A STUDY ON DRIVING FORCES BEHAIND THE SUCCESSFUL DEWORMIN IN KOREA:

FOREIGN AID, GOVERNMENT OWNERSHIP, AND SANITARY CONDTIONS

By

Ji-Yeun Park

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
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ABSTRACT

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Nowadays, deworming is an urgent issue in many developing countries. This is largely because parasitic diseases threaten people in that they adversely affect the proper functioning of organs and can even take a human life, even slowing down further economic progress while weakening human capital. To this day, it is generally accepted idea that there is causal relationship between economic progress and deworming. In other words, as capita per income increases, sanitation and hygiene levels are improved, which in turn lower parasite infection rate. In this respect, the case of Korea's deworming is unique because Korea completed its deworming program in the late 1970s at a time when Korea was still an impoverished country with a per capita income of just US $ 1,729. It means that deworming in Korea was not a result of its economic progress. Then, how could Korea eradicate parasitic diseases in a very short period of time regardless of its poor economic conditions? Foreign aid played a significant role in launching deworming project. More importantly, Korea had improved sanitation conditions through the New Village Movement in the early 1970. The New Village Movement ignited the general public's desire for environmental cleanup by providing incentives based on merit-based approach. On top of that, under the strong governmental ownership, Korea could effectively allocate limited resources into the New Village Movement, and it maximized deworming impacts dramatically. Furthermore, it has been found that deworming had significantly positive impacts on public health in Korea.

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I. INTRODUCTION

Many developing countries today suffer from chronic parasitic diseases. Interestingly, they have far lower level of economic progress than areas where parasitic diseases are rare. Indeed, parasitic diseases are concentrated in less developed areas such as sub-Saharan African, Latin America and South-East Asia. A careful analysis of parasitic diseases distribution trends indicates that there is a certain correlation between the incidence of parasitic diseases and the level of economic progress. This leads us to a natural question: how do parasitic diseases hold back economic progress in developing countries?

At the outset, it is imperative to clarify what I mean when I talk about parasitic diseases. Parasitic diseases are illnesses caused by infection with parasites such as protozoa (one-celled animals), worms, or insects. They include malaria and schistosomiasis, the world's most common serious infectious diseases. To be specific, parasitic diseases threaten people in that they adversely affect the proper functioning of organs and can even take a human life. In particular, parasitic diseases are especially widespread among children. In the human capital side, they can cause children to suffer impaired physical and intellectual development. This point has significant meaning because human capital is one of critical factors for economic progress. Therefore, the answer to the above question might lie in the multiple correlations between parasitic diseases, deteriorating quality of public health and sluggish economic growth; parasitic diseases may have a negative impact on public health, which in turn causes poor human capital that would retards economic growth. In short, parasitic diseases directly affect humans and indirectly hold back economic growth. It is the primary reason why parasitic diseases have becoming a major obstacle in promoting economic progress. As such, no one would oppose the necessity of deworming project in less developed countries with

serious parasitic diseases, as it has been widely reported that deworming has a high social return.[1]

Then, what conditions would be needed for achieving deworming? Previous studies have pointed out that economic growth, which causes improvements in sanitation and personal hygiene, is a prerequisites for deworming.[2] At first glance, this seems logically rigorous — deworming can be accomplished through economy growth. However, even if we assume that it is true, there is one country that did not follow such common pattern of deworming process.

The case of Korea's deworming is unique because Korea completed its deworming program in the late 1970s at a time when Korea was still an impoverished country with a per capita income of just US $ 1,729. Most intriguingly, it took Korea only approximately 10 years to complete its deworming program. Korea had been an endemic zone for parasitic diseases until the 1960s due to its poor economic conditions. However, after the early 1970s, Korea's parasite infection rate rapidly decreased, and now it is extremely difficult to find individuals suffering from parasitic diseases. These facts clearly infer that deworming in Korea was not the result of economic progress, which is why we should pay attention to the Korean case.

Then, how could Korea eradicate parasitic diseases in such a short period of time despite of its poor economic condition? First, Korea could eradicate parasites by obtaining

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[1] Social benefit cost ratio for deworming investment would be massive: 245.9 for the returns in terms of earnings and 145.9 in terms of wage productivity (Sarah Baird et al.(2011)) A fuller social benefit-cost calculation would consider general equilibrium effects in the labor market of boosting productivity among younger cohorts, for instance, on the outcomes of older cohorts. The general equilibrium effects will depend on the degree and speed of aggregate physical capital accumulation in response to human capital gains (Duflo 2004), as well as the magnitude of any positive human capital spillovers across neighbors and coworkers (Moretti 2004, Mas and Moretti 2009). Duflo (2004) finds mixed impacts on the cohorts too old to have directly benefited from the 1970's school construction program in Indonesia, with positive gains in labor market participation but some moderate drops in wages among those working.

[2] Muchiri, Ouma, and King (1996) find that school children account for 85 to 90 percent of all heavy schistosomiasis infections in nine eastern Kenyan villages. Moreover, conditional on infection levels, children are most likely to spread worm infections because they are less likely to use latrines and more generally have poor hygiene practices (Ouma (1987), Butterworth et al. (1991)).

enough financial resources through foreign aid. Most parasite control programs in developing countries encounter serious problems at the initial stages Such as difficulties securing financial resources. Korea was able to establish groundwork for its deworming project by means of foreign aid. More importantly, the government's New Village Movement focused on improving sanitation conditions, accelerating the deworming process. While Korea had struggled to improve sanitation conditions in the early 1970, the New Village Movement fuelled the general public's desire for sanitary environmental conditions by providing incentives around a merit-based approach. On top of that, through strong governmental backing, Korea was able to maximize the effectiveness of the New Village Movement by preventing corruption and stimulating a spirit of self-reliance/self-help. As such, regardless of its economic progress, Korea improved its sanitation conditions remarkably through the New Village Movement, which played a decisive role in Korea's parasite control program by eliminating parasitic diseases in the countryside and cities.

The most notable change to Korea brought about the parasite control programs lies in the public heath level. Chai (2011) contends that there were several benefits caused by deworming. First, deworming had a positive impact on children's physical development in Korea. Second, deworming led to higher levels of nutrition and health. Third, deworming was also accountable for decreased in biliary and other complications of ascariasis. Lastly, he argues that deworming played a significant role in increasing life expectancy even though it is difficult to directly clarify its impacts in this area.

The purpose of this paper is both to clarify the driving force behind deworming by analyzing Korea's successful parasite control experience and to offer information about the impacts of dewomring.

The remainder of the study is organized as follow. Section 2 provides the previous studies, Section 3 develops historical context of the deworming process in Korea. Section 4

describes the empirical data dealing with the correlation between both improved sanitation facilities and drinking-water resources and parasite infection rate, proving the importance of sanitation policies for deworming. Section 5 describes deworming impacts on public health, Section 6 discusses policy implication and Section 7 concludes. To begin now, I would like to briefly introduce previous studies' stance on deworming.

II. PREVIOUS STUDY

Butterworth et al. (1991) say that children are most likely to spread worm infections because they are less likely to use latrines and more generally have poor hygiene practices. Wang, Hwang and Chen also hold that parasitic diseases are closely connected to the level of living standard. According to their survey, which implemented after the termination of the 15 year population-based control project in 2001 to estimate the effects of pinworm infection on schoolchildren in Taiwan, it has been found that pinworm infection are largely associated with the socioeconomic status, specifically personal hygiene and sanitary conditions of the children. These two studies give credible explanation for the reason why parasitic diseases are less prevalent in advanced countries where socioeconomic status and sanitary level are high, proving the negative relationship between economic progress and the incidence of parasitic diseases. As many previous literatures imply, deworming and economic progress generally move together. However, as I already mentioned in section 1, parasitic diseases in Korea began to decrease rapidly after the early 1970s without reference to economic development. This suggests that Korean case deserve analyzing its driving force behind the unprecedented deworming.

When it comes to deworming impacts on public health, SABIN vaccine institute pays attention to soil-transmitted helminthes (STHs), which referred to intestinal worms such as

roundworm, hookworm and whipworm. They point out that intestinal worm infections cause negative impacts on child health, particularly on child nutrition, which in turn hamper children's mental development leading to decreased school attendance and poor academic performance. To conclude, they argue that a cost effective method for solving the problem is to introduce deworming drugs because they are safe and simple to administer, leading to improvement in child health.

III. HISTORICAL CONTEXT OF DEWORMING IN KOREA

Before I deal with the deworming impacts, I want to offer a historical overview of parasite eradication in Korea taking holistic point of view with the greater details. In particular, in this section, I want to focus on demonstrating the driving force behind the Korea's successful parasite control.

A. Background of deworming project

In the past, Korea had the stigma of being a parasite kingdom. After Korea's liberation, intestinal worm infections in Korea estimated by one foreign expert at 82.4% (Hunter et al., 1949), and such high infection rates lasted for almost 15 years. As a typical farming country, Korea's overall sanitary conditions and residential environment was poor. For instance, it was common to use human waste as fertilizer, which provided a friendly environment for soil-transmitted helminthes.

Table 1 clearly shows how parasite infection rate was serious over the Korea. In the late 1960s, estimated national parasite infection rate significantly decreased to 58.2%. Nevertheless, since parasite infection rate showed wide gap between areas, parasite infection

rate still reached 70-80% in some areas.

Table 1.Dissertations on Parasite infection rate in Korea

Reporter (Year)	Examination year	No. of Subjects	Egg prevalence rate (%)	Area (subjects)
Hunter et al. (1949)	1948	919	82.4	National (Residents)
Brook et al. (1956)	1951	1726	81.3	Soldiers from North Korea (Prisoner)
Crane et al. (1965)	1964	-	90	Cheonju (Patients)
Kim (1969)	1964	408	71.8	Kwangju (Patients)
Choi (1967)	1966	210	72.8	Kwangju (Students)
Kim et al. (1968)	1967	1314	78.4	Kyungki-do (Patients)
Kim (1969)	1967	500	60.2	Kwangju (Patient)
	1969	545	53.9	Kwangju (Patients)
Seo et al. (1969)	1967-1969	40581	58.2	National (Residents)

Source: Korean parasite management ODA business model development, KOFIH and KAHP, 2011.7

Intestinal worm infections involving hookworm, whipworm and roundworm are among the world's most widespread diseases, with roughly one in four people infected (Bundy 1994, de Silva et al.2003). These soil-transmitted helminthes were also widespread in Korea. Especially, among intestinal worms, roundworm and hookworm have a significant detrimental impact on the human body. They cause not only nutrition deficiency, abdominal pain, anemia, diarrhea and enteritis but also, more seriously, biliary ascariasis which requires emergency surgery. Young children, in particular, are more subject to the intestinal worm infections compared to adult due to their lower levels of resistance, and children, therefore suffered from further health complications including loss of life. As such, intestinal worm infections not only inhibit physical and mental growth for children, but also cause digestive trouble including enteritis for adults, leading to substantial loss in labor and treatment cost. Korean parasitologists estimated that the annual loss caused by about 40 parasites directly and indirectly exceeded US $ 1 billion (2.55 billion won), while the number of the deaths caused by only one parasite reached 2 thousands. Moreover, the amount of blood deprived

from parasites was 1,168 thousand milliliters, which caused substantial losses labor productivity corresponding to about 48 billion won. Therefore, under these circumstances, it was not surprising that Korean government began to recognize the necessity of deworming.

B. Efforts against Parasites in Korea

Since Korea suffered from high intestinal worm infections that cause anemia and even death, it was natural for Korea to embark on deworming program. Korean government strongly believed that a large-scale a parasite control program should be organized, developed and managed at the national level to successfully complete the deworming project. So, Korean government began taking actions following to root out parasitic diseases.

1) The government established “Korea Association of Parasite Eradication” in 1964.
2) The government selected elementary, secondary and tertiary students as the main targets for administration
3) The government enacted the Law for the Prevention of Parasitic Diseases (1966) to providing legal support for its efforts.

The government selected the Korea Association of Parasite Eradication (KAPE) to be the main institute responsible for promoting the deworming project, and KAPE then established 11 branches in cities and provinces across the country to more effectively develop the parasite control program. KAPE launched its parasite control program under the slogan “ten years movement for a 0 % parasite infection rate”. With the enactment of the Law for the Prevention of Parasitic Diseases in 1966, KAPE began its parasite control program in earnest by collecting examination data from elementary, secondary and tertiary students. The parasite control program for students was implemented under a provision of the Law for the

Prevention of Parasitic Diseases and its Enforcement Regulations. As the incidence of parasitic infection rate decreased, the scope of the target areas for the mass system involving environmental hygiene and health education, examination of feces twice a year, and twice-yearly medication began to decrease. By February of 1992, examination of feces was only conducted once a year in the provincial areas, and it was only implemented for individuals who desired to have the examination.

Table 2.KAPE's examination for feces and changes in important indicators

	Twice a year	Once a year in metropolitan	Twice a year in cities	Once a year in provincial areas
Span (Total 27 years)	20 years (1969-1988)	3 years (1993-1995)	1 year (1992)	3 years (1989-1991)
Change in total infection rate (%)	73.2 →1.2	0.8→0.3	0.2	0.2→0.2
Egg prevalence (%)	55.4→0.6	0.3→0.1	0.07	0.02→0.02
No. of Subjects	271,847,192	26,954,005	4,295,294	4,565,700
No. of positives	79,983,676	151,519	8,363	9,942

Source: Korean parasite management ODA business model development, KOFIH and KAHP, 2011.7

However, it was hard to employ the results of the student examination as a national trend. To resolve the problem, the Ministry of Health and Society, along with KAPE, began to implement a national survey for intestinal worm infections. Conducted by KAPE in 1971, the survey had conducted by 2004. By collecting samples corresponding to thousands of the general public, they carried out credible examinations and summarized the results according to such criteria as parasite, gender, ages and income level. It is unusual to conduct regular examination for intestinal worm infections at national level anywhere in the world. Thus, it is true to say that this is a record of Korea's successful process of parasite management. Thanks to such assiduous efforts, the parasite infection rate substantially decreased from more than 80% in 1960s to almost 0% in 1990s. Korea had removed the dishonor of being named the

parasite kingdom, and attained honor of successful becoming a parasite-free country.

C. Deworming project and legal support

In the 1960s, more than 90% of people were infected with parasitic diseases in Korea. Under these circumstances, the Korean government enacted the Law for the Prevention of Parasitic Diseases in 1966 in order to improve and promote public health by preventing and eradicating parasites. The Law for the Prevention of Parasitic Diseases (Act 1789) defines a parasitic disease as ascaridiose, hookworm disease, teanisais, clonorchis sinensis and paragonimus westerman and other illness stipulated by Ministry of Health and Social Affairs ordinance. Article 3 stipulates the duty of examination and treatment so that workers and students in areas prone to infection are examined more than once a year or twice a year respectively. The fine for violating this law was under five thousand won – not an insignificant sum at the time. Furthermore, there were other articles dealing with the construction of prevention facilities, restrictions on the use of human waste, designation of examination center for parasite, commissions on parasites, parasite prevention associations and delegations of power. In addition, the article which entitled the Korean government to support deworming project, wholly or in part, was established. One provision we should particularly pay attention to is Article 5. Article 5 limited the use of human waste. Based on the article, it was not permitted for anyone to use human waste as fertilizer if it was not treated by a human waste treatment facility as set defined in Article 4 Article 11:2 of the Act on the Disposal of Sewage**.** Human waste was a primary cause of parasitic diseases in Korea, so it is presumed that restricting the use human waste as fertilizer would contribute to significantly reducing parasite infection with the law's promulgation.

The revised laws in 1991 further broadened the scope of the definition of parasitic diseases encompassing roundworm, whipworm, threadworm, clonorchis sinensis, lung flukes,

intestinal flukes, tapeworms. On top of that, areas with high possibility of infection were embodied as areas where clonorchis sinensis and lung fluke infections can easily occur, and the compulsory number of parasite examinations was reduced. Today, the Law for the Prevention of Parasitic Diseases has been abolished, and with the Law for the Prevention of Parasite Diseases and Management enacted and promulgated (amended in 2009.1.29, enforcement in 2010.12.30). Under the current legislation, article 63 stipulates that Korea Association of Health Promotion is responsible for the business of preventing communicable diseases caused by parasites, which are defined as diseases requiring surveillance through regular examination. In order words, the law has been changed according to Korea's successful management of parasitic diseases.

Korean government enacted this law for eradicating parasites at the initiatory stage of deworming project. If it had not been for this law, Korea might still have suffered from parasitic diseases because it is extremely difficult to force organizations or individuals to observe the rules for deworming. By stipulating detailed rules, which regulate behaviors that can lead to parasitic diseases, Korea government could effectively manage parasite control program, resulting in rapid decrease in parasites in a very short period of time. To conclude, establishing strong legal support is really important step for efficient policy design and implementation.

D. Outcomes of deworming project

i. Decreasing trends in egg prevalence rate

The parasite examination for elementary, secondary and tertiary school was conducted from 1969 to 1995. The number of 6,511,926 – 16,229,764 people was examined regularly

every spring and autumn. Egg prevalence rate decreased to 55.4-55.6% in 1969-1970, 38.7% in 1975, 12.2% in 1985, 0.2% in 1990, and finally 0.02% in 1995. In addition, about 20,000-47,000 people were randomly selected every 5 years for the national intestinal worm infections examination through 1st and 7th examination. Egg prevalence rate decreased to 54.9% in 1971, 41% in 1976, 13% in 1981, 2.1% in 1986, 0.3% in 1992, 0.06% in 1997, and 0.03% in 2004. All results considered, it is manifested that egg prevalence rate significantly decreased from 1969 to 1995 in both students and residents.

ii. Change in U-rate

Egg prevalence is divided into two kinds – fertilized egg and unfertilized egg. Fertilized egg is created after fertilization occurs, and as a result it becomes an embryonated egg that is infected by host. On the other hand, unfertilized egg is created without fertilization so that died out. U-rate means the ratio of unfertilized egg to total egg prevalence. Therefore, the higher U-rate, the less egg prevalence is.

U-rates of elementary, secondary and tertiary school were all low at the very first stage of the program. However, U-rate began to climb to 0.4 in 1980-1981 from 0.2 in 1943-1974. In 1991, U-rate increased up to 0.7, and since then U-rate kept remaining approximately 0.5. These results present that parasite prevalence level was very high in 1973-1974 and since then, endemicity steadily decreased, leading to consistent lower level since 1988.

Table 3.Primary, secondary and tertiary Egg prevalence rate trends (1969-1995)

Year	No. of Subjects	Egg prevalence			U-rate
		Unfertilized egg	Fertilized egg	Total	
1969	6551926	—	—	3631699 (55.4)	—
1970	10871280	—	—	6042588 (55.6)	—
1971	11813868	—	—	6100187 (51.6)	—
1972	11243033	—	—	5148951 (45.8)	—
1973	12116892	1136687 (9.4)	4695540 (38.8)	5830227 (48.1)	0.2
1974	11901236	896301 (7.5)	3650208 (30.7)	4545509 (38.2)	0.2
1975	12480942	934247 (7.5)	3901162 (31.3)	4835409 (38.7)	0.19
1976	13434636	978360 (7.3)	3540956 (26.4)	4519433 (33.7)	0.22
1977	14160212	965005 (6.8)	3246956 (22.9)	4211724 (29.7)	0.23
1978	15030061	684005 (4.6)	2229938 (14.8)	2914865 (19.4)	0.24
1979	15592977	746000 (4.8)	1601664 (10.3)	2347664 (15.1)	0.32
1980	15495361	720355 (4.6)	1162655 (7.5)	1882895 (12.2)	0.38
1981	16229764	661154 (4.1)	996606 (6.1)	1657760 (10.2)	0.4
1982	16216136	1042498 (3.1)	620413 (3.8)	1122911 (6.9)	0.45
1983	16220369	366771 (2.4)	374132 (2.3)	760903 (4.7)	0.51
1984	16091005	257276 (1.6)	217198 (1.5)	492474 (3.1)	0.52
1985	15812300	176837 (1.1)	142961 (0.9)	319798 (2.1)	0.52
1986	14861006	112517 (0.8)	87408 (0.6)	199925 (1.4)	0.57
1987	13206807	60884 (0.5)	52205 (0.5)	112698 (0.9)	0.56
1988	12703799	39920 (0.4)	30289 (0.3)	112184 (0.6)	0.67
1989	9594316	20328 (0.2)	12928 (0.3)	33256(0.3)	0.67
1990	9146913	12150 (0.1)	9638 (0.1)	21788 (0.2)	0.5
1991	8212776	5693 (0.07)	3597 (0.1)	9290 (0.1)	0.7
1992	4294499	1653 (0.04)	1239 (0.03)	2892 (0.07)	0.57
1993	1699141	444 (0.02)	661 (0.02)	1105 (0.04)	0.5
1994	1531706	334 (0.02)	334 (0.02)	668 (0.04)	0.5
1995	1334517	156 (0.01)	85 (0.006)	241 (0.02)	0.5
Total	307836478				

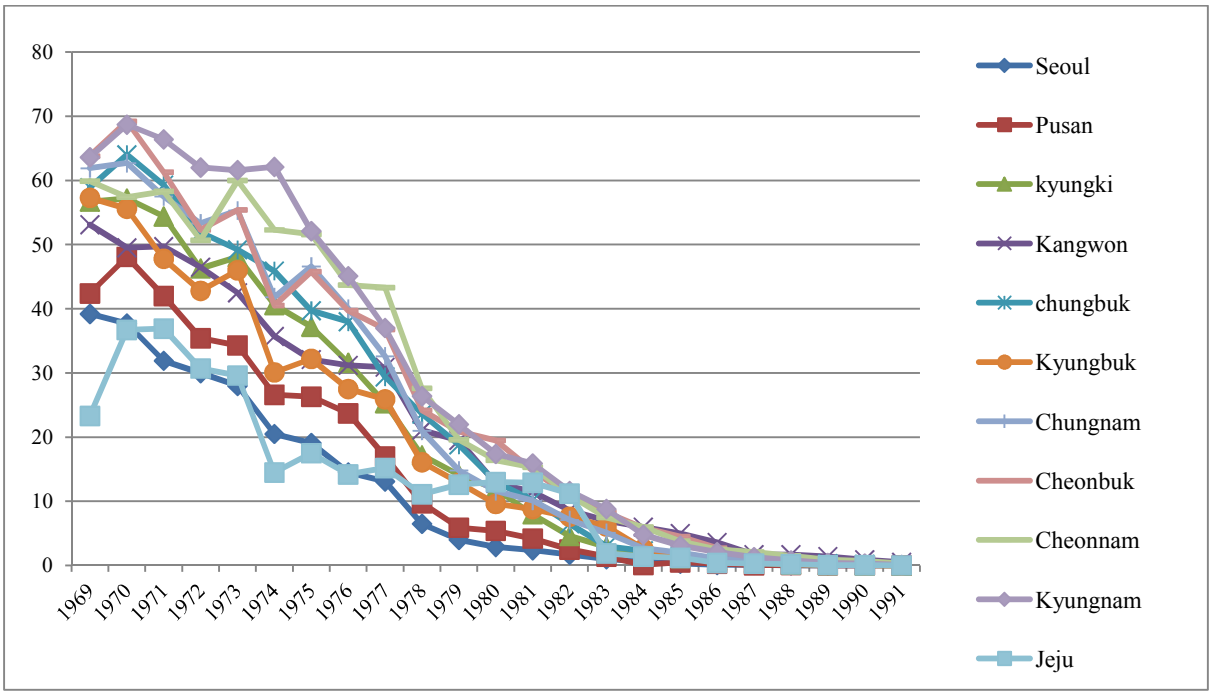
Note: it is estimated by combining two examination results of spring and autumn

Source: Korean parasite management ODA business model development, KOFIH and KAHP, 2011.7

iii. Decreasing trends in egg prevalence according to areas

As seen in Figure 1, there was dramatic change in egg prevalence rate since 1969 and finally, infection rate reached almost zero % in 1990. More than any other area, Southern/Western area (Chungnam, Kuungnam, Cheonbuk, Cheonnam and Jeju) recorded the highest worm burden in addition to the largest decrease in egg prevalence rate, followed by Northern/Eastern area (Kyungki, Kangwon, Chungbuk and Kyungbuk) and metropolitan city (Seoul and Pusan). Eventually, difference of egg prevalence rate between provinces disappeared in 1995.

Figure 1.Egg prevalence rate according to provinces in Korea

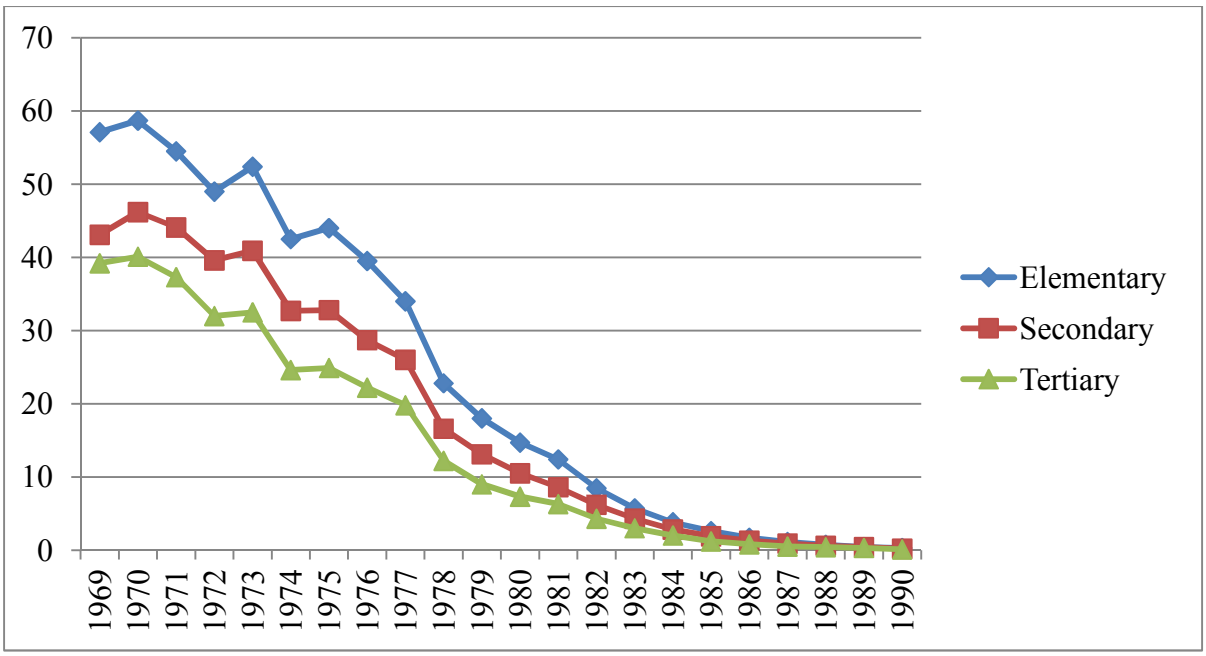


Source: Ministry of health and welfare

iv. Decreasing trends in egg prevalence according to elementary, secondary and tertiary

Parasite eradication for students in Korea was conducted based on clause 2 Article 3 of the Law for the Prevention of Parasitic Diseases and enforcement regulations. The KAPE has conducted regular examination for parasites by targeting primary, secondary, and tertiary students as major subjects. As seen in Figure 2, egg prevalence of primary, secondary, and tertiary students had moved together except for some fluctuation of positive for parasite.

Figure 2.Trends of egg prevalence rate (%)



Source: Korean parasite management ODA business model development, KOFIH and KAHP, 2011.7

Egg prevalence in 1969 was 57.1%, 43.1% and 39.2% respectively. In 1979, egg prevalence decreased to 18%, 13.1%, and 9% respectively, and finally all reached almost zero percent in 1990. Interestingly, parasite infection rate was on the decline as school grade increased. Parasite infection rate had been dominant in elementary school, and next was

middle school and tertiary was last one.

v. Estimation of cure rate cased by once mass medication at national level

From 1969 to 1995, when student mass management system for parasites was conducted, there was twice a year mass medication (from 1989 to 1995, there was once a year mass medication). To estimate cure rate resulted from once medication, certain formula is needed. Based on Chia (1983)'s report, we can obtain formula as following. $Y= 1-(1-X)^{7.2}$, where Y is current prevalence rate, X is monthly reinfection rate and 7.2 means average life expectancy of parasites. Monthly reinfection rate was 9.9% in spring of 1973, 0.75% in spring of 1983 and 0.01% in spring of 1993. Computed theoretical annual reinfection rate of once mass medication impacts are 50%, 70% and 90% respectively. Based on the theoretical annual reinfection rate, Chia compared them with previous monthly reinfection rate. As a result, the cure rate was higher than 70% and lower than 90%, illustrating that it is very significant level as mass medication impact.

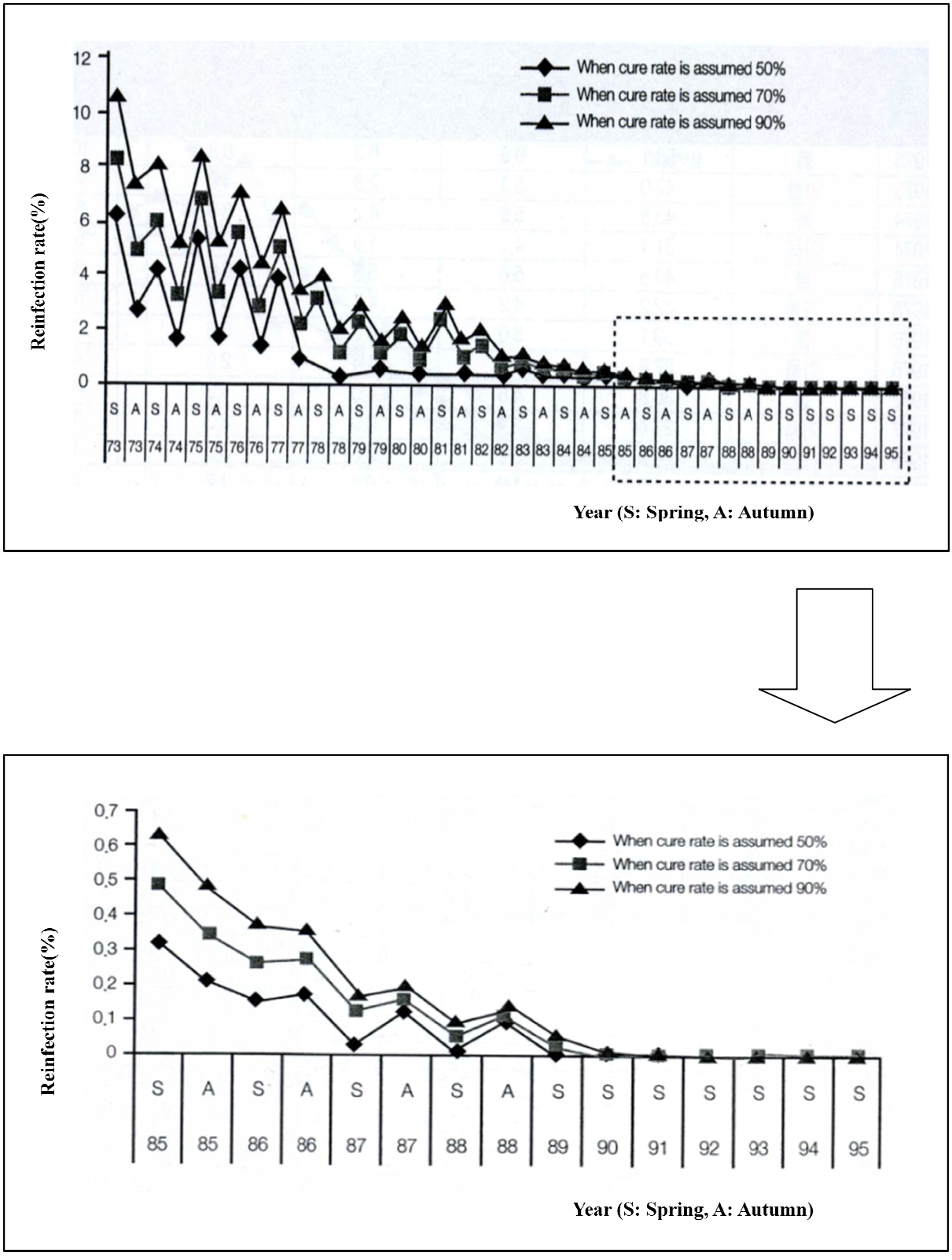
Table 4.Actual egg prevalence rate, theoretical prevalence rate and expected cure rate for estimating the effectiveness of mass medication

Year	Season	Monthly reinfection rate(%)				
		Egg Prevalence rate(%)	Expected the cure rate*			
			theoretical prevalence rate	50%	70%	90%
1973	Spring	53.1	9.9	6.3	8.3	10.6
1973	Autumn	42	5.3	2.8	4.9	7.3
1974	Spring	43.8	5.5	4.2	6	8.1
1974	Autumn	31.4	4.1	1.6	3.3	5.1

1975	Spring	44.5	5.6	5.5	6.9	8.5
1975	Autumn	32.2	4.2	1.7	3.4	5.3
1976	Spring	39.1	5	4.3	5.6	7.1
1976	Autumn	27.8	3.6	1.4	2.9	4.4
1977	Spring	35.8	4.6	4	5.2	6.5
1977	Autumn	23.4	3.1	0.9	2.2	3.6
1978	Spring	24.5	3.2	2.3	3.2	4.1
1978	Autumn	14.2	1.9	0.3	1.2	2.1
1979	Spring	17.8	2.4	1.9	2.4	2.9
1979	Autumn	12.3	1.4	0.6	1.2	1.8
1980	Spring	14.6	2	1.5	1.9	2.4
1980	Autumn	9.5	1.3	0.4	0.9	1.4
1981	Spring	12.3	1.8	1.9	2.5	3
1981	Autumn	8.1	1.2	0.5	1.1	1.8
1982	Spring	8.4	1.2	1.1	1.5	2
1982	Autumn	5.3	0.75	0.3	0.7	1.1
1983	Spring	5.2	0.75	0.6	0.9	1.2
1983	Autumn	4.1	0.58	0.4	0.6	0.9
1984	Spring	3.6	0.51	0.4	0.6	0.8
1984	Autumn	2.5	0.35	0.21	0.44	0.66
1985	Spring	2.3	0.32	0.32	0.48	0.63
1985	Autumn	1.8	0.25	0.2	0.34	0.48
1986	Spring	1.4	0.2	0.15	0.26	0.37
1986	Autumn	1.3	0.18	0.18	0.27	0.36
1987	Spring	0.8	0.11	0.03	0.13	0.17
1987	Autumn	0.9	0.12	0.013	0.17	0.2
1988	Spring	0.5	0.07	0.088	0.06	0.1
1988	Autumn	0.6	0.08	0	0.11	0.14
1989**	Spring	0.3	0.04	0.005	0.03	0.06
1990	Spring	0.2	0.03	0.005	0.011	0.017
1991	Spring	0.1	0.01	0	0.004	0.008
1992	Spring	0.07	0.01	0.002	0.004	0.006
1993	Spring	0.07	0.01	0.004	0.005	0.006
1994	Spring	0.04	0.006	0.0005	0.0019	0.0033
1995	Spring	0.02	0.003	0	0.0008	0.0016

*Monthly reinfection rate in the last six month; Y-Y'(1-C) = $1-(1-X)^4$, where Y is the current prevalence, Y' is the previous one (six month ago), and C is the cure rate
**Formula for monthly reinfection rate after 1989 is; Y-Y'(1-C) = $1-(1-X)^{10}$,
Source: Seo et al.(1983) and Chai et al.(1997)

Figure 3.**Actual egg prevalence rate, theoretical prevalence rate and expected cure rate for estimating the effectiveness of mass medication**



Source: Seo et al., 1983 and Chiai et al., 1997

All above four results indicate that deworming project implemented by the KAPE had significantly contributed to reducing intestinal worm infections in Korea. The 54th World Health Assembly in May 2001 announced that Korea successfully eradiated soil-transmitted helminthes in their territory. Then, next question would be that what is secret behind the Korea's miraculous parasite eradication. In the following section, I want to explain how Korea overcame challenges for moving ahead in deworming with greater detail.

E. Driving force behind successful control of parasitic disease

i. Financial resources

Even though the parasite control program in Korea had substantially positive outcome in the end, the parasite control program was unable to bring about a noticeable impact immediately due to financial constraints. At the very initial stages of its foundation, the Korea Association of Parasite Eradication had trouble securing the necessary financial resources needed to purchase equipment and employ staff for parasitological examination. Fortunately, those financial constraints were soon resolved through foreign aid, particularly from Japan.

The first assistance to KAPE came from KAVA, the world association of Christian groups. KAPE and KAVA developed a cooperative relationship under the goal of the "ten years movement for 0 % parasite infection rate", and implanted a diverse range of programs such as educational programs, surveys and research, pilot projects, and examinations. KAVA offered not only deworming drugs for expelling worms but also piperazine and sodium nitrite that are required for parasite examination and administration that enable to cover total 34,980 persons in 104 parasite eradication pilot areas.

The Japanese Overseas Technical Cooperation Agency (OTCA) also provided Korea

with substantial assistance in term of technical equipments and medicine. Aid from Japan began in earnest through the OTCA agreement. From 1968 to 1974, OTCA offered a considerable amount of materials. By taking advantage of the assistance, KAPE was able to create the fundamental conditions necessary to undertake an effective parasite control program. KAPE invited Japanese parasitologists, marking the beginning of cooperation for parasite control between Korea and Japan. With a managing director in the Japanese Parasite Prevention Association visiting KAPE, mutual cooperation on deworming started gradually founding a concrete shape. To be specific, US $ 57,750 in funds were supplied in the first year, US $ 55,450 in the second year making a total of US $ 11,800 appropriated for financial aid from Japan. Additionally, Japanese parasitologists and associated managers visited Korea to provide technical support in first year, allowing Korean to learn their advanced techniques. With the placement of testing equipments introduced from Japan, inspection offices and skilled experts were assigned in each city and province, accelerating the parasite control program. In short, KAPE received substantial support including equipment, technical education, and medicine from OTCA, and they organized branches to provide a well-organized parasite control program through the financial support from OTCA and the Japan World Exposition. Thus, it is certain that if it had not been for foreign aid, Korea could have not established such a strong foothold in its parasite control program.

At the same time, KAPE received assistance from the Korean government. However, it was not enough to maintain its programs. For this reason, a proposal of imposing a very cheap examination fee for its parasite examination services for primary, secondary and tertiary schools was suggested and adopted. The proposal allowed KAPE to gain additional funding and ultimately continue its parasite control program.

To conclude, foreign aid paved the way for Korea’s successful parasite control program, helping KAPE stabilize their work from both within and without. From this, we can infer that

foreign aid plays a remarkable role in resolving the financial constraints of developing countries, encouraging them to promote the programs more actively.

Table 5.National examination for Intestinal worm infection Performance Resources

Year	No. of Subjects	Subsidy	Department in charge
1971	25987	3400	The Ministry of health and society chronic disease department, KAPE
1976	30220	5000	"
1981	40119	109000	"
1986	47671	163900	"
1992	51556	190000	The Ministry of health and Welfare, health education department, KAHP
1997	49977	179600	The Ministry of health and Welfare, health policy department, KAHP
2004	22828	205000	Korea Centers for Disease Control and Prevention/ Korea National Institute of Health, KAHP
Total	268358	855900	

Source: Korean parasite management ODA business model development, KOFIH and KAHP, 2011.7

ii. The New Village Movement

Of course, no one could deny that Korea could not have completed the parasite control program successfully without foreign aid from abroad. However, it would be a stretch to say that foreign aid was the sole reason for Korea's successful parasite eradication. Even though the parasite control program in Korea benefited greatly from foreign aid, the effectiveness of deworming program was maximized through centrally coordinated program, the so-called New Village Movement.

The New Village Movement was centrally coordinated economic plan whose primary goal was to modernize rural Korea. There are several characteristics of the New Village Movement. First, the New Village Movement was tightly controlled by the strong leadership of President Park Cheong-hee. In addition, all projects in New Village Movement were based

around the community, not the individual. Lastly, the New Village Movement took a performance-based approach, encouraging villagers to work together for communal projects.

In the first year, the government supplied materials that could be effectively employed for various New Village Movement projects, and further resources were provided in the second year. By 1976, total of US $ 18 million, consisting of 44% of government funds and 56% of residents' fund, was invested in rural area for the New Village Movement. (Table 6)

Table 6.Composition of subsidy for New Village Movement

Year	Total (A)	Sub total	Government	local	loan.etc	Villagers(B)	B/A(%)
1971	122	41	27	14		81	66.4
1972	313	33	20	13		280	89.5
1973	984	215	125	90		769	78.2
1974	1328	308	121	173	14	1020	76.8
1975	2959	1653	666	579	408	1306	44.1
1976	3226	1651	484	396	771	1575	48.8
1977	4665	2460	599	723	1138	2205	47.3
1978	6342	3384	654	773	1957	2958	46.6
1979	7582	4252	1258	1010	1984	3330	43.9

Source: Jin-Kwang So(2007); "Local community governance and *Saemaul movement* in Korea" Korean Association for local government Studies journal, 19(3).93~112

What's interesting is in Table 6 is that the subsidy from villagers accounted for a great part of the New Village Movement's funding. Of course, government spent substantial financial resources on the New Village Movement. However, it was not enough to complete all projects. Insufficient financial resources were covered by donations by the villagers. They spontaneously donated land or money for the sake of communal projects under the New Village Movement. What attracted the villagers' voluntary participation in New Village Movement?

To find the answer, we need to understand the land reform conducted in the early 1960s.

Land reforms in Korea were undertaken between 1948 and 1957. Based on the Land Reformation Law, the Korean government distributed land to farmers by allowing them to pay for the land though rice harvests. Farmers who had received land from the government had to pay 30% yield of the rice harvested from the land over five years. After the land reforms, most farmers in Korea became owner-operators, and there was homogeneity in terms of economic status among farmers in a village unit of rural Korea. This homogeneity later became the social factor that spurred the participation of villagers in the implementation of New Village Movement projects (Park Jin-Hwan, 1998, p12).

Of course, landowners were reluctant to donate their precious resources for the sake of the village at first. It was natural for them because farm land was the most valuable resource for farmers in rural area, even though the price of land was not as expensive as that of urban areas. However, as the number of farmer who donates their land for communal projects increased, more and more people started to donate their land for the communal projects. Because most villagers owned the land, leaders in each village could encourage landowners to donate land for communal projects. If it had not been for land donations from the villagers, the New Village Movement might have failed. One example of how land donations contributed to a successful New Village Movement project can be seen in the village road project. Village road constructions benefited greatly from land donations by villagers. An average 680 m^2 of land per village was donated by villagers, with total area of land donated at 15.4 million m^2 (Table 7). Based on this information, we can be inferred that land donation from villagers contributed significantly to improving village roads. Furthermore, power plants was later also established after village roads were completed.

Table 7.Length of village roads improved and area of land donated (22,700 villages)

Description	National total	Average per village
Length of village roads improved*	7,351 km	320 meters
Area of land donated for village roads (square meters)	15.4 million m^2	680 m^2
Area of land donated per meter of road	2.1 m^2	2.1 m^2

***Added length of village access road and feeder road**

Source: Ministry of Home Affair, *The Saemaul Movement*, 1972

Simultaneously, a performance-based incentive system also provided a catalyst for the success of New Village Movement. All villages participating in New Village Movement were evaluated and rewarded based on their performance. Material support was given only to the self-help villages through the government's strict evaluation. One important material provided was cement. In 1971, only 16.600 villages (48% of total villages) with good evaluations continued to receive 500 bags of cement along with 1 ton of iron reinforcing rod. Using the cement and steel wire provided by the government, each village could initiate a myriad of projects. In particular, cement and electricity as the rewards for high performing villages helped improve living environments since they are invaluable resources for establishing a variety of facilities and power plants.

This merit-based approach was an effective tool for encouraging people to actively participate in New Village Movement, resulting in its optimized performance. Strong government intervention based on a stick and carrot approach inspired villagers to have adopted an ethic of self-help and cooperation. Such an ethic encouraged people not to waste limited resources and work hard for communal projects. On the other hand, the strict merit-based evaluation process prevented people or village leaders from becoming corrupt. Corruption is one of biggest problems facing developing countries. In general, developing countries lack the leadership to control corruption so that substantial amount of foreign aid

becomes wasted on unnecessary projects. Of course, this is not easy to eradicate in short-term. However the corruption problem could be minimized by utilizing centrally coordinated projects based on a merit-base approach like the New Village Movement.

When it came to deworming, the New Village Movement was significant because it contributed greatly to improving the sanitary conditions that are an indispensible part of the deworming program. Combined with the effects of public policy including mass medication and examination for parasites implemented by KAPE, improved sanitary conditions caused by the New Village Movement in rural area had a decisive effect on deworming.

Table 8.Performance of New Village Movement 1970-1980

Project	Measure	Goal in 1971 (A)	Performance until 1980 (B)	B/A
Widening village roads	Km	26266	43558	166
Developing Farm roads	Km	49167	61797	126
Constructing bridges	Unit	76749	79516	104
Building Community halls	House	35608	37012	104
Building storages	House	34665	22143	64
Building workplaces	Unit	34665	6263	18
Building cattle sheds	Unit	32729	4476	14
Small Reservoirs	Unit	10122	13327	132
Building dikes	Unit	22787	31625	139
Constructing waterways	Km	4043	5161	128
Organizing Brooks	Km	17239	9677	56
Improving houses	1000 houses	544	225	42
Improving settlements	Village	—	2747	—
Small town Revitalization	Unit	1529	843	55
Temporary water service	Unit	32624	28130	86
Sewage	Km	8654	15559	179
Electrification work	1000 Households	2834	2777	98
Communication service	Village	18633	18633	100
Constructing factories	Unit	950	717	75
Reforestation program	Ha	967362	642804	66

Note: Improving settlement projects was implemented without initial goal in 1971.
Source: Jin-Kwang So (2007); "Local community governance and *Saemaul movement* in Korea" Korean Association for local government Studies journal, 19(3).93~112

Table 8 illustrates each project's performances. Among many projects, sewage or electricity projects showed excellent results. The rapid increase in the rural electrification rate in the 1970s greatly contributed to improving the drinking water supply system. The rural area electrification rate increased from 20% in 1970 to 98% in 1977. As the supply of rural electricity increased, some farmhouses began to install water pumps in the kitchen connected by plastic pipes to the wells located near the farmhouses. (Park Jin-Hwan, 1998, P104)

Among the many New Village Movement projects, sanitation related projects such as improving the sewerage and drinking-water system played a crucial role in preventing and reducing intestinal worm infections. Generally, parasitic diseases are caused by bathing in, swimming in, or drinking water containing parasites and by contact with untreated sewage. In addition, during Korea's early stages of industrialization, human waste was often used as fertilizer, which was a factor that for the prevalence of intestinal worm infections, so-called soil-transmitted helminthes, in Korea. Thus, both building flush toilets equipped with septic tanks and improving sanitation facilities such as the sewage system were absolutely necessary for parasite eradication. Drinking water is another main channel of parasitic diseases, and well organized water-resources are an effective method of preventing and reducing parasite infection rates.

In this regard, the New Village Movement's concentration on improving sanitary conditions was helpful for reducing parasite infection rate. Korea Association of Health Promotion (KAHP) and Korea Foundation for International Healthcare (KOFIH) (2011) says that one of the factors that contributed to its rapid decrease were the efforts to improve public health through the building sanitation facilities through the New Village Movement during the 1970s.

As a result, had not been for New Village Movement, even though financial problem was resolved through foreign aid, Korea could not have eliminated parasite diseases so

successfully in such a very short period of time, and would still remain a parasite kingdom to this day.

Ⅳ. EMPIRICAL EVIDENCE

Before moving to discuss policy implication based on Korean case, it is necessary to verify casual relationship between sanitation and deworming. Unsanitary conditions are regarded as one of fundamental causes of parasitic diseases.[3] Indeed, the areas where parasitic diseases are mainly concentrated have relatively poor sanitation facilities and drinking-water sources than the area with lower parasitic diseases and good sanitary conditions. Such phenomenon indicates that improving sanitary conditions is a key to parasite control program.

To verify this assumption, I collected empirical data from developing countries with high parasite infection rate. First of all, I set the incidence rate of Lymphatic filariasis, soil-transmitted helminthes, and schistosomiasis as Y variables because WHO provides accurate statistical data. The reason why I divide parasitic diseases into three categories is that according to climate or geographical factors and so on largely influence the type of prevalent parasitic diseases. WHO announces that South-East Asia Region accounts for approximately 65% of LF infection rate, African region accounts for 30%, and other tropical areas takes up the remainder. To be specific, LF infection rate is 7.9, STH infection rate is 39.4, and schistomosiasis is 23.1 in Kenya. Kenya has relatively high incidence rate of STH as compared to LF. Comoros's STH and schistosomiasis infection rate is 39.4 and 23.1 respectively, which is quite larger than LF infection rate (7.9). Uganda have high infection

[3] pinworm infection was found to be significantly associated with the socioeconomic status,personal hygiene and sanitary conditions of the children. L.-C. WANG1 et al. (2009) "Enterobius vermicularis infection in schoolchildren: a large-scale survey 6 years after a population-based control"

rate in LF and STH, while schistomiasis rate is relatively low (16.3). Second, the purpose of this section is to estimate casual relationship between sanitation conditions and the incidence of parasitic diseases. For this reason, I employed population using improved sanitation facilities and population using improved water-resources as X variables.

Figure 4 and Figure 5 clearly illustrate how much Lymphatic filariasis caused by roundworm, one of common parasitic diseases in developing countries, is affected by sanitary conditions. Korea also suffered from that illness seriously until the 1960s.[4] Figure 4 and Figure 5 demonstrate negative correlation between the incidences of LF and improved sanitation facilities and drinking-water sources, respectively. However, scatters represent widely diffused spots. WHO defines the Lymphatic filariasis as infection which occurs when filarial parasites are transmitted to humans through mosquitoes. Therefore, it is presumed that the impacts of sanitary conditions on deworming were not strong even though it had contributed to deworming to some degree.

Soil-transmitted helminthes show the most densely plotted graph. Except in few cases, most countries have strong negative correlation between sanitary conditions and parasitic diseases. Soil-transmitted helminth infection is caused by ingestion of eggs from contaminated soil (*A. lumbricoides* and *T. trichiura*) or by active penetration of the skin by larvae in the soil (hookworms) (WHO). It means that sanitary conditions are really important for preventing and reducing soil-transmitted helminthes. Thus, we can conclude that improving sanitation and drinking water resource is an effective method of reducing and preventing Soil-transmitted helminth infection. Indeed, Korean government struggled to improve sanitation facilities and drinking water resources thought the New Village Movement, and as a result, soil-transmitted helminth infection that was widespread in Korea in the 1960s

[4] For Nam jeju-gun, the positive rate was reported to have ranged from 12 to 16.8% according to the investigators during the 1960s. During the 1970s, however, it considerably decreased from 3.7 to 4.0 %. (Hyeng-Il Cheun et al.,2009)

began to rapidly decrease.

Lastly, schistosomiasis also demonstrates negative relationship between the infection rate and sanitary conditions. Especially, improved drinking-water resources represent relatively steep slope. This is largely because schistosomiasis is infected by trematode flatworms of the genus *Schistosoma,* and larval forms of the parasites, which are released by freshwater snails, penetrate the skin of people in the water. In addition, some eggs released by females are passed out of the body in the urine or faeces. For these reasons, improving sanitation is also indispensible part for controlling parasitic diseases.

All scatters show that sanitary conditions have a vital role in reducing parasite infection rate. In particular, soil-transmitted helminthes are closely related to sanitary conditions. As the number of people using improved sanitation facilities and drinking-water resources increase, parasitic diseases including Lymphatic filariasis, soil-transmitted helminthes, and schistosomiasis decrease. Therefore, it is obvious that improving both sanitation facilities and drinking-water sources can be an effective method in preventing and reducing parasite diseases.

These empirical evidences might offer opportunity to verify the question of whether New Village Movement had actually contributed to reduce parasitic diseases or not. It is well-known fact that improving sanitation facilities such as toilet and drinking-water resource accounted for critical parts among many projects implemented under the New Village Movement. Since empirical analysis in this section proves that improving sanitary conditions and drinking-water sources play a significant role in reducing the frequency of parasite diseases, it would not be a stretch to say that improved sanitation level through New Village Movement had actually contributed to prevent further parasite infections.

Figure 4.Correlation between the incidence of LF and population using improved Sanitation facilities

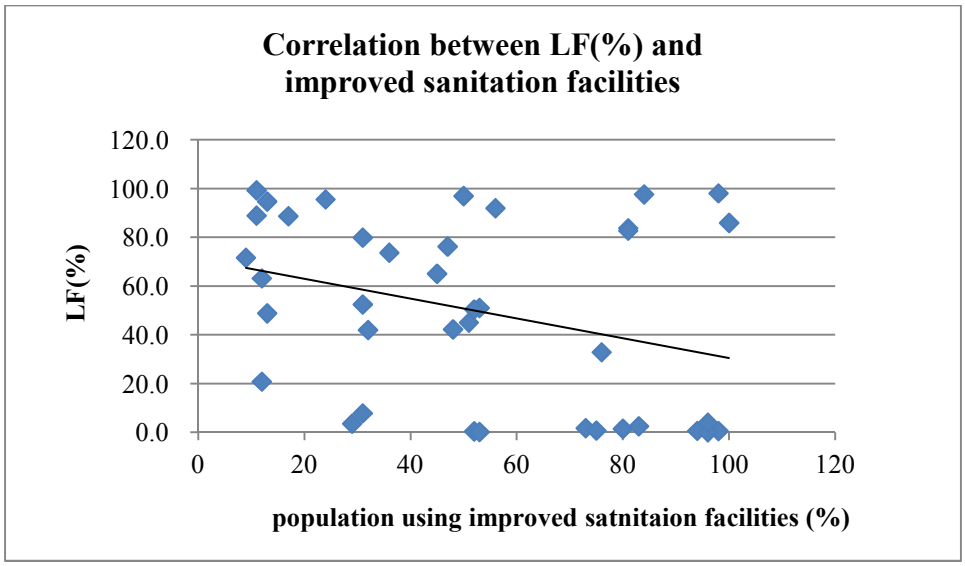


Figure 5.Correlation between the incidence of LF and population using improved Drinking-water sources

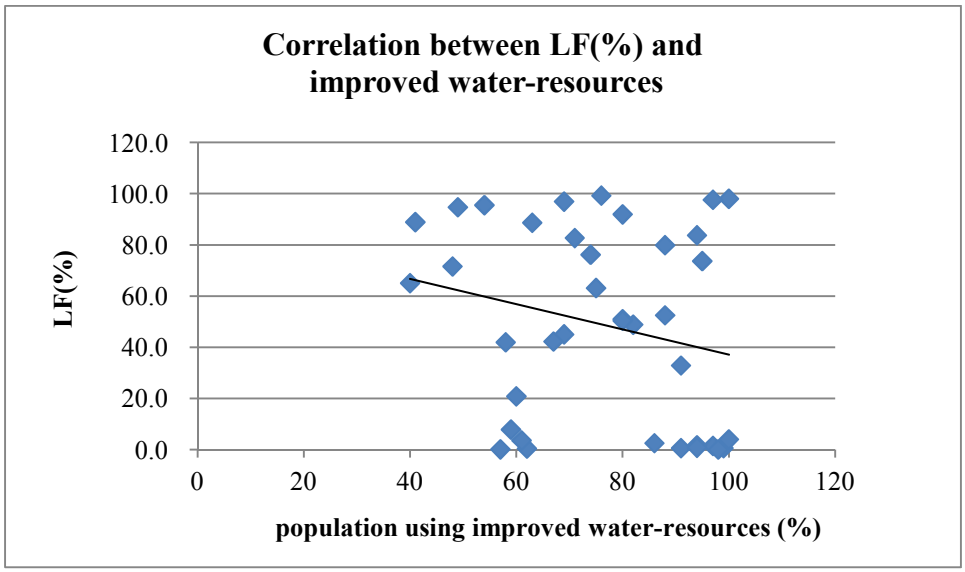


Figure 6.Correlation between the incidence of STH and population using improved Sanitation facilities

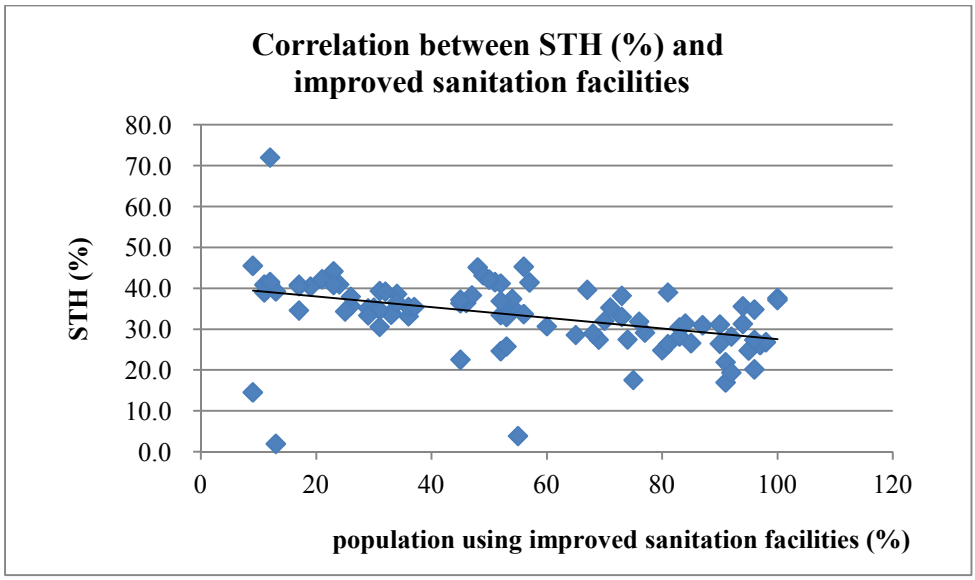


Figure 7.Correlation between the incidence of STH and population using improved Drinking-water sources

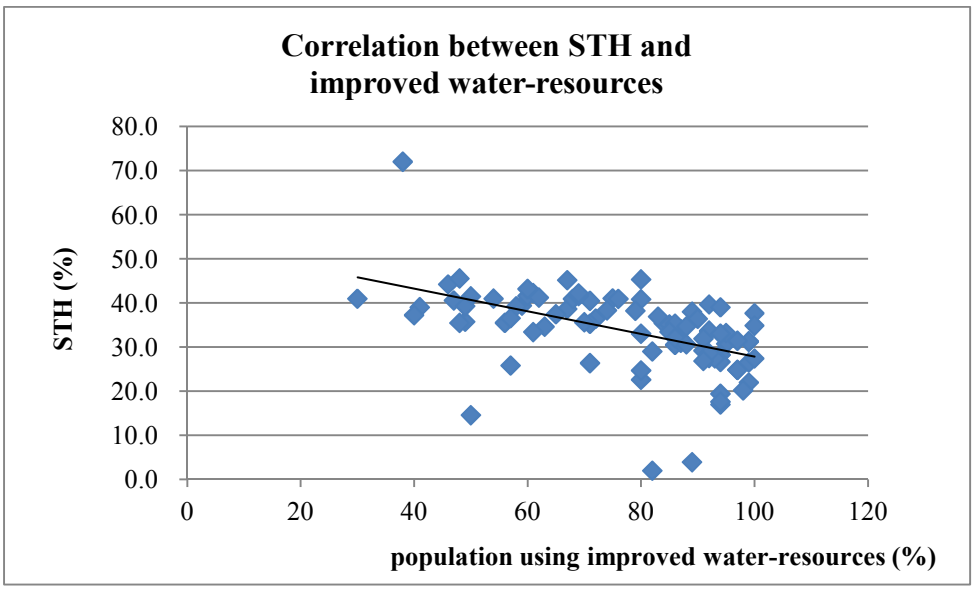


Figure 8.Correlation between the incidence of Schistosomiasis and population using improved Sanitation facilities

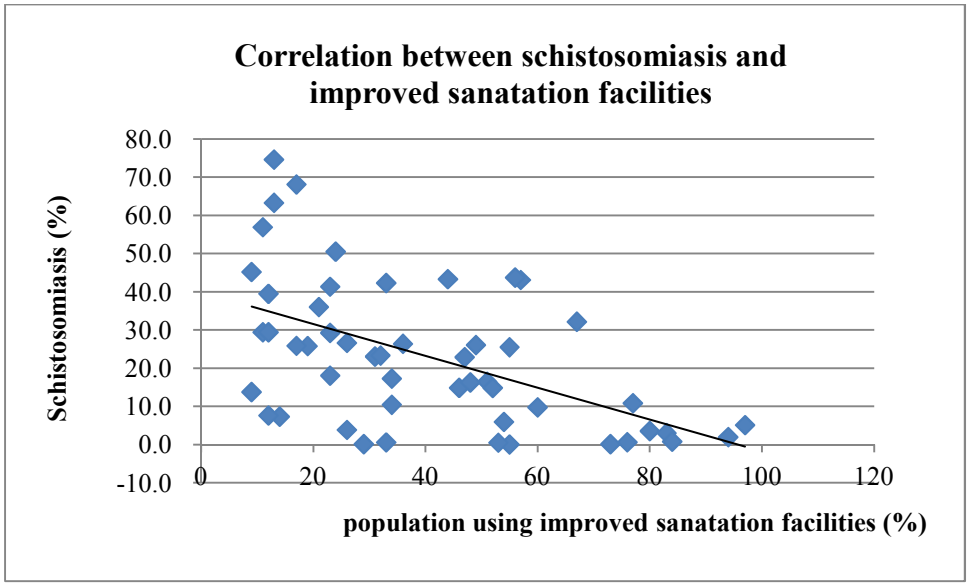
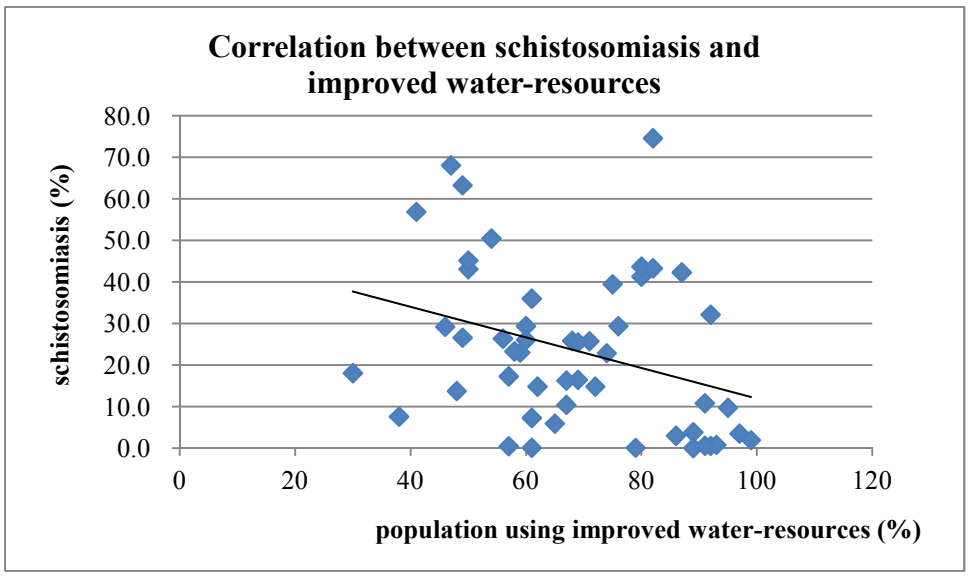


Figure 9.Correlation between the incidence of Schistosomiasis and population using Drinking-water sources



Note: I employ of Population requiring PC for LF and population requiring PC for STH as infection rate. WHO provides statistic data of Population requiring PC for LF, which means total population living in all the endemic IUs and which require preventive chemotherapy (PC). Similarly, population requiring PC for STH means total population of Pre-SAC and SAC living in all the endemic areas in a country and which require preventive chemotherapy (PC). WHO announce that Population requiring PC based on L.Chitsulo et al. / Acta Tropica 77(2000)41-51

In the case of schistosomiasis, infection rate is based on population infected that means estimated estimated number of people infected.

pre-SAC – pre-school age children aged => 1 and < 5 years

SAC – school age children aged => 5 and < 15years

Ⅴ. DEWORMING IMPACTS

A. Physical development

Chai (2011) studied deworming impacts on children's physical development. Over 10 years, children's physical development in terms of height and weight has increased remarkably. He asserts that deworming might played a crucial role in improving students' physical development.

Figure10.Student Physical development treads (height) 1998-2009

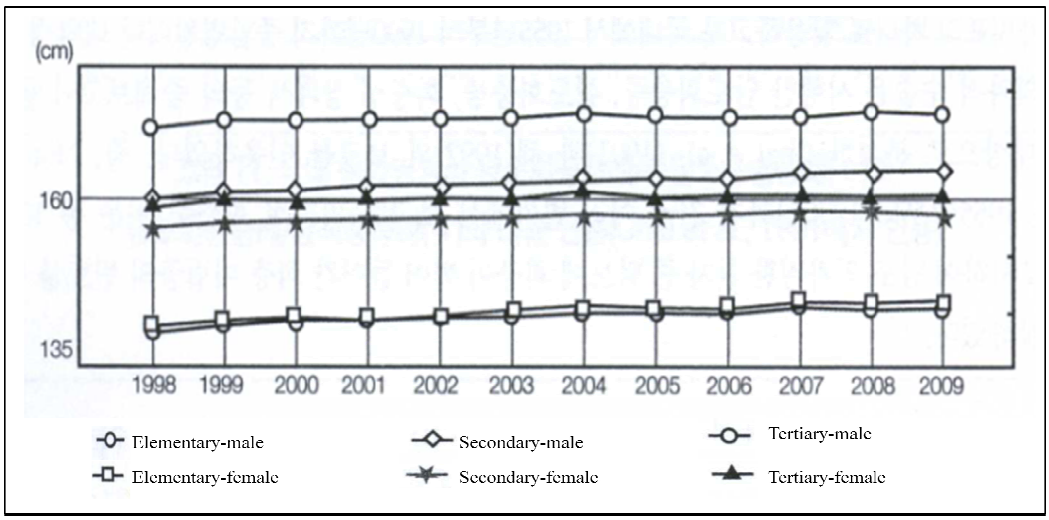
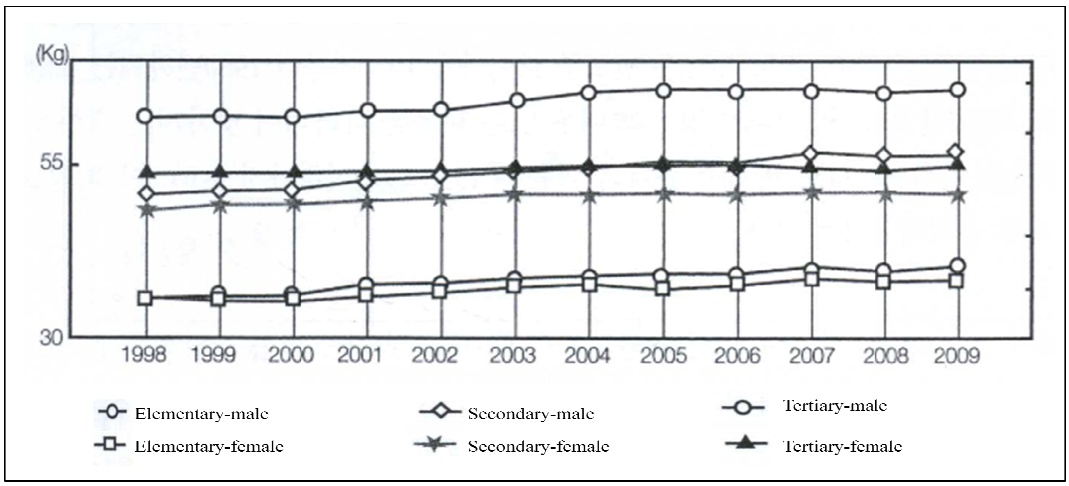


Figure 11.Student Physical development treads (weight) 1998-2009



Source: Korean Educational Development research Institute

B. Nutrition and health index

As compared to the past, overall nutrition and health index in Korea has increased. Chai (2011) assumes that there is substantial correlation between deworming and improved nutrition and health index. Sarah Baird et al.(2011) hold that there is evidence that adult health also improved as a result of deworming, saying that many studies have found that self-reported health reliably predicts actual morbidity and mortality even when other known health risk factors are accounted for (Idler and Benyamini 1997, Haddock *et al.* 2006, Brook *et al.* 1984).[5]

The growing evidence that deworming improves immunological resistance to other infections, such as malaria (i.e., Kirwan *et al.* 2010), also indicates that health benefits might be caused by deworming beyond those captured solely in anthropometric measures.

C. Decrease in surgical ascariasis

Chai et al.(1991) studied the frequency of Biliary Ascariasis based on longitudinal data that obtained from total 102 dissertations on biliary and other complications of ascariasis reported from general hospitals from 1955 to 1990. The analysis shows that the number of case reported from 102 dissertations on biliary and other complications of ascariasis was total 1,129. Among them, a case of Biliary Ascariasis had the greatest number (1,198 cases, 92.2%), appendicitis was 44 cases (3.4%), intestinal obstruction was 39 cases (3.0%),

[5] Note that it is somewhat difficult to interpret this impact causally since it may partially reflect health gains driven by the higher adult earnings detailed above, in addition to the direct health benefits of earlier deworming. Yet the fact that there were similar positive and statistically significant impacts on self-reported health in earlier periods, namely, in surveys administered in 1999 before most in sample individuals were working (see Table 11, panel C and Miguel and Kremer 2004), suggests that at least part of the effect is directly due to deworming. Sarah Baird et al.(2011)

pancreatic duct obstruction was 17 cases (1.3%), and a case of peritoneal abscess formation was 1 (0.1%).

Table 9.Surgical conditions of ascariasis reported during 1955-1989 in Korea

Conditions	No. cases reported	% to total cases
Biliary ascariasis	1198	92.2
Appendicitis	44	3.4
Intestinal obstruction	39	3
Pancreatic duct obstruction	17	1.3
Peritoncal abacess formation	1	0.1
Total	1299	100

Source: Chai et al (1991).“Reduction in the incidence of biliary and other surgical complications of ascariasis according to the decrease of its national egg prevalence in Korea”, The Korean Journal of Parasitology. Vol 29

The ratio of biliary Ascariasis patients to total Biliary surgery patients showed a high frequency range of 8 -20% from 1955 to 1970, and its ratio started rapidly decreasing to 4-8% from 1970-1980. Finally, the ratio reached almost 0% since 1980. On the other hand, the ratio of biliary Ascariasis patients to cholelithiasis patients was high (9-16%) from 1958 to 1970, and then rapidly decreased since 1970.

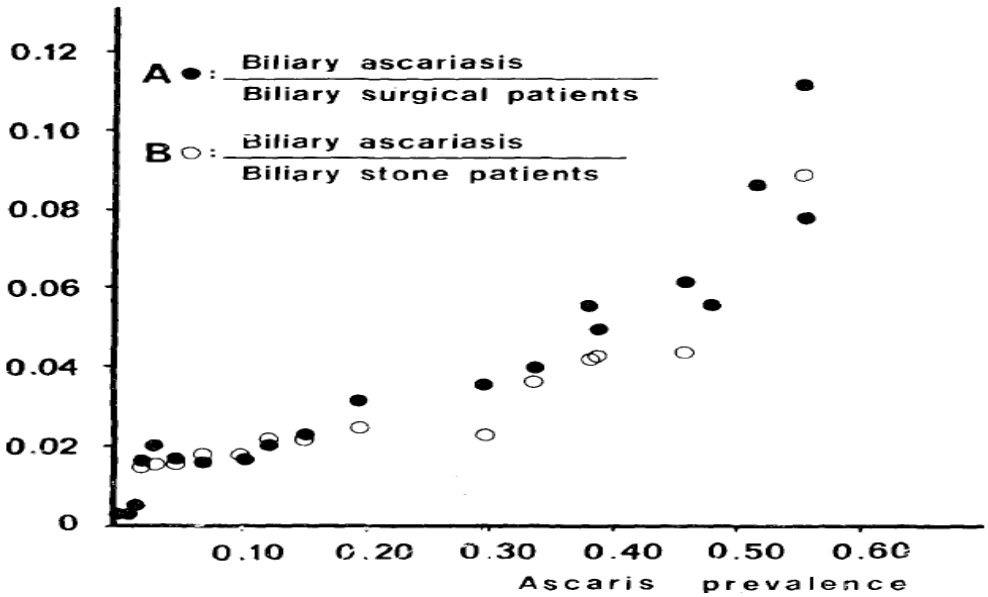
Table 6 represents these two indicators by year – the ratio of biliary Ascariasis patients to total Biliary surgery patients (A) and the ratio of biliary Ascariasis patients to cholelithiasis patients (B). Figure 5 shows clear correlation between these two annual factors and national student egg prevalence rate.

The number of biliary Ascariasis by year also supports identical result. In other words, from 1955 to 1969, annual average cases of biliary Ascariasis were more than 38. However, reported number of cases was decreased to 10 from 1970 to 1980, to 8 in 1985. From 1986 to 1989, only one case was reported. On the other hands, the appendicitis patients caused by

parasites accounted for approximately 1% before 1970. However, its cases decreased to almost 0 % since 1970. There were several cases of parasites which cause intestinal obstruction by 1975, but the cases were barely reported since 1975.

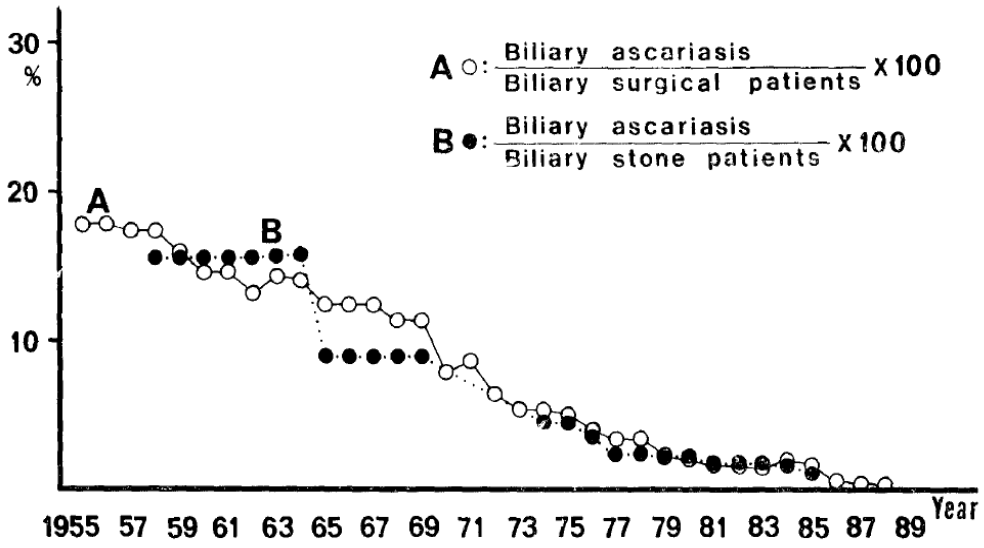
To sum up, the successful control over parasites can be judged that they had significantly contributed to improving public health by reducing other complications of ascariasis as well as parasite infection rate.

Figure 12.Positive correlations of Ascaris egg prevalence and proportion of biliary ascariasis case/biliary surgical patients (A), and Ascaris egg prevalence and proportion of biliary ascariasis cases/biliary stone pariones (B)



Source: Chai et al (1991). "Reduction in the incidence of biliary and other surgical complications of ascariasis according to the decrease of its national egg prevalence in Korea. The Korean Journal of Parasitology. Vol 29

Figure 13.Decreasing patterns of the proportion (%) of biliary ascariasis cases/biliary surgical patients (A) and of biliary ascariasis cases/biliary stone patients (B)



Source: Chai et al (1991). "Reduction in the incidence of biliary and other surgical complications of ascariasis according to the decrease of its national egg prevalence in Korea", The Korean Journal of Parasitology. Vol 29

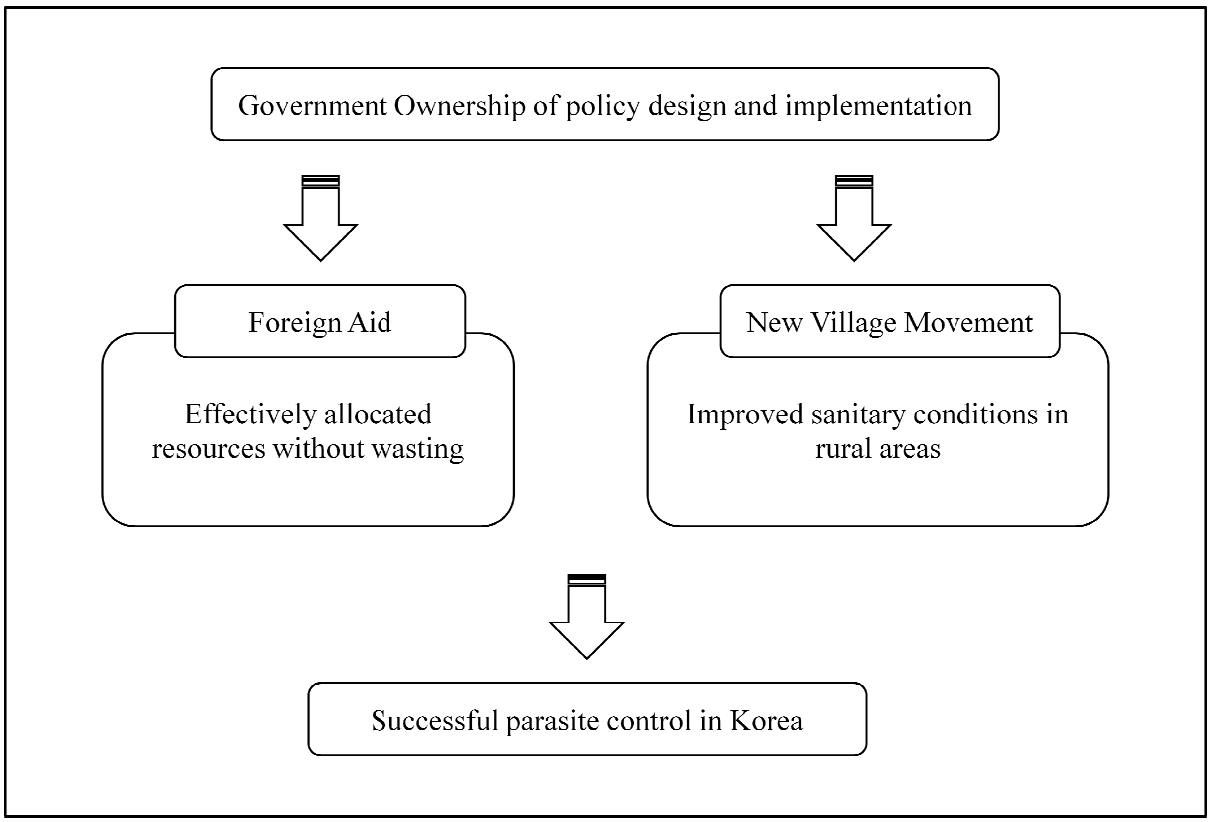
D. Increase in life expectancy

There are a myriad of factors influencing life expectancy. One of them is whether people are come down with diseases. Especially, cancer of leukemia can be direct elements. Parasites are also crucial factor. In particular, intestinal parasites or ascaris either threaten the life of people directly or enfeeble the body over a long period of time. Although it is not easy to prove the benefit of deworming directly, it is considered that deworming played a significant role in increasing life expectancy.

Ⅵ. POLICY IMPLICATION

Korea's deworming is unique because Korea completed its deworming program in the very short period of time under the specific mechanism. First, foreign aid played a significant role in launching deworming project. More importantly, Korea had improved sanitation conditions through the New Village Movement in the early 1970. The New Village Movement ignited the general public's desire for environmental cleanup by providing incentives based on merit-based approach. On top of that, under the strong governmental ownership, Korea could effectively allocate limited resources into the New Village Movement, and it maximized deworming impacts dramatically. This mechanism is well displayed in Figure 14.

Figure 14.Mechanism of Korea's deworming



In developing this analysis, I put forward few policy implications for developing countries facing with deworming issues. It has been proven that deworming has positive impacts on public health. In this regard, the deworming issue is drawing tremulous attention nowadays. Then, which policy tools should be established for the success? A successful policy for deworming in developing countries might be realized when three fundamental components are satisfied; financial resources for the program, a centrally coordinated process, and sanitation oriented program.

First, foreign aid can be useful resource that is fundamental condition for launching parasite control programs in developing countries. In practice, many developing countries have never even dreamed of parasite control programs due to financial constraints. However, deworming is not negligible matter because it can determine the future of the nation, affecting public health. Then, what would be a solution to financial problem in developing countries? The answer lies in foreign aid from advanced countries or international organizations such as World Bank and ADB. Indeed, many developing countries rely on foreign assistance to implement various development plans as well as deworming projects. In the case of Kenya, thanks to the wholehearted assistance and financial resources from the Dutch nonprofit organization Christelijk Africa (ICS), they were able to begin a primary school deworming project (PSDP), which has had a significant positive impact on their society in terms of education and public health.

Without enough financial resources, no program can be effective. Thus, relying on foreign aid from advanced countries is not only the most feasible and easiest way to secure financial resources, but is also indispensible for the introduction of the program in developing countries. In short, obtaining financial resources is the first fundamental problem that developing countries should resolve for the program. However it is not all. How to utilize such resources is another important matter. Even if developing countries could solve the

insufficient funding problem, if they waste resources it will result in ineffective outcome. In addition, since the financial crisis of 2008, donor countries are less likely to spend their expenditures on Official Development Assistance (ODA). Under the circumstance, each developing country should allocate its limited foreign aid more effectively than ever. Without being aware of these lessons, developing countries might fail to achieve progress through its deworming project.

Second, to optimize the effectiveness of deworming, governments should create favorable conditions through centrally coordinated processes with strong government ownership. The importance of centrally planned intervention surrounding parasite control program is manifest in Korean case. Parasite control program was coeval with New Village Movement, which pursued improving living standards in rural area under strong government guidance. Moreover, through the enactment of parasite prevention laws, the government paved the way for the enforcement of the program. These two factors played a significant role in maximizing the effectiveness of the parasite control program in Korea. This is largely because New Village Movement's performance-based approach not only inspired an ethic of self-help but also prevented corruption. Since villages with superior performances were able to receive more materials from the government, the residents worked with one mind without wasting resources. Thus, it is obvious that even though foreign aid was secured and allocated into the program, the program would not have been so successfully carried out if it was not under government control. For these reasons, parasite control program should be implemented under a "Big push" mechanism to encourage people to actively participate in the program, preventing further corruption. In particular, when it comes to the corruption problem, developing countries should pay more attention to deal with that issue. Compared to advanced countries, developing countries have a relatively higher level of corruption, and more seriously, the central governments do not have ability to control corruption. It is true

that their lack of ability is a main obstacle to push forward with the deworming project in developing countries. Thus, it is important for developing countries to place parasite control programs under the strong control of government though centrally coordinated programs.

Lastly, the government should focus on improving sanitary conditions for successful parasite control program. The more improved sanitation facilities are, the less parasitic diseases occur. In general, developing countries have less access to improved sanitation facilities which is why developing countries suffer from parasitic diseases, ultimately slowing their down economic progress. To be specific, it is more desirable to target rural areas, rather urban areas, when it comes to improving sanitation facilities. Even in China, world's second biggest economy, the parasite infection rate in rural areas is substantially high, while it is rare to find parasite infection in urban area. It seems that the gap between the levels of sanitation between two areas has led to a significantly difference in parasite infection rates. Therefore, developing countries should not miss the importance of sanitation improvement in rural areas as well as urban areas for parasite eradication.

We have look over some lessons learned. To sum up, Korea's successful parasite control infers that the effectiveness of its parasite control program had a more satisfactory outcome when the environmental cleanup is supported by strong government intervention while allocating foreign aid effectively. Therefore, developing countries should keep in mind that combining parasite control programs with centrally governmental programs, the so-called "big push", is essential for success.

Ⅶ. CONCLUSION

The purpose of this paper is both to clarify the driving force behind deworming by analyzing Korea's successful parasite control experience and to offer information about the impacts of dewomring.

What was driving force behind the Korea's parasite eradication? Korea not only overcame financial constraints by taking advantage of foreign aid but also effectively allocated foreign aid without wasting of the resources. More importantly, it was coeval with the New Village Movement focusing on improving sanitary conditions. Since all policy designs such as foreign aid, the New Village Movement, and legal support were controlled and implemented by strong government ownership, Korea could eradicate parasitic diseases successfully in the late 1970s regardless of poor economic status. Hence, Korean case deserves being analyzed because Korea provides developing countries with hope that developing countries also can achieve deworming through appropriate policy design under strong government ownership without reference to their poor economic status.

The essence of deworming policy lies in sanitary conditions. As I already explained in Section 4, parasitic diseases such as lymphatic filariasis, soil-transmitted helminthes, and schistosomiasis have negative relationship with improved sanitary conditions. It means that improving sanitary conditions is indispensable for successful deworming.

To conclude, deworming has higher returns in terms of public health, education, and even economic progress, and that is why developing countries should complete parasite control program. This paper would be a useful guideline for developing countries indicating how to secure financial resources and what policy should be implemented for successful deworming. It is obvious that deworming is an important policy issue in developing countries because prevalent parasitic diseases are one of primary obstacles to further economic

progress as well as public health. Therefore, Korean case would provide valuable lessons for developing countries suggesting the way in which they should move ahead for successful deworming in a short period of time.

APPENDICIES

Appendix A

Parasite infection rate according to provinces

Year	Seoul	Busan	Kyungki	Kangwon	Chungbuk	Kyungbuk	Chungnam	Cheonbuk	Cheonnam	Kyungnam	Jeju
1969	39.2	42.4	56.7	53.1	58.9	57.3	61.9	63.8	59.9	63.6	23.3
1970	37.7	48.1	57.2	49.5	64	55.6	62.7	69.2	57.4	68.7	36.7
1971	31.9	42	54.4	49.7	59.3	47.8	57.5	61.3	58.3	66.4	36.9
1972	30	35.4	46.3	46.5	51.9	42.8	53.3	52.3	50.7	62	30.7
1973	28	34.3	48.1	42.5	49.2	46	55.3	55.4	60	61.6	29.6
1974	20.5	26.6	40.6	35.7	45.9	30.1	41.8	40.5	52.3	62.1	14.5
1975	19.1	26.3	37.2	32.1	39.7	32.2	46.6	45.8	51.6	52.1	17.5
1976	14.5	23.7	31.6	31.2	38	27.5	40	39.7	43.7	45.1	14.2
1977	13.1	17	25.3	30.9	29.4	25.9	32.6	36.8	43.3	37	15.2
1978	6.5	9.7	17.2	21.1	23.6	16.1	21	24.2	27.6	26.4	11.1
1979	4	5.9	14.1	19.5	18.8	12.9	14.8	20.9	19.6	22	12.6
1980	2.9	5.4	11.9	12.8	13	9.6	11.6	19.5	16.4	17.4	13
1981	2.4	4.2	8	11.5	10.2	8.8	10.1	14.8	15.3	15.9	12.9
1982	1.7	2.5	4.6	8.6	6.5	7.6	7.1	10.8	10.9	11.6	11.2
1983	1	1.4	2.9	7	3	6.1	5.1	8.3	7.5	8.8	1.9
1984	0.6	0.1	1.8	6	2.3	2.6	2.7	5.9	6	4.8	1.4
1985	0.3	0.5	1.2	5	1.5	1.5	2	4.5	3.8	3.1	1.2
1986	0.1	0.3	0.8	3.6	1.1	0.8	1.1	2.7	2.5	2.1	0.4
1987	0.09	0.06	0.4	1.7	0.8	0.5	0.8	1.6	2.1	1.3	0.3
1988	0.02	0.08	0.2	1.7	0.3	0.2	0.5	0.9	1.5	0.8	0.2
1989	0.03	0.03	0.1	1.4	0.3	0.1	0.4	0.6	0.9	0.4	0.08
1990	0.006	0.02	0.05	0.9	0.2	0.06	0.3	0.5	0.7	0.3	0.05
1991	0.05	0.008	0.02	0.5	0.06	0.03	0.09	0.2	0.3	0.1	0.02

Source: Korean parasite management ODA business model development, KOPFH & KAPH, 2011.7

Appendix B

Trends of positive for egg prevalence according to elementary, middle, and secondary school

Year	Elementary (%)	Secondary (%)	Tertiary (%)
1969	57.1	43.1	39.2
1970	58.7	46.2	40.1
1971	54.5	44.1	37.3
1972	49	39.6	32
1973	52.4	40.9	32.5
1974	42.5	32.7	24.6
1975	44	32.8	24.9
1976	39.5	28.7	22.2
1977	34	26	19.8
1978	22.8	16.6	12.2
1979	18	13.1	9
1980	14.7	10.5	7.3
1981	12.4	8.6	6.3
1982	8.45	6.2	4.3
1983	5.7	4.3	3
1984	3.8	2.8	2
1985	2.6	1.9	1.2
1986	1.7	1.3	0.8
1987	1.1	0.9	0.5
1988	0.7	0.6	0.4
1989	0.4	0.4	0.3
1990	0.3	0.2	0.1

Source: Korean parasite management ODA business model development, KOPFH & KAPH, 2011.7

Appendix C

Result of examination for parasites that targets workers

Year	No. of subjects	Egg prevalence	%	A.I	H.w	T.t	T.o	E.v	C.s	P.w	M.y	T.s	H.n	Other
1973	29338	22042	75	13940	1038	15246	841	23	1724	3	—	188	0	10
1974	39517	25811	65	15107	143	15646	21	13	1377	0	—	88	0	14
1975	159699	102218	64	67813	783	62092	288	62	4024	8	—	543	0	329
1976	184601	78519	43	52044	380	40909	188	26	3001	14	—	476	0	178
1977	170742	66956	39	43442	137	34433	38	47	1600	9	—	330	0	532
1978	272244	76393	28	48063	102	34382	57	314	2528	6	512	153	109	15
1979	527145	137147	26	86719	865	65406	246	662	5210	7	1192	303	188	34
1980	628172	147462	24	90764	928	69524	77	1413	5372	6	1536	358	266	25
1981	692880	130445	19	79795	417	57482	196	789	5200	5	1801	323	133	21
1982	530327	74423	14	40003	124	20148	548	4299	5504	4	1449	199	159	8
1983	470895	45655	9.7	27908	228	14641	62	1158	1842	4	574	158	78	4
1984	425676	31921	7.5	20742	26	7548	9	386	2115	1	462	148	87	1
1985	398462	20292	5.1	10533	14	7548	9	447	2462	3	395	145	129	1
1986	428308	19743	4.6	11125	34	6400	5	243	2568	8	519	132	95	2
1987	406514	12981	3.2	6436	8	5217	0	245	2044	6	218	121	84	3
1988	127233	3109	2.4	464	1	618	0	19	1695	11	340	37	22	2
1989	38636	1724	4.5	90	0	168	0	10	1338	5	144	16	15	0
1990	52524	1615	3.1	93	2	139	0	662	660	3	38	12	3	1
1991	30734	938	3.1	19	1	102	0	37	674	5	89	19	4	0
1992	14657	458	3.1	34	0	55	0	68	274	2	24	4	0	0
1993	23651	828	3.5	8	0	16	0	11	547	3	247	3	0	0
1994	4053	112	2.8	2	0	3	0	2	61	1	44	0	0	0

Source: Korean parasite management ODA business model development, KOPFH & KAPH, 2011.

Appendix D

Population suing improved drinking-water sources and sanitation facilities, and LF

Country	LF (%)	Population using improved Sanitation facilities (%)	Population using improved Water-resources (%)
Benin	63.2	12	75
Burkina Faso	99.3	11	76
Cameroon	76.3	47	74
Comoros	73.8	36	95
Ghana	48.9	13	82
Kenya	7.9	31	59
Madagascar	89.0	11	41
Malawi	92.0	56	80
Niger	71.7	9	48
Nigeria	42.0	32	58
Senegal	45.1	51	69
Sierra Leone	94.8	13	49
Togo	20.9	12	60
Uganda	42.3	48	67
Tanzania	95.6	24	54
Brazil	1.5	80	97
Dominican Republic	2.6	83	86
Guyana	83.8	81	94
Haiti	88.7	17	63
Egypt	0.7	94	99
Yemen	0.5	52	62
Bangladesh	51.1	53	80
India	52.6	31	88
Indonesia	50.5	52	80
Maldives	0.6	98	91
Myanmar	82.8	81	71
Nepal	80.0	31	88
Thailand	0.1	96	98
Timor-Leste	97.0	50	69
Cambodia	3.6	29	61
French Polynesia	98.1	98	100
Laos	0.2	53	57
Malaysia	4.1	96	100
Marshall Islands	1.8	73	94
Papua New Guinea	65.1	45	40
Philippines	32.9	76	91
Samoa	86.0	100	—
Tuvalu	97.7	84	97
Viet Nam	0.8	75	94

Source: WHO statistic

Appendix E

Population suing improved drinking-water sources and sanitation facilities, and STH

Country	STH (%)	Population using improved sanitation facilities (%)	Population using improved water-resources (%)
Angola	41.5	57	50
Benin	41.1	12	75
Botswana	30.8	60	95
Burkina Faso	40.9	11	76
Burundi	36.5	46	72
Cameroon	38.3	47	74
Cape Verde	35.4	54	84
Central African Republic	38.7	34	67
Chad	14.6	9	50
Comoros	33.2	36	95
Congo	35.3	30	71
Cote d'Ivoire	40.9	23	80
Democratic Republic of the Congo	44.2	23	46
Ethiopia	72.1	12	38
Gabon	34.1	33	87
Gambia	39.7	67	92
Ghana	2.0	13	82
Guinea	40.5	19	71
Guinea-Bissau	42.3	21	61
Kenya	39.4	31	59
Lesotho	35.1	29	85
Liberia	40.9	17	68
Madagascar	39.0	11	41
Malawi	45.3	56	80
Mali	35.5	36	56
Mauritania	35.8	26	49
Mauritius	22.0	91	99
Mozambique	40.6	17	47
Namibia	33.6	33	92
Niger	45.6	9	48
Nigeria	39.3	32	58
Rwanda	37.5	54	65
Sao Tome and Principe	38.0	26	89
Senegal	41.6	51	69
Sierra Leone	39.3	13	49
South Africa	29.2	77	91
Swaziland	37.7	100	100
Togo	41.6	12	60
Uganda	45.2	48	67

Tanzania	41.0	24	54
Zambia	43.2	49	60
Antigua and Barbuda	25.4		
Belize	31.2	90	99
Bolivia	34.4	25	86
Brazil	24.9	80	97
Colombia	27.5	74	92
Costa Rica	24.8	95	97
Cuba	17.0	91	94
Dominican Republic	30.5	83	86
Ecuador	28.2	92	94
El Salvador	31.0	87	87
Grenada	26.2	97	
Guatemala	39.0	81	94
Haiti	34.6	17	63
Honduras	35.3	71	86
Jamaica	28.2	83	94
Mexico	26.7	85	94
Nicaragua	33.5	52	85
Panama	27.5	69	93
Paraguay	32.1	70	86
Peru	29.0	68	82
Trinidad and Tobago	19.4	92	94
Afghanistan	35.5	37	48
Djibouti	33.8	56	92
Egypt	31.4	94	99
Iraq	38.2	73	79
Pakistan	36.4	45	90
Somalia	41.0	23	30
Sudan	36.6	34	57
Yemen	41.2	52	62
Azerbaijan	22.6	45	80
Tajikistan	35.6	94	70
Turkey	26.5	90	99
Bangladesh	33.0	53	80
Bhutan	28.6	65	92
India	30.6	31	88
Indonesia	24.7	52	80
Maldives	26.9	98	91
Myanmar	26.4	81	71
Nepal	34.7	31	88
Thailand	20.2	96	98
Timor-Leste	42.2	50	69
Cambodia	33.4	29	61
China	3.9	55	89
Laos	25.8	53	57
Malaysia	27.4	96	100
Marshall Islands	33.1	73	94
Papua New Guinea	37.3	45	40
Philippines	31.9	76	91

Samoa	37.2	100	
Tonga	34.9	96	100
Tuvalu	31.5	84	97
Vanuatu	36.9	52	83
Viet Nam	17.6	75	94

Source: WHO statistic

Appendix F

Population suing improved drinking-water sources and sanitation facilities, and Schistomiasis

Country	Schistomiasis (%)	Populaiton using improved sanitation facilities (%)	Population using improved water-resources (%)
Angola	43.1	57	50
Benin	39.5	12	75
Botswana	9.7	60	95
Burkina Faso	29.4	11	76
Burundi	14.9	46	72
Cameroon	22.9	47	74
Central African Republic	10.4	34	67
Chad	45.2	9	50
Cote d'Ivoire	41.3	23	80
Democratic Republic of the Congo	29.3	23	46
Eritrea	7.3	14	61
Ethiopia	7.6	12	38
Gabon	42.3	33	87
Gambia	32.2	67	92
Ghana	74.6	13	82
Guinea	25.8	19	71
Guinea-Bissau	36.0	21	61
Kenya	23.1	31	59
Liberia	25.9	17	68
Madagascar	56.9	11	41
Malawi	43.7	56	80
Mali	26.4	36	56
Mauritania	26.6	26	49
Mozambique	68.1	17	47
Namibia	0.6	33	92
Niger	13.8	9	48
Nigeria	23.3	32	58
Rwanda	5.9	54	65
Sao Tome and Principe	3.9	26	89
Senegal	16.5	51	69
Sierra Leone	63.3	13	49
South Africa	10.9	77	91
Swaziland	25.5	55	69
Togo	29.4	12	60
Uganda	16.3	48	67
Tanzania	50.5	24	54

Zambia	26.1	49	60
Zimbabwe	43.3	44	82
Brazil	3.5	80	97
Dominican Republic	3.0	83	86
Suriname	0.8	84	93
Egypt	2.0	94	99
Iraq	0.1	73	79
Libyan Arab Jamahiriya	5.1	97	—
Somalia	18.1	23	30
Sudan	17.3	34	57
Yemen	14.9	52	62
Cambodia	0.1	29	61
China	0.1	55	89
Laos	0.5	53	57
Philippines	0.6	76	91

Source: WHO statistic

Appendix G

Law for the prevention of Parasitic Diseases of 1966

Enactment 1966.4.25 Act 1789

Article 1.Purpose

This law is designed to improve and promote national health by preventing and eradicating parasitic diseases.

Article 2.Definition

This law defines parasitic diseases as ascaridiose, hookworm disease, teanisais, clonorchis sinensis and paragonimus westerman and other illness that was stipulated by Ministry of Health and Social affair ordinance.

Article 3.Duties of medical examination and treatment

① Those who in areas where are prone to parasitic diseases and those who in occupations having numerous contacts with the public should receive examination and treatment for parasites more than once a year.

② Principals of each school should conduct student examination for parasites and give treatment to them more than twice a year.

③ Types of examination and treatment, designation of areas, and other necessary matters based on clause 2 are determined by Ministry of Health and Social Affair ordinance.

Article 4.Installation of preventive facilities

Mayors of Seoul and Pusan, or mayors and provincial governors should install public restroom, community well, and human waste treatment facilities and manage them.

Article 5.Limitation of use of human waste

It is not permitted for anyone to use human waste as fertilizer if it is not treated by human waste treatment facilities based on Article 4 or clause 2 Article 11 of Act on the Disposal of Sewage.

Article 6.Visitation and pickup

① It is possible to collect stuffs which are required for examination and test for parasitic diseases if Minister of Health and Social Affair, mayors of Seoul and Pusan, or mayors and provincial governors recognize the necessity for prevention of parasitic diseases.

② State or local governments should give justifiable compensation for loss caused by pickup of stuffs based on previous clause.

Article 7.Designation of parasite testing agency

① Minister of Health and Social Affair, mayors of Seoul and Pusan, or mayors and provincial governors can designate parasite testing agency with testing facilities that are needed to examine human waste and food based on rules of Article 3 and Article 6.

② Matters of facilities standards, inspection method, procedures, and further examination in parasite testing agency are determined by Ministry of Health and Social Affair ordinance.

Article 8.Parasite committee

① Ministry of Health and Social Affair have a parasite committee to respond to the Minister of Health and Social Affair's request.

② All matters for organization and operating the committee are provided by executive order.

Article 9.Parasite Prevention Association

① There is Korea Association of Parasite Eradication for doing research study on parasites and preventive business.

② Korea Association of Parasite Eradication is incorporated enterprise.

③ Provision on incorporated association is applied unless there is no particular rule in this law.

Article 10.Delegation of power

Ministry of Health and Social Affairs can delegate some of authorities to mayor of Seoul, Pusan, and governors.

Article 11.Assistance

① The government can give subsidy in whole or in part for expenses as following.

I. Expenses incurred by student examination and treatment for parasites based on clause 2 Article 3.

II. Expenses incurred by facility installation and improvement based on Article 4.

III. Expenses incurred by expense account of organization as testing agency that are designated by Minister of Health and Social Affair based on clause 1 Article 7.

IV. Expenses incurred by preventive business based on clause 1 Article 9

② Mayors of Seoul and Pusan, or mayors and provincial governors can give subsidy in whole or in part for expenses as following.

I. Expenses incurred by examination based on clause 1 Article 3.

II. Expenses incurred by installation and improvement based on Article 4.

III. Expenses incurred by expense account of organization as testing agency that are designated by mayors of Seoul and Pusan, or mayors and provincial governors based on clause 1 Article 7.

Article 12.Penalty

The fine for violating clause 1 Article 3 is under five thousand won.

Article 13.Enforcement Ordinance

Requirements for this law are provided by executive order.

BIBLIOGRAPHY

Adrienne M. Lucas. *Malaria Eradication and Educational Attainment: Evidence from Paraguay and Sri Lanka*. 2010

American Journal of Tropical Medicine and Hygiene, 55, 127–134.

A study about application of the New Village Movement for regional development in Africa. UNPOG Seoul, 2011

BUTTERWORTH, A. E., R. F. STURROCK, J. H. OUMA, G. G. MBUGUA, A. J. C. FULFORD, H. C. KARIUKI, and D. KOECH. "Comparison of Different Chemotherapy Strategies Against Schistosomiasis Mansoni in Machakos District, Kenya: Effects on Human Infection and Morbidity." *Parasitology*, 103, 339–355, 1991

Duflo, Esther. "The medium-run effects of educational expansion: Evidence from a large school construction program in Indonesia", *J. of Development Economics*, 74(1), 163-197, 2004

Edward Miguel and Michael Kremer. "Worms: Identifying impacts on education and health in the presence of treatment externalities." 2004

Hyeng-Il Cheun, Yoon Kong, Shin-Hyeong Cho, Jong-Yil Chai, Joo-shil Lee, Jong-Koo Lee, and Tong-soo Kim. "Successful control of Lymphatic Filariasis in the Republic of Korea" *Korean J Parasitol*. Vol. 47, No.4 : 323-335, 2009

Jong-Yil Chai, Seung-Yull Cho, Soon-Hyung Lee and Byong-Seol Seo. "Reduction in the incidence of biliary and other surgical complications of ascariasis according to the decrease of irs national egg prevalence in Korea. The Korean Journal of Parasitology. Vol 29, No. 2, 101-111, 1991

Jin-Kwang So. "Local community governance and Saemaul Movement in Korea." Korean Association for local government Studies journal, 19(3).93~112, 2007

Joon-Kyung Kim and Kwang Sung Kim "Impact of Foreign Aid on Korea's Development"

KOFIH, Korean Association of Health Promotion. "Korean parasite management ODA Business model development." 2011

L.-C. WANG, K.-P HWANG and E.-R CHEN. "Enterobius vermicularis infection in schoolchildren: a large-scale survey 6 years after a population-based control." 2009

Sarah Baird, Michael Kremer, Joan Hamory Hicks and Edward Miguel. “Worms at Work: Long-run impacts of Child Health gains.” 2010

SABIN vaccine institute. “The Impact of Deworming on Education.” 2009

Mas, Alexandre and Enrico Moretti. “Peers at Work”, *American Economic Review*, 99(1), 112-145. 2009

Moretti, Enrico. “Workers’ Education, Spillovers and Productivity: Evidence from Plant-Level Production Functions”, *American Economic Review*, 94(3), 656-690. 2004

MUCHIRI, ERIC M., JOHN H. OUMA, and CHARLES H. KING. “Dynamics and Control of *Schistosoma Haematobium* Transmission in Kenya: An Overview of the Mwambweni Project.” 1996

OUMA, J. H. “Transmission of Schistosoma Mansoni in an Endemic Area of Kenya, with Special Reference to the Role of Human Defecation Behaviour and Sanitary Practices.” Ph.D. Thesis, University of Liverpool. 1987

Park Jin-Hwan.“The Saemaul Movement, Korea’s approach to Rural Modernization in 1970s.” Korea Rural Economic Institute. 1998