ENVIRONMENTAL AND WASTE MANAGEMENT: ADVANCEMENTS THROUGH THE ENVIRONMENTAL MANAGEMENT SCIENCE PROGRAM

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USING STELLA SYSTEM DYNAMIC MODEL TO ANALYZE GREENHOUSE GASES' EMISSION FROM SOLID WASTE MANAGEMENT IN TAIWAN (698466)

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ABSTRACT

Using system dynamic model (SDM), such as STELLA, to analyze the waste management policy is a new trial for Taiwan's research communities. We have developed an easy and relatively accurate model for analyzing the greenhouse gases' emission for the wastes from animal farming and municipalities. With the local research data of past decade, we extract the most prominent factors and assemble the SDM. The results and scenarios were compared with the national inventory.

By comparing to the past data, we found these models reasonably represent the situation in Taiwan. However, SDM can program many scenarios and produce much prediction data. With the development of many program control tools on STELLA, we believe the models could be of further use by researchers or policy-makers to find the needed research topics, to set the future scenarios and to determine the management tools.

Keywords: waste management policy, Taiwan, system dynamic model

EXTENDED ABSTRACT

System dynamic models (SDM) have long been used as a scenarios setting and prediction tools. However, it was seldom use in Taiwan. This study first analyzed the research data on the greenhouse gases' (GHGs) emission for the last decade. Then, we used the collected and analyzed database as the baseline to establish the SDM by STELLA. Then, several scenarios were set up to compare with our national inventory and other researches.

Many researches on the GHGs were done in Taiwan, especially on the agricultural sector. Although the researches on paddy fields were the most abundant, many searches were done on other sub-sectors, such as animal farming, waste from animal farming, fruit and vegetation fields, etc. The GHGs emissions from municipal wastes were also studied well. Many local parameters were developed through these studied. After we collected and analyzed the local research data of wastes on animal farming and municipal wastes for the last decades. We use the STELLA to develop the SDMs (as shown in Figure 1 and 3). The fitted scenarios were relatively comparable to the past research and our national inventory (Figure 2 and 4, Table 1).

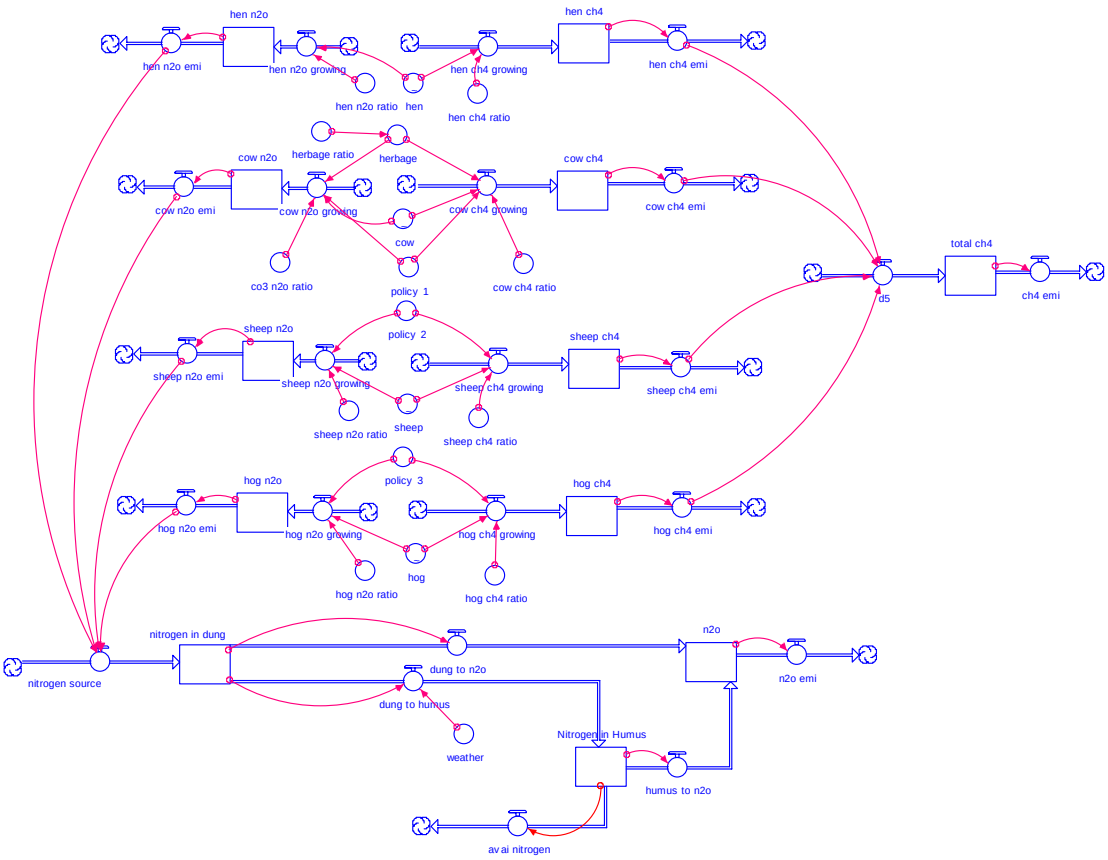

Figure 1. STELLA's SDM for GHGs emission from wastes of animal farming in Taiwan

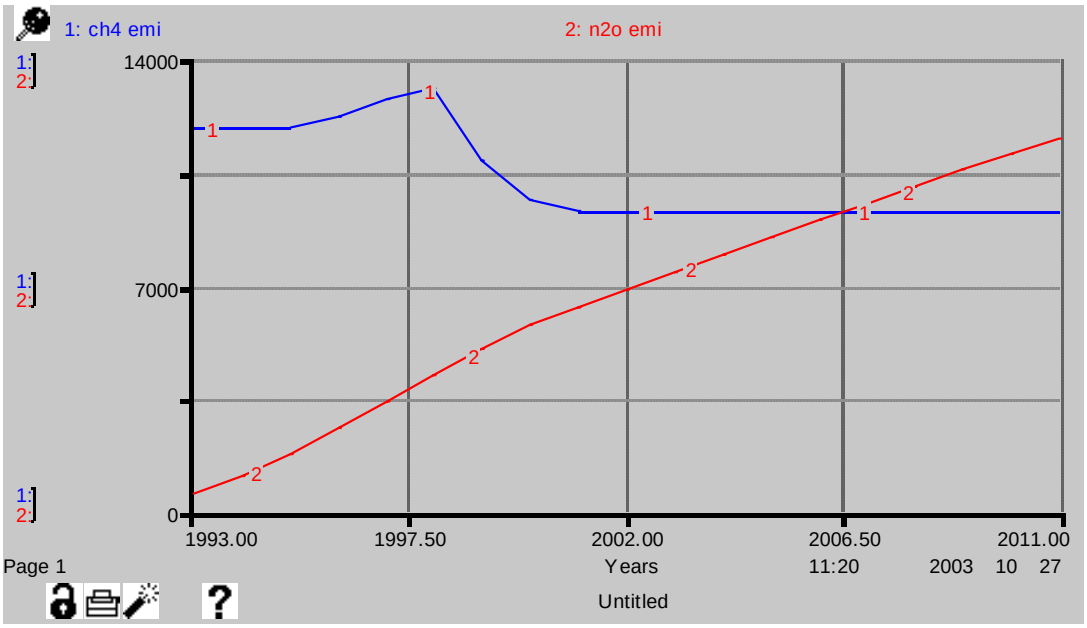

Figure 2. The simulation of GHGs emission by wastes from animal farming in Taiwan

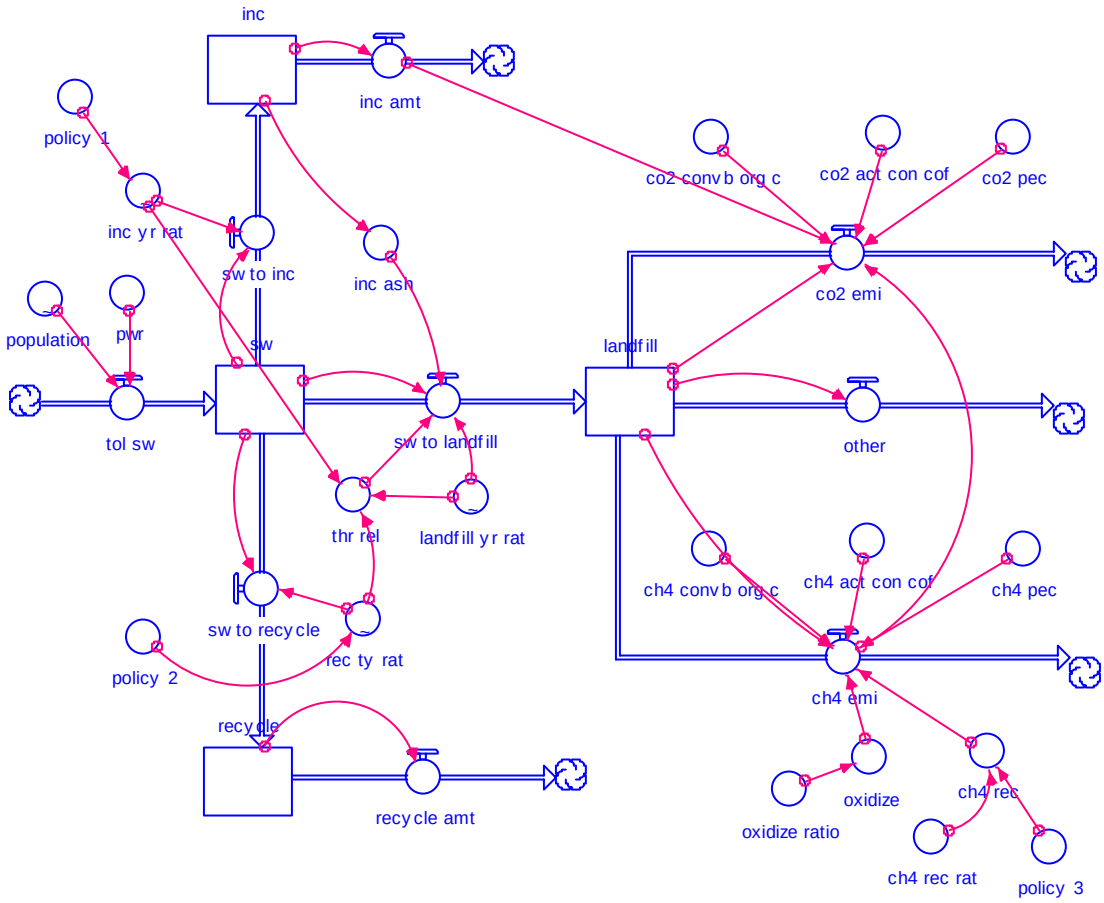

Figure 3. STELLA's SDM for GHGs emission from municipal wastes in Taiwan

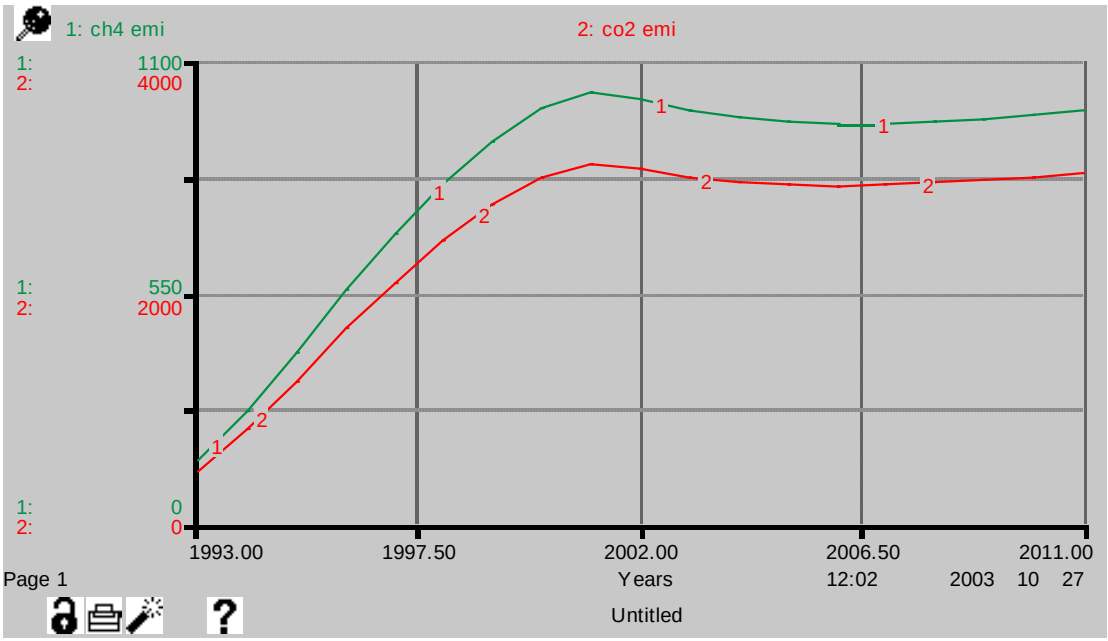

Figure 4. The simulation of GHGs emission by municipal wastes in Taiwan

Table 1. The comparison of GHGs from municipal wastes with other researchers

Yr	Methane					Carbon Dioxide (CO_2)				
	National Inventory	Past Research	This Study	Recycle Inc 20%	Recycle Dec 20%	National Inventory	Past Research	This Study	Recycle Inc 20%	Recycle Dec 20%
1993	779	758	147	146	147	2450	2084	444	442	444
1994	798	750	264	263	264	2516	2063	798	796	798
1995	724	700	405	401	405	2892	1925	1224	1213	1224
1996	776	593	555	548	556	3002	1631	1680	1658	1683
1997	725	621	686	674	689	3008	1708	2078	2040	2085
1998	708	-	806	790	811	2956	-	2442	2393	2457
1999	626	-	908	889	916	302	-	2752	2695	2777
2000	-	-	987	968	1000	-	-	2993	2936	3033
2001	-	-	1025	1009	1046	-	-	3112	3065	3175
2002	-	-	1007	996	1038	-	-	3062	3028	3157
2003	-	-	982	973	1019	-	-	2993	2966	3106

註：— no evaluation.

These models could reasonable represent the GHGs' emission situation in Taiwan. Further study found that the recycle policy in municipal wastes will not change the GHG emission, both for methane and carbon dioxide. Other strategies, such as the recovery

of methane from landfills and enhancement of methane oxidation on the landfill covers, could reduce the methane emission effectively. Many other strategies and policy tools could also be found by using program control tools on STELLA once the models had further proven their usefulness. After the proper development, we believe these models could be used by researchers or policy-makers to find their needed research topics, to set the future scenarios and to determine the management tools. One such example is to find out how active methane oxidation is among the landfill covers which would greatly benefit the accuracy on estimating and reducing methane emission from municipal solid wastes.