Economic Policies for Efficient Water Use in Thailand

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ABSTRACT

A Computable General Equilibrium (CGE) model was employed to investigate the economy-wide of the set of policies for Efficient Water Use in Thailand. The set of Policies composed of 2 sub-policies: collection of fee from irrigation users and adjustment of pipe water prices. The results indicated that the set of policies of demand side management was more efficient than the supply side policies. The demand side policy could decrease water use; furthermore, it could increase agricultural price, improve welfare of agricultural households and economic growth.

Key words: water use, demand side management, efficiency, computable general equilibrium (CGE), social accounting matrix (SAM)

INTRODUCTION

Thailand had faced a problem of water shortage all along. The Government has coped with the problems focusing on supply side management through increasing water storage capacity and transporting water over long distances. Demand side management, on the other hand, could be useful to emphasis on increasing efficiency among water users. This study sought the policies for efficient water use by application of Computable General Equilibrium (CGE) model.

This paper was structured as follows: Following the introduction, section 2 covered a brief overview of water resource situation and conceptual plan on efficient water use policy. Section 3 covered the structure of the CGE model with reference to its major feature. Section 4 covered impact analysis, section 5 the result and section 6 included conclusion and recommendation.

Overview of water resources in Thailand

During 1996 to 2004 water demand increased by 34.95 percentage. In 2004, water demand in Thailand was about 74,686 million cu.m. composing of 2,982 mil cu.m. for consumption, 1,503 mil cu.m. for industry, 45,538 million cu.m. for agriculture and 24,663 million cu.m. for environment,i.e. state ecological for tide control (Table 1). This growing water demand had so far been responded by increasing water storage capacity. Thailand had many water development projects of different sizes (83 large-size, 682 medium-size, and more than 90,000 small-size projects). Water storage capacity was about 71,388 million cubic meters. When comparing between water demand and water storage capacity, we saw there were water shortage.

If we considered demand side, there were 2 inefficiencies of water users in agricultural activity and water consumers. Water for agricultural activities were available free of charge, so farmers had low

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Table 1 Water demand, 1996 - 2004.

Unit : million cu.m.

Items	Year		Percent change (%)
	1996	2004	
Consumption	2,095	2,982	42.34
Industry	1,164	1,503	29.07
Agriculture	36,747	45,538	23.92
Environment	15,336	24,663	60.82
Total demand	55,342	74,686	34.95

Source: Royal Irrigation Department (RID), 2005.

interest on careful utilization. Sixty point nine seven percent of an agricultural sector was the largest water user of annual water withdrawals (Figure 1). Rice transplanting used 2,000 cu.m./rai/crop. For human consumption, pipe water supply authority [the Provincial Water Works Authority (PWA) and the Public Works Department (PWD)] bought water from Royal Irrigation Department (RID) at 0.50 Baht/cu.m then treated and sold water to household at 11.24 Baht/cu.m. At this rate, households used a lot of water which was about 150 cu.m./person/day, while the necessary requirement was 50 cu.m./person/day.

Low water prices and high subsidies for capital investments and operations and maintenance (O&M) cost threatened financial viability of irrigation supplies. This problem was particularly serious due to huge future financial resource requirements of these sectors (Mark and Ximing, 2002). Water pricing policies had been considered for better water allocation, conservation of water resources, financial sustainability, and avoiding environmental conflicts. However, water pricing policy was difficult to be implemented in the agricultural sector. Molle (2002)

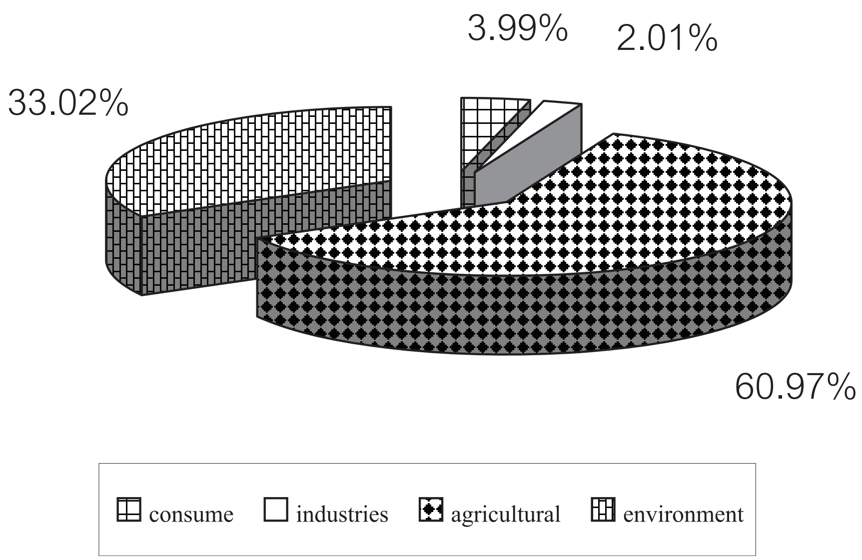

Figure 1 Share of water used, 2003
Source: Royal Irrigation Department (RID), 2005.

summarized a number of reasons why agricultural water charges remained low: a small percentage of the gross product of water, political sensitivity to increase in food prices, competitiveness on international markets. Thai farmers were poor and did not like to change pattern of transplanting. Elasticity of water demand in agriculture with respect to water prices was very low. Irrigation water pricing for full capital cost appeared unlikely in most of the developing world. So recovery of O& M costs would require a major reform in pricing policy.

This study attempted to investigate demand side management policies with a hypothesis that charge on irrigation water and increasing pipe water price was more efficient than supply side management.

MATERIALS AND METHODS

Model

Computable General Equilibrium (CGE) model was used to analyze economy wide impacts of changes in water use policies (Xinshen *et al.*,2002). The characteristics of the model were composed of 3 parts. First, it generated a set of prices consistent with equilibrium in an economy. These prices were based on production and consumption decisions, which in turn determined employment and incomes in various sectors of the economy. Second, the model specifies interactions and linkages between markets. Third, the CGE model was based on a specification of the economic structure which was critical for tracing the impact of an external shock or policy change. The setting of the model was shown below.

Each activity was assumed to maximize profits, defined as the difference between revenue earned and the cost of factors and intermediate inputs. Profits maximized were subject to a production technology. At the top level, the technology was specified by a Leontief function of the quantities of value-added and aggregate intermediate input. Value-added was itself a CES function of primary factors whereas the aggregate intermediate input was a Leontief function of disaggregated intermediate inputs. Each activity produced one commodity. The revenue of the activity was defined by the level of the activity, yields, and commodity prices at the producer level. As part of its profit-maximizing decision, each activity used a set of factors up to the point where the marginal revenue product of each factor was equal to its wage. Factor wages differ across activities, not only when the market was segmented but also for mobile factors. The quantity supplied of each factor was fixed at the observed level. An economy-wide wage variable was free to assure that the sum of demands from all activities was equal to the quantity supplied.

Aggregated domestic output was allocated between exports and domestic sales on the assumption that suppliers maximize sales revenue for any given aggregate output level, subject to imperfect transformability between exports and domestic sales, expressed by a constant-elasticity-of-transformation (CET) function. The price received by domestic suppliers for exports was expressed in domestic currency and adjusted for the transactions cost (to the border) and export taxes (if any). The supply price for domestic sales was equal to the price paid by domestic water users minus the transactions cost of domestic marketing (from the supplier to the demander) per unit of domestic sales. If the commodity was not exported, total output was passed to the domestic market.

Domestic demand was made up of the sum of demands for household consumption, government consumption, investment, intermediate inputs, and transactions (trade and transportation) inputs. To the extent that a commodity was imported, all domestic market demands were for a composite commodity made up of imports and domestic output, the demands for which were derived on the assumption that domestic demanders minimize cost subject to imperfect substitutability. This was also captured by a CES aggregation function. The import prices paid by domestic demanders also included import tariffs at fixed ad valorem rates and the cost of a fixed quantity of transaction services per import unit which cover the cost of moving the commodity from the border to the demander. Similarly, the derived demand for domestic output was met by domestic suppliers. The prices paid by the demanders included the cost of transaction services. The prices received by domestic suppliers were net of this transactions cost.

Flexible prices equilibrated demands and supplies of domestically marketed domestic output. The assumptions of imperfect transformability between exports and domestic sales of domestic output and imperfect substitutability between imports and domestically sold domestic output permitted the model to better reflect the empirical realities of most countries.

In the model, institutions were represented by households, enterprises, the government, and the rest of the world. The households receive direct and indirect income from the enterprises, and other institutions. Transfers from the rest of the world to households were fixed in foreign currency. Household incomes were paid for direct taxes, saving, consumption, and transferred to other institutions. Direct taxes and transfers to other domestic institutions were defined as fixed shares of household income. The treatment of direct tax and savings shares were related to the choice of closure rule for the government and savings-investment balances. The income of household that remained (after taxes, savings, and transfers to other institutions) was spent on consumption. Household consumption covered marketed commodities, purchased at market prices that included commodity taxes and transactions costs. Household consumption was allocated across different commodities according to "Linear Expenditure System (LES)" demand functions.

Instead of being paid directly to the households, factor incomes might be paid to enterprises. Enterprises might also receive transfers from other institutions. Enterprise incomes were allocated to direct taxes, savings, and transfers to other institutions. Enterprises did not consume. Apart from this, the payments to and from enterprises were modeled in the same way as the same payments to and from households.

The government collected taxes and received transfers from other institutions. All taxes were at fixed ad valorem rates. The government used this income to purchase commodities for its consumption and for CPI-indexed transfers to other institutions. Government consumption was fixed in real terms whereas government transfers to domestic institutions (households and enterprises) were CPI-indexed. Government savings was the difference between government income and spending.

The rest of the world was the only remaining institution. As noted, transfer payments from the rest of the world and domestic institutions and factors were all fixed in foreign currency. Foreign savings (or the current account deficit) was the difference between foreign currency spending and receipts (Bernard *et al.*, 1997).

The closure rules for macro system constraints in this model was composed of 3 parts as follows:

- ❑ Government : Flexible government savings and fixed direct tax rates
- ❑ Rest of the World: Flexible foreign savings and fixed real exchange rate
- ❑ Savings-Investment: Flexible capital formation and fixed MPS for all households

The Activities of this model were disaggregated into 23 production activities (Table 2), which produced 23 commodities and employed 2 primary inputs(Labor and Capital). On the demand side, there were 2 household groups (Agricultural and Non-Agricultural Household), one was enterprise and the other was public group.

Data

Social Accounting Matrix -SAM was used in the CGE model. It was a useful framework for preparing consistent, multi-sectoral, economic data that integrated national income, input-output, flow-of-funds, and foreign trade statistics into a comprehensive and consistent dataset (Jennifer C.,

Table 2 Code and description.

Code	Activity / commodity	Description
AC1	Activity 1 / commodity 1	Paddy
AC2	Activity 2 / commodity 2	Field crop
AC3	Activity 3 / commodity 3	Fruits
AC4	Activity 4 / commodity 4	Swine
AC5	Activity 5 / commodity 5	Other livestock
AC6	Activity 6 / commodity 6	Agricultural services
AC7	Activity 7 / commodity 7	Logging and other forestry products
AC8	Activity 8 / commodity 8	Fishery
AC9	Activity 9 / commodity 9	Mining and quarrying
AC10	Activity 10 / commodity 10	Energy
AC11	Activity 11 / commodity 11	Agricultural industries
AC12	Activity 12 / commodity 12	Textile and printing
AC13	Activity 13 / commodity 13	Other industries
AC14	Activity 14 / commodity 14	Fertilizer and pesticides
AC15	Activity 15 / commodity 15	Construction and structural clay products
AC16	Activity 16 / commodity 16	Engines and others industrial machinery
AC17	Activity 17 / commodity 17	Other services
AC18	Activity 18 / commodity 18	Restaurant and drinking place
AC19	Activity 19 / commodity 19	Transport
AC20	Activity 20 / commodity 20	Other activities
AC21	Activity 21 / commodity 21	Irrigation
AC22	Activity 22 / commodity 22	Transmission water system
AC23	Activity 23 / commodity 23	Pipe water supply

Source: Modify form INPUT- OUTPUT 2000

2002). Once a SAM for a particular year was constructed, it provided a static image, or a snapshot of a country economic structure. From SAM, the implicit parameters could be derived.

The main features of a SAM were threefold. First, the accounts were represented as a square matrix; where the incomings and outgoings for each account were shown as a corresponding row and column of the matrix. The underlying principle of double-entry accounting required that total revenue (row total) had to be equal to the total expenditure (column total) for each account in SAM. Second, it was comprehensive, in the sense that it portrayed all the economic activities of the system (consumption, production, accumulation and distribution), although it was not necessary in equivalent detail. Thirdly, SAM was flexible, in that, although it was usually set up in a standard, in the basic framework there was a large measure of flexibility both in the degree of disaggregation and in the emphasis placed on different parts of the economic system.

The Social Accounting Matrix for this study was extended to incorporate water resources which reflected the true scarcity of water for different uses. The intersectoral flows reflected the process by which irrigation water was produced and transmitted to 3 Activities such as agriculture, surface pipe water and transmission raw water system. Each of these flows appeared as a cell entry in the condensed SAM in Table 3. There was a Royal Irrigation Development (RID) which provided irrigation water to activities. Agriculture account used irrigation water at zero

Table 3 Social Accounting Matrix was extended to incorporate water resources.

Items		Activities						Commodities																	
		Agricultural	Industry	Service	Irrigation water	Pipe water	Tranmission water	Agricultural	Industry	Service	Irrigation water	Pipe water	Tranmission water	Labor	Capital	Agricultural household	Non-agricultural household	Firms	Government	Direct tax	Indirect tax	Subsidy	Save/invest	Rest of world	Total
Activities	Agricultural																								
	Industry																								
	Service																								
	Irrigation water																								
	Pipe water																								
	Tranmission water																								
Commodities	Agricultural																								
	Industry																								
	Service																								
	Irrigation water	A				B	C																		
	Pipe water																								
	Tranmission water																								
	Labor																								
	Capital																								
	Agricultural household																								
	Non-agricultural household																								
	Firms																								
	Government																					-A-B-C			
	Direct tax																								
	Indirect tax																								
	Subsidy	-A				-B	-C																		
	Save/invest																								
	Rest of world																								
	Total																								

price and other accounts used irrigation water at 0.50 Baht/cu.m. There was then in principle a flow from agriculture to RID represented by the amount "A" "B" and "C" for agricultural activity, pipe water supply and water transmission system respectively. This amount would be measured at market prices and corresponds to the actual costs of production and transmission of water. Since the RID bore positive costs from supplying irrigation water, activities were in effect receiving a subsidy or transfer payment from the government. These appeared as entry "-A","-B" and "-C".

Simulation analysis

We used Social Accounting Matrix (SAM) and set of elasticity to calibrate unknown parameters and to get structure equations at benchmark equilibrium. A very important part of any CGE-analysis was to examine the sensitivity of the results. There were two main reasons for this. The first problem was well known from traditional econometrics : namely, that the model could be very sensitive to the specification of the functional forms. In a CGE-model this meant examining the consequences of changing some of the equations or assumptions. The second problem was caused by the fact that estimates generated by CGE model did not come with standard deviations, since the calibration procedure leaves zero degrees of freedom. These exogenous parameters were usually crucial to the behavior of the model, and often minor change in an exogenous parameter could have a large impact. For CGE-model, the main variable that would be studied in the sensitivity was the Equivalent Variation (EV). This was done mainly to emphasize the focal point for CGE-models were welfare analysis.

From analysis, the model was valid because when we changed Armington elasticity within an interval of [-70 %, 70%] a change in Equivalent Variation (EV) were [-0.49 %, 3.43 %] relative to a central case. This model could be used for simulation analysis.

Simulation was developed against two 'time frames' to capture different types of adjustment to the shock. In this study, there were 2 scenarios as follows:

❑ Supply side management: improving transporting water system as shift parameter by increasing 30 % from base case.

❑ Demand side management: collecting fee from irrigation user at recovery of O& M costs rate, adjusting pipe water price by increasing 5 %

The effect from shock was measured in the medium-run time frame which the economic system could reallocate both labor and capital (Jennifer M., 2002). The percentage change in variables of the shock in this study was composed of variables such as domestic production, domestic consumption, export, import, household consumption, household income after tax, government income, investment, primary factor demand, price of primary factor, price index of composite consumption, real GDP and equivalent variation.

RESULTS

The effect of shock was provided in Table 4-5. Each table recorded the percentage from benchmark equilibrium of variables.

In simulating the impacts of the supply side management, when irrigation production efficiency increased 30 %, raw water demand would increase 645.84 million cu.m. The agricultural activities such as transplanting rice, field crop and fruits would expand 1.29, 1.32, and 1.42% respectively. Expansion in rice transplantation was due to farmers' ability to increase water use without any payment on water supply. When agricultural products were increased, the price of them was decreased. For industrial products, it almost increased while the prices of some industry product were increased and some were decreased. Water consumption for agricultural and non-agricultural household increased 0.98 and 1.15% respectively. The production of pipe water supply and water transmission increased according to increase in industry product and consumption. The cost of living declined by 1.12 percent. This aggregate welfare gain was also captured by the increase in consumer's total consumption. In other words, the equivalent variation (EV) of agricultural and non-agricultural household would increase by 8,363.83 and 30,450.79 million Baht respectively. Real GDP would grow 0.73 %.

From simulation on demand side management, when set of policies were used, agricultural activities reduced by 0.37, 0.29, 0.32 % for transplanting rice, field crop, and fruit respectively, at the same time the price of these were increased. Some of industry production was decreased. Water consumption for agricultural and non-agricultural household decreased 1.35, and 1.38 % respectively. As a whole, raw water demand was decreased 0.32 or 136.72 mil cu.m. The equivalent variation (EV) of agricultural household decreased 0.15 % or 1,600.38 mil Baht. Real GDP grew slightly 0.27 %.

CONCLUSION

The supply and demand side management policies could be analysed in the context of a Social Accounting Matrix (SAM) framework and Computable General Equilibrium (CGE) model. Two simulations were carried out to show the policy impacts. The result suggested that if in the future water resource policies remained unchanged, on supply side management, there would be water use in-efficiency, water demand would increase all along. In this study, water demand increased 645.84 million cu.m. via raw water supply, which was mostly used in agriculture. Although supply side management could lead to growth of GDP and better welfare of household, water shortage would still take place in the future. Conversely, the demand side management could relieve water shortage because water demand decreased 136.72 million cu.m. So, water could be reserved for use during the late raining. Furthermore it could increase agricultural price. Although economic

Table 4 Effect of supply side policies.

Unit: Percent

Activities/commodities	Price		Quantity								VAT
	Consumtion	Production	X	Xd	E	M	AHcon	NAHcon	L	K	
Micro level											
Activity 1 / commodity 1	-5.1984	-5.1984	1.2962	0.0130	11.2676	0.0000	2.4509	2.3646	-1.6790	2.8875	-0.0174
Activity 2 / commodity 2	-0.0892	-0.0993	1.3176	0.0134	0.1958	-0.0579	1.2961	1.3276	1.1493	1.4085	0.0107
Activity 3 / commodity 3	-0.4154	-0.4729	1.4224	0.0143	0.9427	-0.2697	1.3658	1.3901	0.3752	1.6468	0.0052
Activity 4 / commodity 4	-0.9036	-0.9039	1.0816	0.0141	0.8144	-0.5883	0.0000	0.0000	1.0609	1.0931	0.0399
Activity 5 / commodity 5	0.1259	0.1307	1.8199	0.0188	-0.2539	0.0818	1.2508	1.2869	1.7814	1.8280	0.0193
Activity 6 / commodity 6	-2.1607	-2.1607	-1.3886	-0.0140	4.4599	-1.4098	0.0000	0.0000	-2.6510	-1.0436	-0.0104
Activity 7 / commodity 7	0.5104	2.4489	2.6559	0.0646	-2.8310	0.3142	1.1690	1.2130	2.6528	2.6575	0.0063
Activity 8 / commodity 8	0.3421	0.3458	1.4652	0.0149	-0.6814	0.2222	1.2037	1.2447	1.1821	1.5598	0.0114
Activity 9 / commodity 9	0.2080	0.2269	0.4029	0.0041	-0.2669	0.1871	2.7794	3.7199	0.4423	0.3888	0.0020
Activity 10 / commodity 10	0.4869	0.9593	2.5318	0.0255	-1.1332	0.4327	1.1732	1.2174	2.5518	2.5225	0.0136
Activity 11 / commodity 11	-0.6897	-0.7722	1.3706	0.0148	0.7884	-0.6198	1.4262	1.4445	1.2890	1.4079	0.0186
Activity 12 / commodity 12	-0.1327	-0.1613	1.0897	0.0136	0.1511	-0.1192	1.7112	1.7175	1.1579	1.0599	0.0127
Activity 13 / commodity 13	0.0925	0.2099	2.0683	0.0248	-0.2132	0.0821	1.6126	1.6725	2.2500	1.9888	0.0202
Activity 14 / commodity 14	-0.3432	-0.3946	0.5584	0.0090	0.2309	-0.3085	1.3974	1.5267	0.2334	0.6628	0.0042
Activity 15 / commodity 15	-0.0375	-0.0550	0.7563	0.0114	0.0431	-0.0337	1.5042	1.7667	0.9089	0.6835	0.0107
Activity 16 / commodity 16	-0.0444	-0.0636	1.1212	0.0112	0.0763	-0.0399	1.7432	1.6912	1.2629	1.0461	0.0141
Activity 17 / commodity 17	0.8128	0.8512	0.2771	0.0028	0.0000	0.7312	2.0384	1.8088	-0.5498	1.3518	0.0044
Activity 18 / commodity 18	-0.2000	-0.2121	1.2964	0.0130	0.2549	-0.1799	1.7979	2.4650	1.3409	1.2772	0.0147
Activity 19 / commodity 19	0.0906	0.0947	0.6017	0.0060	-0.1135	0.0816	1.2573	1.2928	0.6214	0.5888	0.0050
Activity 20 / commodity 20	-6.4774	-6.5713	-8.1105	-0.0811	0.0000	-5.8535	2.7608	2.6412	-9.5297	-7.8115	-0.0216
Activity 21 / commodity 21	-3.9401	-3.9401	1.2911	0.0129	0.0000	0.0000	0.0000	0.0000	-7.1981	-23.0261	-0.0093
Activity 22 / commodity 22	0.9222	0.9222	1.9244	0.0192	0.0000	0.0000	0.0000	0.0000	1.8924	1.9279	0.0079
Activity 23 / commodity 23	0.0905	0.0906	0.9824	0.0098	0.0000	0.0815	0.9798	1.1454	0.7744	1.0905	0.0030

Macro level

Real GDP	0.7250	Wage	0.7626	Income after tax	
Government income	0.6689	Capital price	-0.0193	Agricultural household	0.6749
Investment	0.3838			Non-agricultural household	0.7020
CPI	-1.1172			utility	
				Agricultural household	0.7704
				Non-agricultural household	0.8500
				EV (MB)	
				Agricultural household	8363.83
				Non-agricultural household	30450.79

Source: analysis

note: X = domestic production, Xd = domestic consumption, E = Export, M = Import, AHcon = agricultural household consumption NAHcon = Non-agricultural household consumption, L = Labor, K = Capital, WP = Waste water permit, VAT = Value-added

Table 5 Effect of demand side policies.

Unit : Percent

Activities/commodities	Price		Quantity								VAT
	Consumtion	Production	X	Xd	E	M	AHcon	NAHcon	L	K	
Micro level											
Activity 1 / commodity 1	8.4187	8.4187	-0.3712	-0.0037	-14.9270	0.0000	-1.7918	-1.6153	-1.2377	0.0838	-0.1053
Activity 2 / commodity 2	0.2023	0.2259	-0.2876	-0.0029	-0.4430	0.1315	-0.2884	-0.2801	-0.4282	-0.2117	-0.0097
Activity 3 / commodity 3	0.4457	0.5088	-0.3221	-0.0032	-0.9998	0.2896	-0.3363	-0.3226	-0.7229	-0.2366	-0.0148
Activity 4 / commodity 4	0.2579	0.2579	-0.5664	-0.0098	-0.2306	0.1675	0.0000	0.0000	-0.4710	-0.6280	0.0116
Activity 5 / commodity 5	0.0331	0.0344	-0.8496	-0.0087	-0.0670	0.0215	-0.2550	-0.2504	-0.8181	-0.8562	-0.0097
Activity 6 / commodity 6	1.0032	1.0032	-0.1040	-0.0010	-1.9742	0.6509	0.0000	0.0000	0.8704	-0.3659	0.0053
Activity 7 / commodity 7	0.0409	0.2051	0.0681	0.0028	-0.2418	0.0265	-0.2565	-0.2517	0.1097	0.0452	0.0002
Activity 8 / commodity 8	0.4068	0.4112	-0.4524	-0.0045	-0.8095	0.2642	-0.3287	-0.3159	-0.2101	-0.5259	-0.0018
Activity 9 / commodity 9	0.1715	0.1871	0.3605	0.0037	-0.2202	0.1543	-0.6365	-0.8041	0.2982	0.3827	0.0007
Activity 10 / commodity 10	-0.0255	-0.0508	-0.1677	-0.0017	0.0606	-0.0230	-0.2432	-0.2400	-0.1725	-0.1655	-0.0007
Activity 11 / commodity 11	0.7998	0.8986	-0.4819	-0.0040	-0.9024	0.7201	-0.4061	-0.3846	-0.5755	-0.4391	-0.0138
Activity 12 / commodity 12	-0.0133	-0.0162	0.0116	0.0001	0.0151	-0.0120	-0.3219	-0.3113	-0.0730	0.0486	-0.0004
Activity 13 / commodity 13	0.0198	0.0455	0.2142	0.0026	-0.0463	0.0178	-0.3235	-0.3208	0.1054	0.2619	0.0002
Activity 14 / commodity 14	0.0774	0.0891	0.0289	0.0011	-0.0519	0.0696	-0.2727	-0.2863	-0.0850	0.0654	-0.0021
Activity 15 / commodity 15	0.1018	0.1494	0.3705	0.0063	-0.1170	0.0914	-0.3143	-0.3518	0.3333	0.3883	0.0017
Activity 16 / commodity 16	0.1036	0.1485	0.6300	0.0063	-0.1779	0.0931	-0.3643	-0.3369	0.4731	0.7133	0.0025
Activity 17 / commodity 17	-0.1141	-0.1195	0.2130	0.0021	0.0000	-0.1027	-0.4163	-0.3511	0.0555	0.4162	-0.0004
Activity 18 / commodity 18	0.1794	0.1904	-0.0293	-0.0003	-0.2278	0.1614	-0.3866	-0.5045	-0.1399	0.0184	-0.0035
Activity 19 / commodity 19	0.0800	0.0836	0.2314	0.0023	-0.1002	0.0720	-0.2641	-0.2585	0.1630	0.2763	0.0006
Activity 20 / commodity 20	-0.1122	-0.1138	-1.4403	-0.0144	0.0000	-0.1010	-0.2261	-0.2248	0.0008	-1.7389	-0.0006
Activity 21 / commodity 21	0.3797	0.3797	-0.3161	-0.0032	0.0000	0.0000	0.0000	0.0000	0.4334	-0.3676	0.0007
Activity 22 / commodity 22	3.8025	3.8025	-0.1282	-0.0013	0.0000	0.0000	0.0000	0.0000	-1.2673	-0.0028	-0.0477
Activity 23 / commodity 23	8.0926	2.6908	0.2099	0.0021	0.0000	2.4160	-1.3527	-1.3863	-0.1221	0.3827	-0.0804

Macro level

Real GDP	0.2730	Wage	-0.1452	Income after tax	
Government income	21.5536	Capital price	-0.1560	Agricultural household	-0.1574
Investment	0.5869			Non-agricultural household	-0.1522
CPI	0.1849			utility	
				Agricultural household	-0.1474
				Non-agricultural household	-0.1608
				EV (MB)	
				Agricultural household	-1600.38
				Non-agricultural household	-5760.40

Source: analysis

note: X = domestic production, Xd = domestic consumption, E = Export, M = Import, AHcon = agricultural household consumption NAHcon = Non-agricultural household consumption, L = Labor, K = Capital, WP = Waste water permit, VAT = Value-added growth would be slightly decreased and welfare of household would be decreased.

For demand side management, other policy as tradable water rights was recommended. Farmers could trade water rights when they had excess water rights. They could sell it to cities which had an increasing demand for water. For this situation, the farmers could gain from selling extra water supply at a good price and the city gained as well because purchasing these water from the government was financially cheaper than building new dams. The study on effect of tradable water rights policy to efficient water used was recommended for the future study.

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