENCE		Qt,Qf	Ep,Eh	Ba1	Ba2,Ba3	Et
Transimissivity (m^2/day)		22.4	11	3	770	37
Storativity (dimension less)		0.05	0.05	0.1	0.2	0.05
Declinning of Water Levels*(m)		0.20	0.83	1.91	0.013	0.28
Radius of influence circle (m)		27.7	25.4	12.1	166	29.5
Water Balance		Balanced	Balanced**	Balanced	Balanced	Balanced
Contamination	Fe&Mn	No	No	Possible	Slightly Possible	No
	Cl	No	Possible	No	No	No
Land Subsidence		No	No	No	No	No

* Calculated drawdown at the hand pump well in 10 m^3/day of pumping for 12 hours at an average aquifer constant of each hydrogeologic unit.

** Water is balanced in the entire groundwater basin,however, there is some possibility of unbalance in the vicinity of the well, particularly, in the hydrogeologic unit Ep and Eh.

CHAPTER 12 CONCLUSIONS AND RECOMMENDATIONS

CONTENTS

CHAPTER 12 CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

(1) Groundwater development

Alluvial sand, Jurassic shale and sandstone, basalt and Triassic tuff constitute the productive aquifers in the Study Area. Groundwater is contained in the intergranular space and the fissure of these formations. The sustained yield of the groundwater basin is estimated to be 575 m^3/day/km^2 in erosional plain of Jurassic formation and 1,370 m^3/day/km^2 in the Basalt Slope (for the 1994-1995 hydrological year).

The optimum yield of a 50-m depth, 6-inch diameter well is estimated as follows: for the alluvial plain: 90-260 l/min, for the Basalt Slope (Ba1 area): 14-88 l/min, for Ba2 area: 1,200-1,800 l/min, for the Ba3 area: 185 l/min, and for the Triassic tuff: 22-90 l/min.

(2) Water supply program

Judging from the groundwater potential of the Study Area, a groundwater water supply for 200 villages is possible. The proposed water supply program, serving a population of 131,789 and supplying 40 lpcd by the target year-2005, plans to construct 486 water supply systems consisting of 485 deep wells equipped with hand pumps and one deep well equipped with a submersible pump, and two maintenance centers. The projcet cost is estimated at Yen 1,726 million.

(3) Project evaluation

It is expected that the project will improve the health and sanitary conditions of the villagers and save the time spent for water collection. The saved time can be utilized for farming activities. The economic benefit of the time saving is estimated at Kip 869 per person per day, and the reduction of medical expenses is estimated at Kip 4,500 per person per year. Considering these factors, a benefit and cost analysis revealed that the project is feasible. The supplied water can also be used for irrigating backyard crops and fruit trees, feeding livestocks and brewing. These activities will eventually raise the village economy.

(4) Environmental impact assessment

The environmental impact caused by the project will be very small in the entire groundwater basin. However, new well locations have to be determined considering the existing wells. The intrusion of salinity-high and iron-manganese-rich groundwater must be prevented in the new wells.

12.2 Recommendations

(1) Earlier implementation of the project

This project of groundwater development will drastically improve the water supply situations

of the 200 villages in Champasak and Saravan Provinces. The project is important since it will become a model of goundwater-based rural water supply development in Laos. Since the supply of clean water is one of the basic human needs, it will benefit and contribute greatly to the rural community in the long term. It will also create a healthy and sanitary environment in the villages, which is the basis of rural develoment. Earlier implemention of the project is, therefore, strongly recommended.

(2) Utilization of hydrogeological map and investigations

It is desirable that the groundwater development be carried out by using the hydrogeological map prepared by the Study Team. The drilling location should be determined based on the geological reconnaisance survey and geophysical explorations. Prior to these surveys, hydrogeological information can be obtained from the hydrogeological map. The hydrogeological data obtained during well construction should be recorded and input to the database prepared by the Study Team.

(3) Monitoring and management of water quality

The contamination caused by human and livestock occurs locally in the existing water sources. The concentrations of iron and manganese in groundwater also exceed the WHO standard, though it does not immediately affect human health. However, periodical monitoring of water quality is strongly recommended. In the groundwater development program, basic water quality items should be analyzed, and the treatment system, such as a simple sand filter, should be installed in some cases.

(4) Establishment of the maintenance center

The proposed maintenance centers provide preventive and curative maintenance services and supply of spare parts to ensure the operation and maintenance by the village people themselves. When this center is established and guarantees the repair of the water supply system, the consciouness of the village people on maintenance will be raised.

The maintenance center should have a permanent staff, guide the management of the water users' association, and organize a mobile maintenance team. The mobile team periodically visits the village, checks and repairs the system with charge. It should grow in number by training the village caretaker during visits using practically the Well Maintenance Text Book prepared by the Study Team.

APPENDIX

TEXT OF HAND PUMP MAINTENANCE

ອົງການຮ່ວມມືສາກົນຍີ່ປຸ່ນ (JICA)

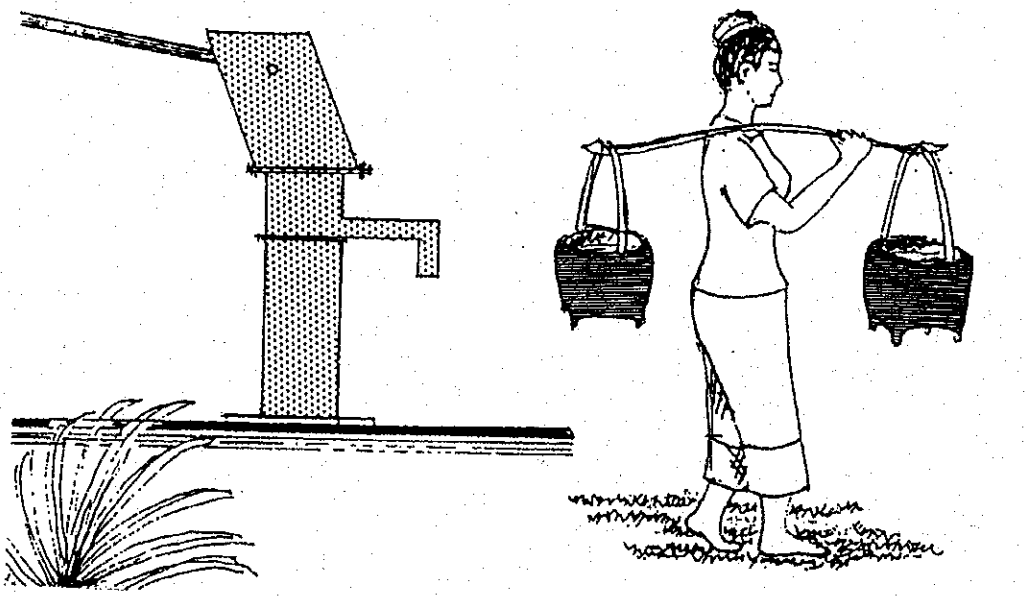
Japan International Cooperation Agency (JICA)

ຄູ່ມືການບຳລຸງຮັກສານ້ຳບ່ໍ

Text of Hand pump Maintenance

ສຳລັບຜູ້ຮັກສາຂັ້ນໝູ່ບ້ານ

for Village Caretaker



ສະຖາບັນອານາໄມ ແລະພະຍຸສາດ

National Institute of Hygiene and Epidemiology

ກະຊວງສາທາລະນະສຸກ ສ.ປ.ປ ລາວ

Ministry of Health, Lao P.D.R.

ແລະ

and

ອົງການຮ່ວມມືສາກົນຍີ່ປຸ່ນ

JICA Study Team

ຄຳນຳ

PREFACE

ການຈັດພິມປຶ້ມຄູ່ມືການນຳໃຊ້ນ້ຳນີ້ ຖືວ່າເປັນການຈັດພິມຄັ້ງທຳອິດ ໂດຍໄດ້ຮັບການອຸປະຖຳຈາກ ອົງການຮ່ວມມືສາກົນຍີ່ປຸ່ນ (JICA) ເພື່ອແນໃສ່ຮັບໃຊ້ໃຫ້ແກ່ຜູ້ທີ່ໄດ້ນຳໃຊ້ ບົວລະບັດຮັກສາ ແລະ ສ້ອມແປງຂັ້ນໝູ່ບ້ານ ກໍຄືບັນດາສຳນັກງານອົງການທີ່ມີສ່ວນ ກ່ຽວຂ້ອງ ແລະປະຊາຊົນຜູ້ນຳໃຊ້ມີຄວາມເຂົ້າໃຈໃນການນຳໃຊ້ ບົວລະບັດ ຮັກສາ, ສ້ອມແປງໃນຂັ້ນພື້ນຖານ.

ພວກເຮົາຫວັງວ່າ ປຶ້ມຫົວນີ້ຈະສາມາດອຳນວຍຄວາມສະດວກ ແລະມີຄຸນປະໂຫຍດມາສູ່ພວກທ່ານ ບໍ່ຫຼາຍກໍໜ້ອຍ ພ້ອມນີ້ກໍສະເໜີມາຍັງທ່ານ ທັງໄດ້ໃຫ້ການແນະນຳ ແລະ ຕຳນິຕິຊົມ ເພື່ອຈະໄດ້ນຳໄປ ປັບປຸງ ແກ້ໄຂໃນຂັ້ນຕໍ່ໄປ.

This well maintenance text book was prepared by the JICA Study Team to provide a guideline for the hand pump system in the villages.

ພ້ອມນີ້ ກໍຖືໂອກາດສະແດງຄວາມຊົມເຊີຍຕໍ່ຄະນະຮຽບຮຽງປຶ້ມ ແລະນັກວິຊາການອຸໂກ ໂຄງການ ຈັດການນ້ຳສະອາດ ທີ່ໄດ້ຊ່ວຍສະໜອງບາງຂໍ້ມູນເຂົ້າໃນປຶ້ມຫົວນີ້ ພ້ອມນີ້ ກໍຂໍຂອບໃຈຢ່າງສູງຕໍ່ ອົງການຮ່ວມມືສາກົນຍີ່ປຸ່ນ ທີ່ຊ່ວຍອຸປະຖຳໃນການພິມໃນຄັ້ງນີ້ ໃຫ້ສຳເລັດພົ້ນໄປດ້ວຍດີ.

We wish to express our sincere thanks to the officials and personnel concerned of the Lao P.D.R.

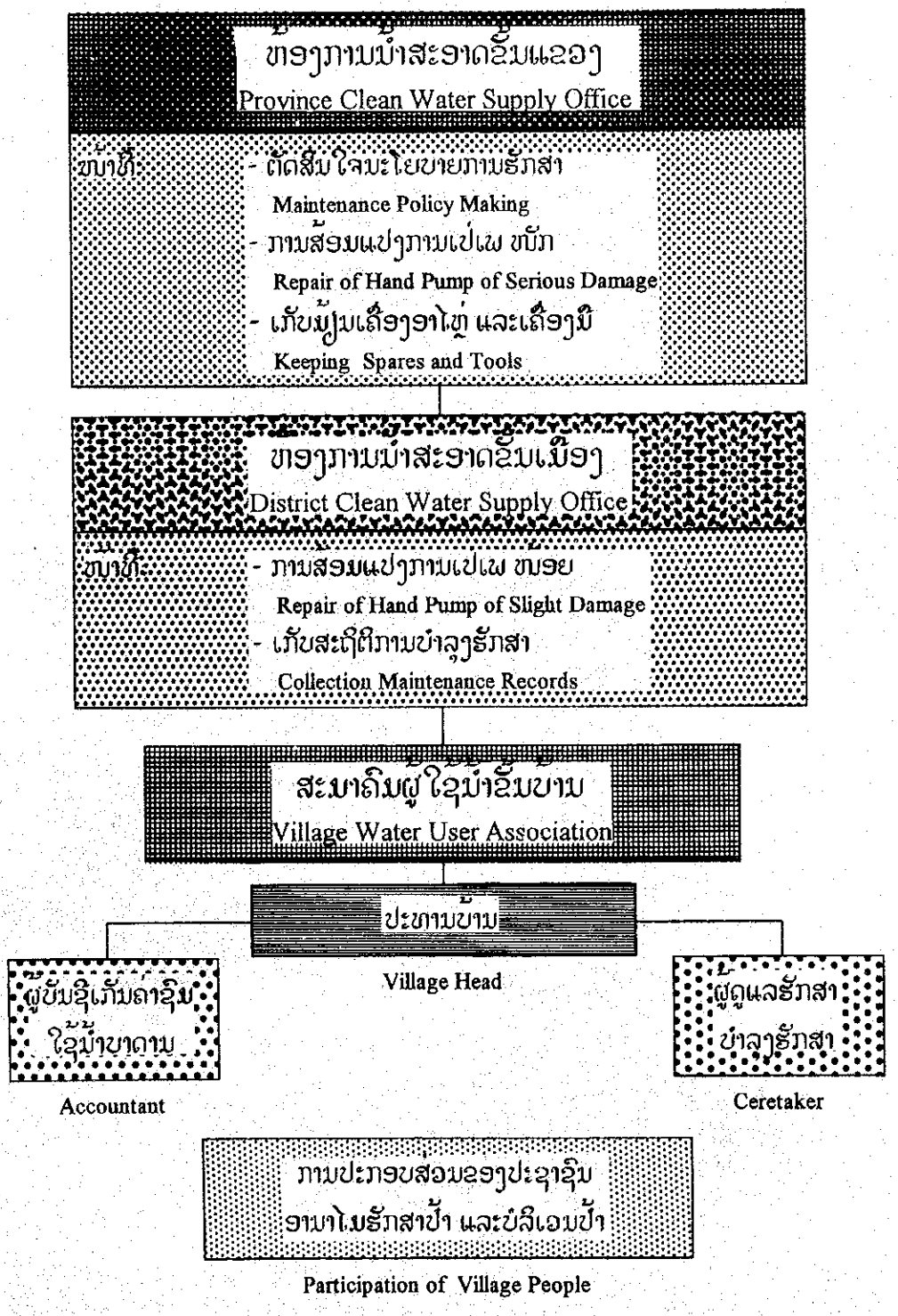
ຈັດທຳໂດຍ:

ຄະນະສຳຫຼວດຂອງ JICA 1995
The JICA Study Team. 1995.

ສາລະບານ

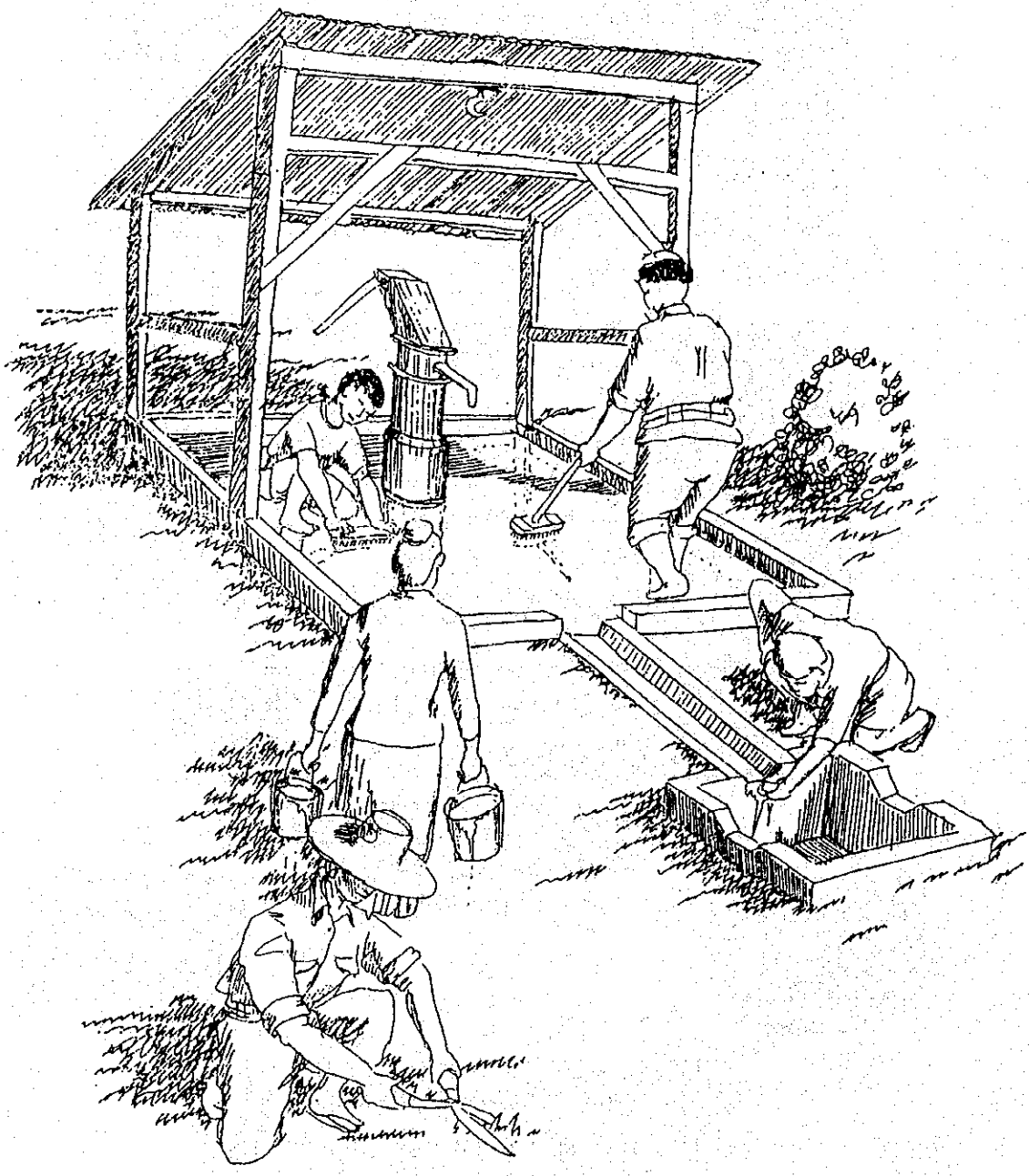
CONTENTS

ໂຄງຮ່າງສາຍການຈັດຕັ້ງ ແລະວິທີການບຳລຸງຮັກສາ
MAINTENANCE POLICY AND ORGANIZATION



• ການໃຫ້ການຮັກສາບໍລິເວນຂອງປ້ຳນ້ຳສະອາດ

KEEP THE PUMP ENVIRONS CLEAN



• ການກວດກາປະຈຳວັນຂອງປ້ຳມ້ຳ

DAILY CHECKING OF THE HAND PUMP

- ກວດເບິ່ງວ່າ:

Check:

1. ການນຳໃຊ້ປ້ຳໄດ້ຍາກ ຫຼືງ່າຍ.

The handle is easy or difficult to operate.

- ໜັ້ນໃສ່ນ້ຳມັນເຄື່ອງ.

If not, Lubricate it by applying grease.

- ກວດເບິ່ງນ໊ອດ, ຕະປູກຼ໋ອ ແລະໂສ້, ຄວນຈະປ່ຽນຖ້າມີການຫຼ້ຍຫ້ຽນ ຫຼືເປ່ເພ.

Check all nuts, bolts and chain, replace them if worn out / damaged parts are found.

2. ກວດເບິ່ງການໄຫຼຂອງນ້ຳຟຸ່ງພໍຕາມຄວາມຕ້ອງການ.

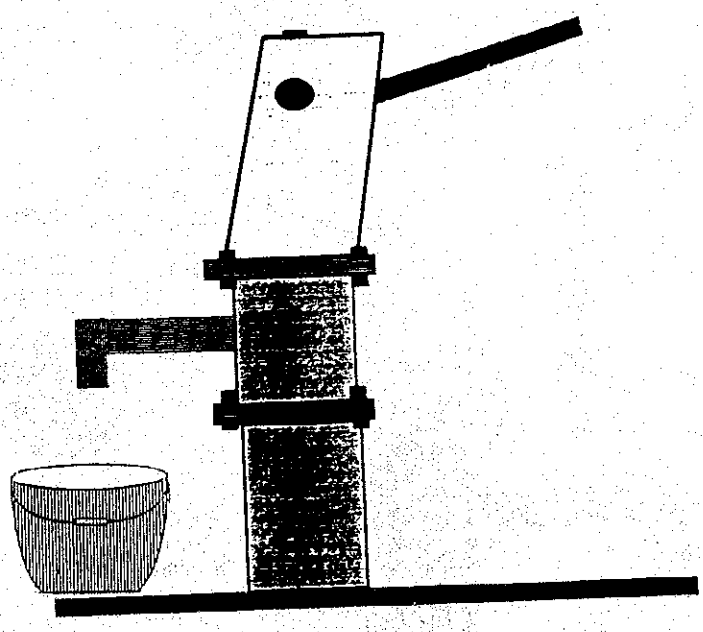
Water discharge is satisfactory.

- ທຳມະດາ, ໜ້ອຍ, ຊ້ຳ ຫຼື ຢຸດ.

If it is little, delayed or stopped, check the cylinder component by yourself.

- ຖ້າຊ້ຳ ຫຼືຢຸດ ໃຫ້ກວດກາລູກສູບດ້ວຍຕົນເອງ ຫຼືຂໍຄວາມຊ່ວຍເຫຼືອຈາກ ພາກສ່ວນທ້ອງການ ນ້ຳສະອາດ ເພື່ອສ້ອມແປງ.

Ask the District Clean Water Supply Office for repair.



• ການປ່ຽນອາໄຫ່ໃຫ້ຫົວນ້ຳ

REPLACING SPARES FOR PUMP HEAD

- ນ້ຳງຝາແລະກວດເບິ່ງນ໊ອດ, ຕະປູກຸງແລະໂສ້

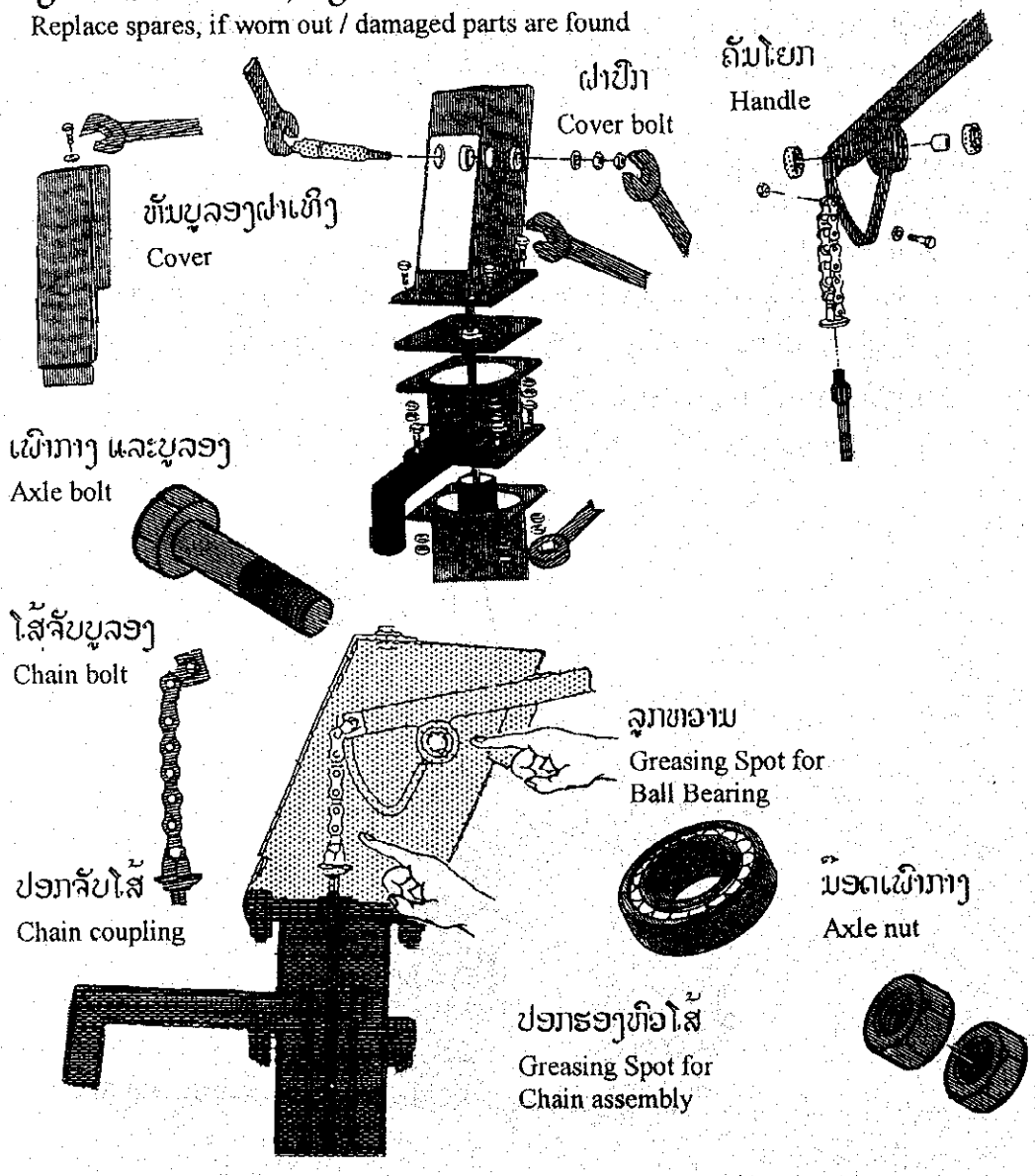
  Dismantle the cover of pump and check all nuts, bolt and chain

- ເອົານ້ຳມັນເຄື່ອງໃສ່

  Lubricate them by applying grease

- ປ່ຽນອາໄຫ່ຖ້າເປ່ເພ ຫຼືຫຼຍຫ້ຽນ

  Replace spares, if worn out / damaged parts are found

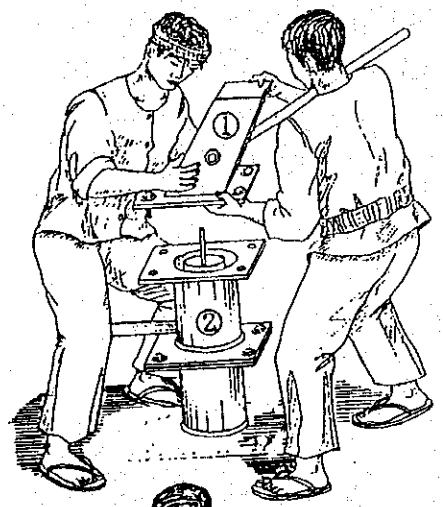


• ການປ່ຽນລະບົບອາວຸ່ມ (1)

PULLING UP OF THE PUMP ROD (1)

ການປ່ຽນວາວ Indian-Mark (3) ແມ່ນບໍ່ຈຳເປັນຖອດທໍ່ສູບນ້ຳ (Riser Pipe) ອອກ.

The valve of Indian Mark (3) can be replaced without pulling out Riser Pipe

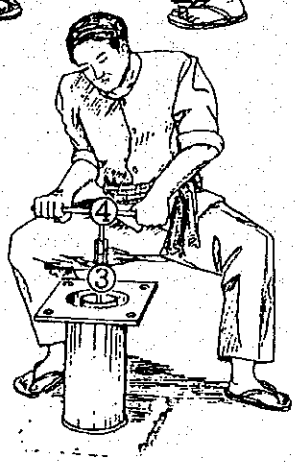


ວິທີປ່ຽນວາວ

Valve replacing procedure

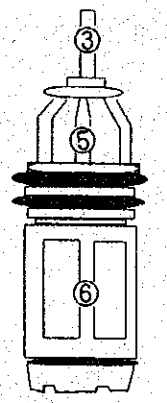
1. ເອົາຫົວປ້ຳ ① ອອກຈາກຕົວປ້ຳ ②

Pump head ① is removed from pump body ②



2. ເອົາຄັນສູບ ③ ຕໍ່ເຂົ້າກັບຄັນໂยກ ④

Rod Lifter ④ is connected with Pump rot ③

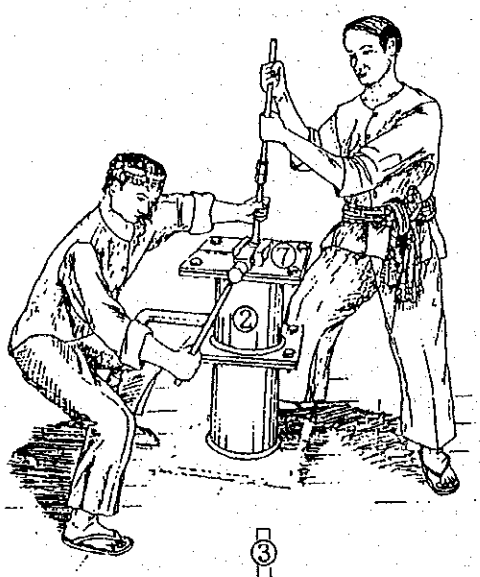


3. ໝຸນຄັນຍົກ ④ ໄປເບ້ຶ້ອງຊ້າຍ ແລ້ວ ຍົກຂຶ້ນຢູ່ໃນການປະກອບຂອງລູກສູບ ເຮົາຈະເຫັນສີ່ມສ່ອມຂອງຫົວວາວ⑤ ແລະກົ້ນວາວ ⑥

When rot lifter ④ is rotated left Upper valve ⑤ and Under valve ⑥ connected in Cylinder assembly

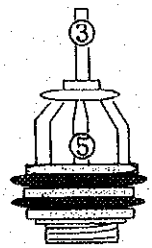
• ການປຸ່ມລະບົບອາອລຸ່ມ (2)

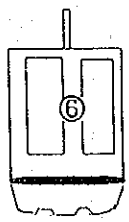
PULLING UP OF THE ROD (2)



4. ເອົາແຜ່ນຮອງຄັ້ນປ້ຳ ⑦ ຕິດຕັ້ງເທິງ ຫົວປ້ຳ ② ຫຼັງຈາກນັ້ນຍົກຄັ້ນປ້ຳຂຶ້ນ

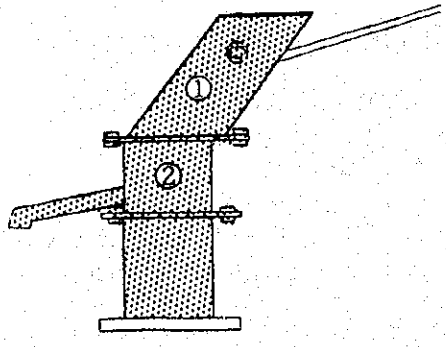
Put the Rod Vice ⑦ on the Pump Body ② and pull up the Rod





5. ກວດກາເບິ່ງຫົວອາອ ⑤ ແລະກົ້ນ ອາອ ⑥ ຖ້າອ່ຳຫຼ້ຍຫຸ້່ມແລ້ວຕ້ອງ ປຸ່່ນອາໃຫ່ໃຫ່ມ

Upper Valve ⑤ and Under Valve ⑥ are checked. If Valve worn out, replace new valves



6. ເອົາຫົວປ້ຳ ① ຕິດຕັ້ງໃສ່ເທິງຫົວ ປ້ຳ ②

Pump head ① is installed at Pump body ②

• ການປ່ຽນອາໄຫ່ອາອຂອງນ້ຳ

REPLACING SPARES FOR PUMP VALVE UNIT

* ຕ້ອງນ້າງປ້ານື ແລະດຶງຄັນປ້ຳຂຶ້ນພ້ອມດ້ອຍລູກສູບ

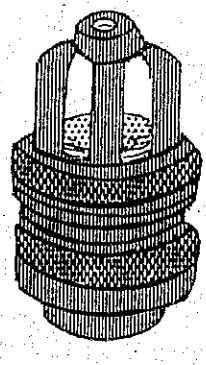
  You have to dismantle hand pump and pull up pump rod with cylinder assembly

* ຖ້າບໍ່ຊຳນານ, ຕ້ອງໃຫ້ທີມ (ຄະນະ) ບຳລຸງຮັກສາຂອງເມືອງ ມາຊ່ວຍ

  If you are not trained, you have to ask maintenance team of the District Clean Water Supply Office for repair

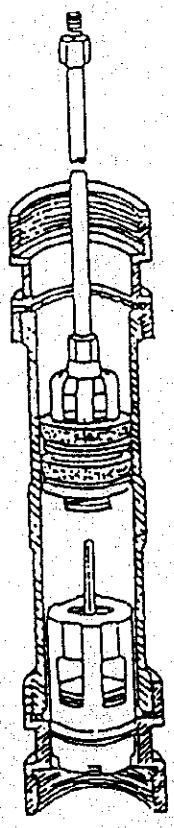
ລະບົບອາອັດນ້ຳເທິງ

Upper Valve Assembly



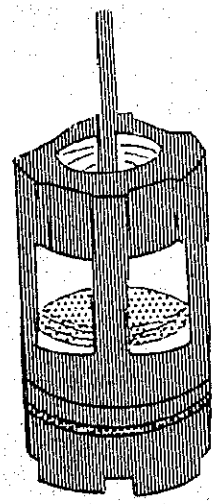
ກ້ານສູບ

Cylinder Assembly



ລະບົບອາອັດນ້ຳລຸ່ມ

Check Valve Assembly

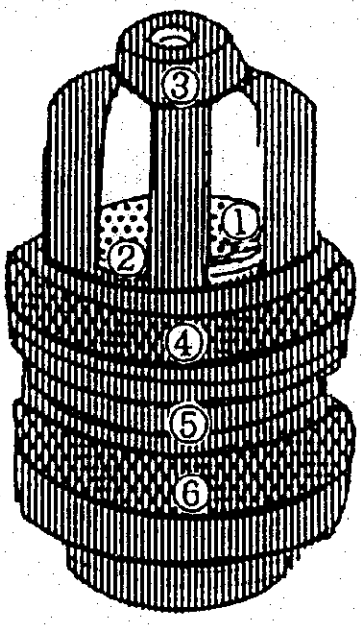


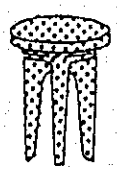
• ລະບົບອາອັດນ້ຳເທິງ

UPPER VALVE ASSEMBLY

ລະບົບອາອັດນ້ຳເທິງ ແລະ ຫ້ອຍ1ງ

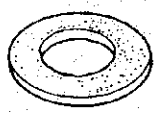
Upper Valve Assembly





① ອາອສິ1ງນ້ຳເທິງ

Upper Valve Guide



② ກ້ອນຢາ1ງອັດນ້ຳເທິງ

Rubber Seating

③ ຂອັນຕ່ຳກ້ານສູບ

Plunger Yoke Body

④ ຝ1ຍສູບ

Pump Bucket

⑤ ຫວ່1ງຝ1ຍສູບ

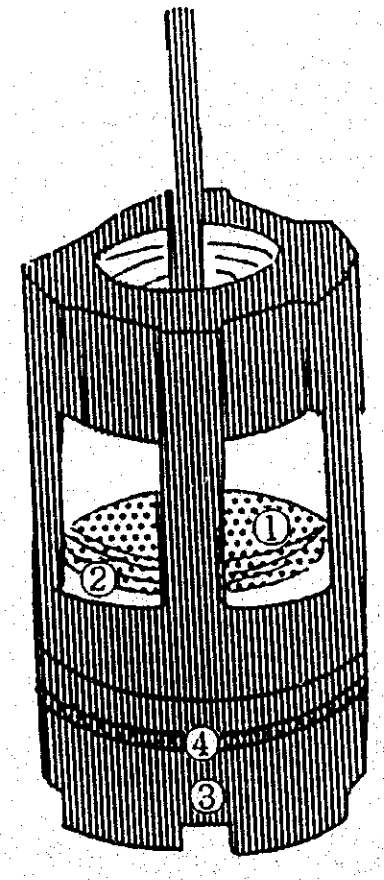
Spacer

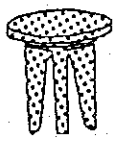
⑥ ຝ1ຍສູບ

Pump Bucket

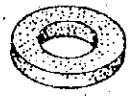
• ລະບົບອາອັດນ້ຳລຸ່ມ
CHECK VALVE ASSEMBLY

ລະບົບອາອັດນ້ຳລຸ່ມ ແລະ ຫົ້ອຢາງ
Check Valve Assembly

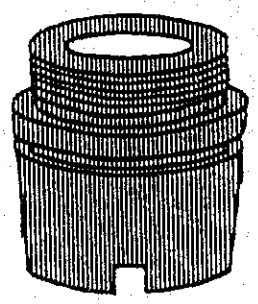




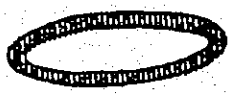
① ອາອສີ່ງນ້ຳລຸ່ມ
Check Valve



② ກ້ອມຢາງອັດນ້ຳລຸ່ມ
Rubber Seating



③ ສີ້ນອາອັດນ້ຳລຸ່ມ
Check Valve Guide



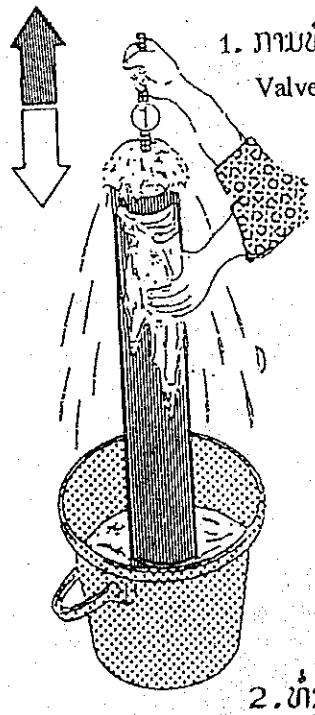
④ ວົງແຫວນອັດນ້ຳລຸ່ມ
0 Ring for Check Valve

• ວິທີທົດລອງເບິ່ງວາວ ແລະ ທໍ່

METHOD OF VALVE AND RISER PIPE TEST

1. ການທົດລອງວາວ

Valve Test

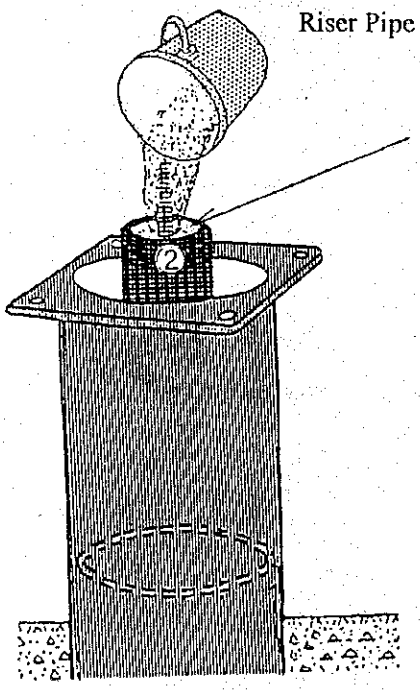


- ດຶງ ແລະຍູ້ຄັນສູບວາວຂຶ້ນລົງ 2-3 ເທື່ອຢູ່ໃນຖັງນ້ຳ ຫຼືຄຸເພື່ອທົດລອງເບິ່ງການດູດໄດ້ດີຫຼືບໍ?
- ໃນກໍລະນີທີ່ນ້ຳບໍ່ຂຶ້ນ ໃຫ້ກວດເບິ່ງວາວ

- Stroke the pump rod ① put in a bucket to test whether water coming up or not.
- In case water does not come up, wash check valve

2. ທໍ່ນ້ຳປ້ຳ

Riser Pipe Test



- ຕື່ມນ້ຳໃຫ້ເຕັມໃນທໍ່ນ້ຳຂຶ້ນ
- ປະໄວ້ປະມານ 1 ຊົ່ວໂມງຖ້າລະດັບນ້ຳຕົກຕ່ຳ ໝາຍຄວາມວ່າ ນ້ຳຮົ່ວອອກຈາກທໍ່ ນ້ຳປ້ຳ

1) Fill water into the Riser Pipe ②
2) Watching water level for 1 hour

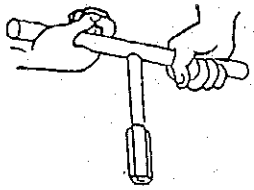
- If water level decline, water leaks from the Riser pipe joint

• ອຸປະກອນເຄື່ອງມືທີ່ສຳຄັນປະຈຳໝູ່ບ້ານ

LIST OF MAIN TOOLS

ຂອງດຶງຈັບເສັ້ນຕີ

Rod Lifter



ກະແຈປາກຕາຍ

19 - Spanner

ປອກຮອງຫົວໂສ້

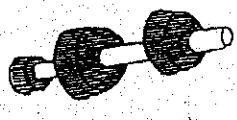
Chain Coupler

ກະແຈເລື່ອນ

Spanner

ອຸປະກອນປຸ່ມລູກຫ່ອ່ານ

Bearing mounting tool

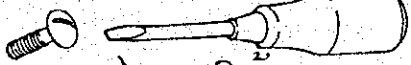


ກະບອກກ້ານສູບ

Rod Vice

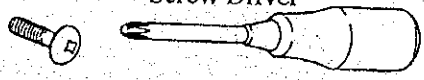
ໄຂຄວງຫົວແປ

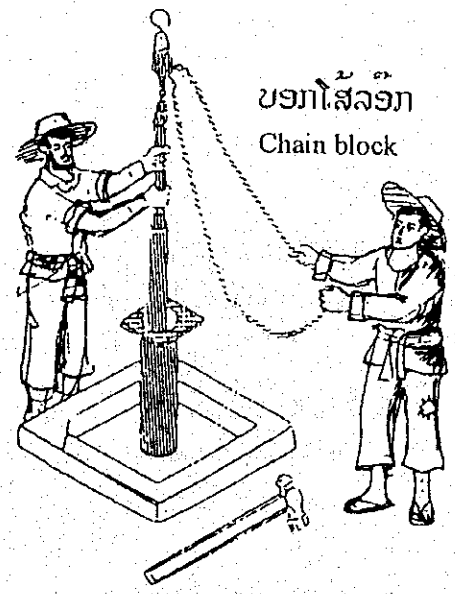
- Screw Driver



ໄຂຄວງຫົວຈຸ່ມ

+ Screw Driver





ບອກໂສ້ລ໊ອກ

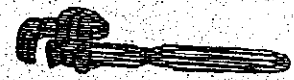
Chain block

ເຄື່ອງດຶງອາອຸ່ມ

Valve lifting adapter

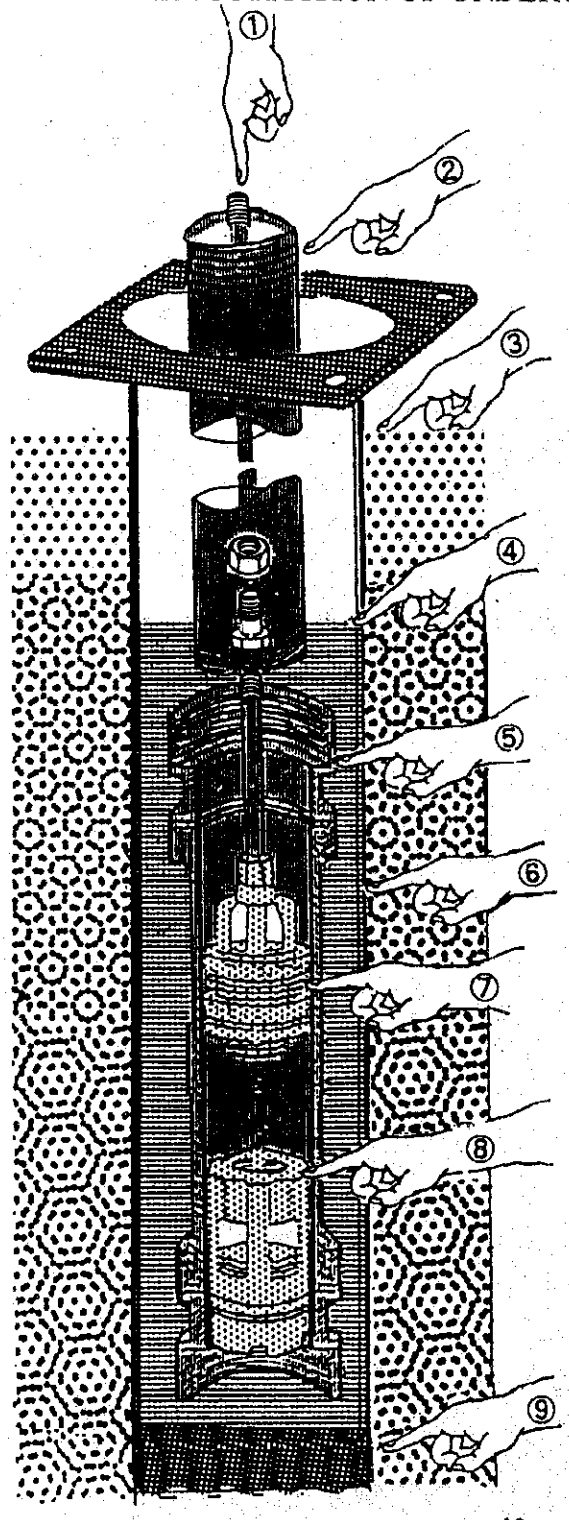
ກະແຈປາກແຂ້

Pipe Wrench



• ຮູບສະແດງຂອງປ້ຳຢູ່ໃນນ້ຳສ້າງ

ILLUSTRATION OF UNDERGROUND PUMP PART



① ກ້ານສູບ
Plunger Rod

② ທໍ່ສົ່ງນ້ຳ
Riser Pipe

③ ລະດັບດິນ
Ground Level

④ ລະດັບນ້ຳ
Water Level

⑤ ບ່ອນຕໍ່
Cylinder assembly

⑥ ຮູສົ່ງ
Casing Pipe

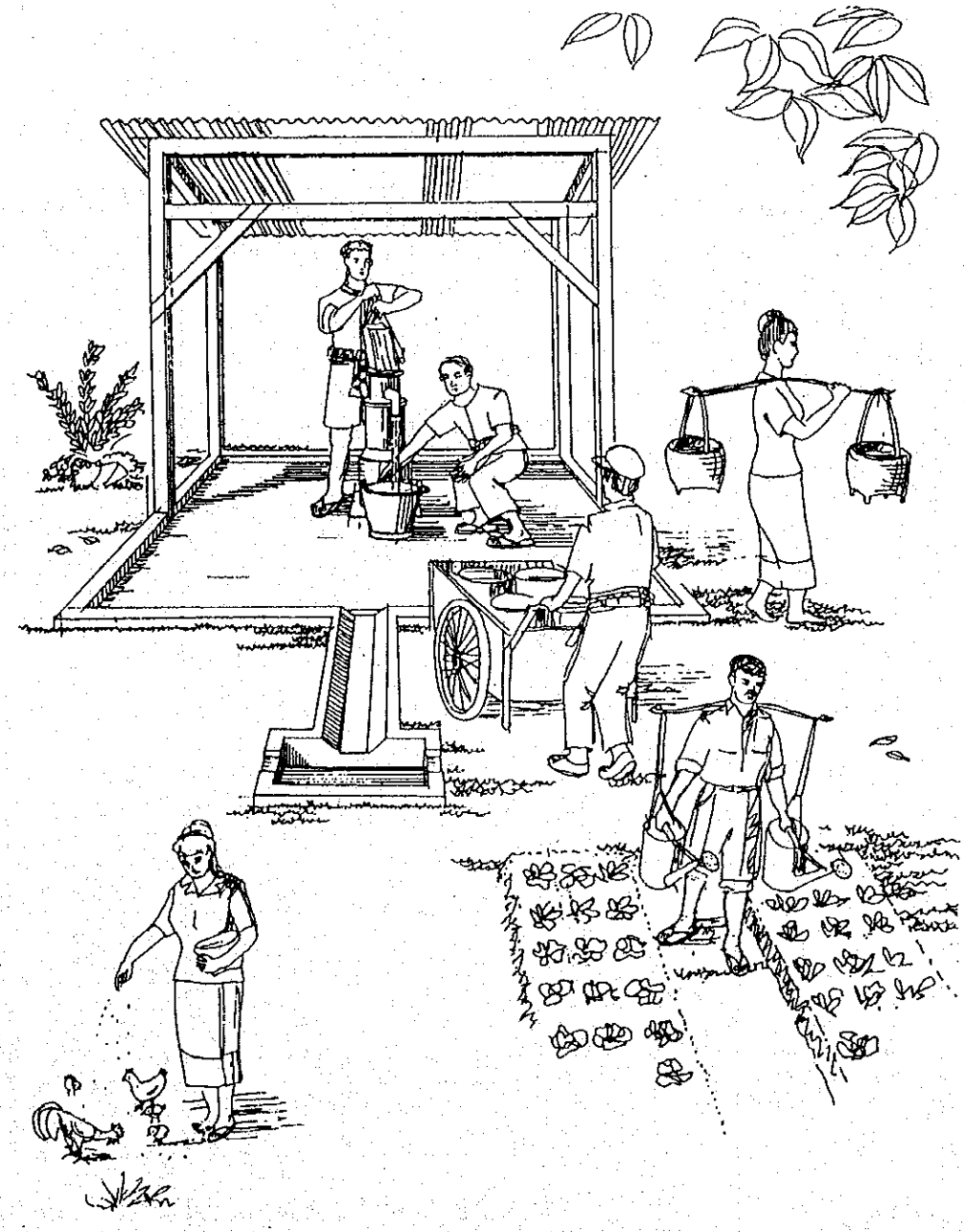
⑦ ຫົວອາວເບ້ຍງເທິງ
Upper valve assembly

⑧ ລະບົບວາວຮັດນ້ຳລຸ່ມ
Check valve assembly

⑨ ຕະແກງ (ແຜ່ນກັ້ນ)
Screen

• ຮູບສະແດງຂອງການນຳໃຊ້ນ້ຳ

ILLUSTRATION OF WATER USE



• ສະຖິຕິການບຳລຸງຮັກສາ
MAINTENANCE HISTORY

ຊື່ບ້ານ :..... ເມືອງ :.....
Name of village District
ແຂວງ :..... ຜູ້ຮັກສາ :.....
Province Care taker

ວັນທີ່ເກີດບັນຫາ Date of occurrence of fault	ວັນສ້ອມແປງ Date of repair	ມູນຄ່າການສ້ອມແປງ Cost of repair	ບ່ອນເປ່ເພ Type of fault	ຜູ້ສ້ອມແປງ By whom repaired

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