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ESTIMATION AND TREND ANALYSIS OF BIOMASS PRODUCTION IN RIVER BASIN IN TAIWAN: 1. CASE IN TAMSUI RIVER BASIN

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Key Words **:** Material flow, Northern Taiwan, Tamsui River basin, biomass, agricultural production

ABSTRACT

This study aims at the Tamsui River basin in the Northern Taiwan, establishing the data and information of biomass (B) of crop (C), forestry (F), fishery (F_i) and livestock (L) materials, and analyzing its yearly variations of the material productions, employees, population, GDP and other productivity items for the crop, forestry, fishery and livestock sectors. Some important indicators, such as the per capita use (PCUB) and intensity of use (IUB) of biomass materials, are established and employed to assess whether the biomass materials are efficiently used in the Tamsui River basin. The results indicate that the Tamsui River basin has become a highly developed region. Its rice production contributed to that of Taiwan has gradually reduced. However, its rice production per harvested area (M_R/A_H) has increased in recent years, indicating the improvement of the valid exploitation of the farm-land resources. In the aspects of material production of biomass (MPB) of the Tamsui River basin, the value increases from 280,407 tons in 1991, to 442,436 tons in 2000, revealing the great demand of these materials in the Tamsui River basin. In regarding to the MPB per person in the Tamsui River basin, the demands decrease from 83.3 kg/person in 1989 to 67.6 kg/person in 2000, respectively, declining about 18.88 %. However, the yearly variation curve after 1992 (54.7 kg/person) shows slow-rising trend. Thus, an improvement of the conservation of MPB in the Tamsui River basin is still needed. The values of MPB per GDP (total GDP for all industrial sectors) and GDP_B (GDP for biomass industrial sectors) in the Tamsui River basin are 22.5 kg/10^6 US$ of GDP in 1989, descending to 11.07 kg/10^6 US$ of GDP in 2000, and 1.49 tons/10^6 US$ of GDP_B in 1989, decreasing to 0.8 tons/10^6 US$ of GDP_B in 1993, approximate 50.78 and 46.17 % reductions, respectively. Here, the measurement of GDP is based on the constant price in 1996 with 1 US$ = 27.46 NT$. All these indicate that the Tamsui River basin has efficient usage of MPB toward its economical growth. The information thus obtained can be used as the reference basis for the related administration in policy making related to the economical efficiency and environment protection.

INTRODUCTION

Prior to 1980, studies on the conservative and efficient usages of the national resources already had gained much attention regarding the sustainability of the economical development [1-3]. In the late 1980s, much interest had risen in the effects of resources consumption upon the environment. Those studies have emphasized the need to analyze adequate data before we can make intelligent decisions on industrial policy [4-7]. Hsiao et al. [8] had developed a dynamic model of domestic material flows of concrete waste and employed statistical analyses to obtain projections of future material flows by using existing statistics and literature sources of data for the construction and demolition wastes generated in Taiwan. They also proposed a long-range consequence of utilizing domestic supply sources including construction waste to assess environmentally sound and economically feasible solutions for satisfying the future demand [9].

Our previous study provided the first thorough investigation of the material production of biomass of

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crop, forestry, fishery and livestock materials in Taiwan (denoted as MPB_{TWN}) [10]. Since 1986, Taiwan has strived to increase the level of competitiveness and to become a member of World Trade Organization (WTO). Therefore, most of the material production measurements are from 1986 to the present. The national information data bank has been established between 1986 ~ 1998. However, the information is the total statistics for the whole nation but not categorized or calculated for different regions (e. g. river regions or administration regions). Thus, one can neither distinguish the material production by region, nor further assess and compare the usages of the biomass resources in different regions in order to serve as the reference basis for the related administration in policy making, which is related to the economical efficiency and environment protection. For addressing the usage information of the regional resources, this study aims at the Tamsui River basin establishing the data and information of biomass of crop, forestry, fishery and livestock materials. The data and information can then be used to compute useful indicators. However, note that this study only considers the regional productions, while does not include the input and output of the biomass materials, wastes and emissions of the pollutants in the Tamsui River basin.

In addition to setup the material production of biomass (MPB) of the Tamsui River basin, this study also analyzes yearly variations of the material productions, employees, population, GDP and other productivity items for the biomass of crop, forestry, fishery and livestock sectors. Some important indicators used in previous studies [9-15], such as the per capita use (PCU) and intensity of use (IU) of materials, are established and employed to assess whether the biomass materials have efficient usage in the Tamsui River basin.

DATA AND COMPUTATION

The computation of the MPB in the Tamsui River basin employs the data collected from 1) the Statistical Abstract pressed by every city and county in the Tamsui River basin [16-20], 2) the Agricultural Statistics Yearbook published by the Council of Agriculture of Taiwan (COAT) [21] between 1986 ~ 2000, and 3) the online data bank of the agricultural global service Web of COAT [22]. The original data are in categorized or itemized form. Some data of biomass are not expressed in weight and should be converted accordingly. After calculating the MRB, we can then analyze its yearly variation and establish the indicators of the efficient usage of materials.

The Tamsui River basin includes all areas of Taipei City and Keelung City while parts of Taipei County, Taoyuan County and Hsinchu County. Noting that some biomass data are provided for the whole county, we would then have to distribute the amount for the whole county to the towns in the Tamsui River basin. For example, the calculation methods of ornamental plants in the river basin of Taoyuan County are illustrated as follows. Firstly, we took accounts of the known crop productions of towns of Taoyuan County in the Tamsui River basin and those of the whole Taoyuan County to obtain their ratios. The known crop products are rice, common crop, special crop, vegetables and fruits. The ratios are as follows.

$$R_1 = \frac{Ri_{Ta}}{Ri_T} \quad (1)$$

$$R_2 = \frac{C_{Ta}}{C_T} \quad (2)$$

$$R_3 = \frac{S_{Ta}}{S_T} \quad (3)$$

$$R_4 = \frac{V_{Ta}}{V_T} \quad (4)$$

$$R_5 = \frac{F_{Ta}}{F_T} \quad (5)$$

where Ri_{Ta}, C_{Ta}, S_{Ta}, V_{Ta}, F_{Ta} = rice, common crop, special crop, vegetable and fruit productions of towns of Taoyuan County in the Tamsui River basin, respectively, and Ri_T, C_T, S_T, V_T, F_T = total rice, common crop, special crop, vegetable and fruit productions in Taoyuan County, respectively.

Secondly, we took the average (R_{ave}) of the ratios of R_1, R_2, R_3, R_4 and R_5. Finally, we used this R_{ave} value as the unknown product' average value for the ratio of productions of towns of Taoyuan County in the Tamsui River basin to those of the whole Taoyuan County. Therefore, the calculated value of the unknown productions of ornamental plants of towns of Taoyuan County in the Tamsui River basin = R_{ave} × total productions of ornamental plants in Taoyuan country. The computation methods of forage and green manure crop productions are similar to those of ornamental plants. These items include productions of young antlers, milk, honey, royal jelly, forestry, fishery and local social and economic data.

RESULTS AND DISCUSSION

1. Agricultural Employment in Tamsui River Basin

Due to the deficiencies of agricultural employment (denoted as E_B) data of the Tamsui River

basin between 1994 ~ 2000 in the available references [16-22], we analyzed its yearly variations between 1986 ~

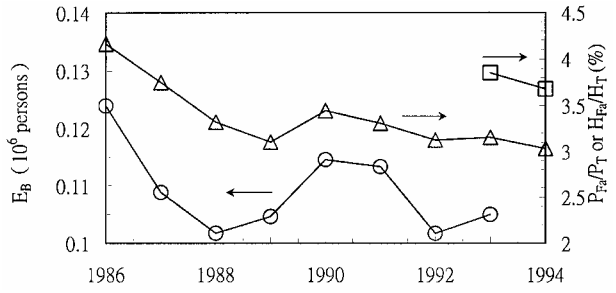

Fig. 1. Time variations of E_B (○), P_{Fa}/P_T (△) and H_{Fa}/H_T (□) in Tamsui River basin. E_B: agricultural employment. P_{Fa}: farm household population. P_T: total population. H_{Fa}: farm households. H_T: total households.

1993. Here, the E_B includes all biomass sectors of crop, forestry, fishery and livestock materials. Figure 1 shows that E_B in the Tamsui River basin decreases from 123.96 × 10^3 persons in 1986 to 105 × 10^3 persons in 1993, dropping off about 18.96 × 10^3 persons and 15.3 %. For the ratio of farm household to total populations (P_{Fa}/P_T), it appears that the value reduces from 4.17 % (234,899 persons of P_{Fa}) in 1986 to 3.03 % (189,397 persons of P_{Fa}) in 1994, declining about 27.34 %. Regarding the ratio of farm to total households (H_{Fa}/H_T), also due to the deficiencies of data, we only analyzed its variations of 1993 and 1994. The values of H_{Fa} are 38,518 and 37,344 households, and of H_{Fa}/H_T are 3.85 and 3.68 % in the Tamsui River basin in 1993 and 1994, respectively.

After the economical growth in Taiwan, the employment opportunities of the non-biomass industrial sectors are increasing, while the E_B, H_{Fa}/H_T and P_{Fa}/P_T are decreasing gradually. This phenomenon symbolizes the change of the role of biomass industries toward the growth of economy, and is also one of the contributions of the biomass industries. If the E_B does not decrease after the economical growth in the Tamsui River basin, neither the efficiency of the biomass industrial productions can be promoted nor can the incomes of farmers be raised. Therefore, we don't need to merely focus on the E_B, but rather pay more attention on the policy to justify the production and management of biomass industries which are beneficial to the E_B.

2. Cultivated Land Area

Figure 2 indicates that the cultivated land area (A_c) in the Tamsui River basin decreases from 50,216 ha in 1986 to 43,037 ha in 2000, dropping off about 14.3 %. The reason may be due to the rapid industrial development, resulting in the industrial structural change. Furthermore, for the A_c per farm household (A_c/H_{Fa}) in the Tamsui River basin, we only analyzed its yearly variations in 1986 ~ 1994 because of the deficiencies of H_{Fa} data in the Tamsui River basin be-

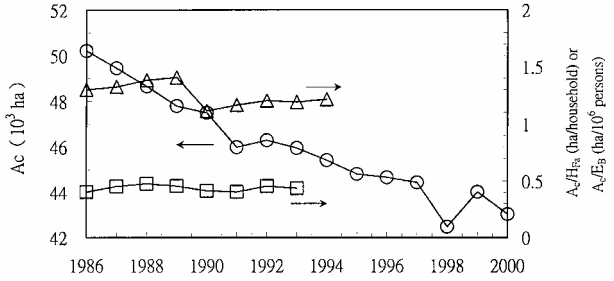

Fig. 2. Time variations of A_c (○), A_c/H_{Fa} (△) and A_c/E_B (□) in Tamsui River basin. A_c: cultivated land area. Other notations: as specified in Fig. 1.

tween 1995 ~ 2000. Therefore, from Fig. 2, the values of Ac/H_{Fa} are between 1.12 ~ 1.41 ha/household in 1986 ~ 1994, showing that the variations are stable. Taking 1994 for example, the A_c, H_{Fa} and A_c/H_{Fa} in the Tamsui River basin are 45,418 ha, 37,344 households and 1.22 ha/household, respectively. Also due to the deficiencies of E_B data in the Tamsui River basin between 1994 ~ 2000, we only focused on the yearly variations of A_c per E_B (A_c/E_B) between 1986 ~ 1993. In Fig. 2, it indicates that the variations of A_c/E_B values are stable and keep at the values between 405.74 ~ 478.15 ha/10^3 persons of E_B. Taking 1993 for example, the E_B, A_C and A_c/E_B in the Tamsui River basin are 105 × 10^3 persons, 45,951 ha and 437.63 ha/10^3 persons, respectively.

The variations of A_c is not only limited by nature factors, but also affected by the structures of industry and economy. The lands of the administration districts in the Tamsui River basin are almost urbanized. The competition of the land usages between agriculture and non-agriculture are drastically. Although many regulations are put on the protection of agricultural lands, there are many agricultural lands transformed into non-agricultural lands by legal ways or out-of-frame methods. Nowadays, the agricultural development is toward multifunctional directions; therefore, the cultivated land area has decreased in the recent years.

3. Rice Planted to Cultivated Land Areas Ratio, Regional to Taiwan Rice Productions Ratio and Rice Productions Per Harvested Area

The rice planted area (A_P) decreases from 17,246 ha in 1986 to 4,393 ha in 2000, descending about 12,853 ha and 74.53 %. From Fig. 3, the rice planted to cultivated land areas ratio (A_p/A_c) drops off from 34.35 % in 1986 to 10.21 % in 2000. From the chronic variation trend, the decreasing values of A_p/A_c are very apparent, revealing that the rice farming in the

Tamsui River basin is not in the main streams of the development of cultivation. Furthermore, the rice production (M_R) decreases from 64,086 tons in 1986 to 22,261 tons in 2000, declining about 65.26 %. The re-

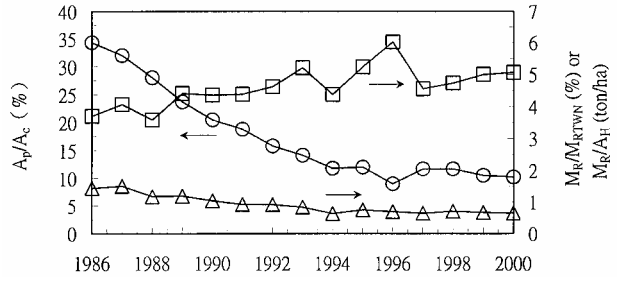

Fig. 3. Time variations of A_p/A_c (○), M_R/M_{RTWN} (△) and M_R/A_H (□) in Tamsui River basin. A_p: rice planted area. M_R: rice production. M_{RTWN}: rice production in Taiwan. A_H: harvested area. A_c: as specified in Fig. 2.

gional to Taiwan rice productions ratio (M_R/ M_{RTWN}) decreases from 1.43 % in 1986 to 0.65 % in 2000. The contribution of rice production in the Tamsui River basin to Taiwan gradually becomes less important. All the information listed above indicates that the Tamsui River basin has become a highly densed developing district and does not produce agricultural production gradually. For the rice production per harvested area (M_R/A_H), the values are between 3.59 ~ 6.02 ton/ha in 1986 ~ 2000 and gradually increase with time, especially in 1996 with a maximum value of 6.02 ton/ha. Considering the improving range, the M_R/A_H value increases from 3.71 ton/ha in 1986 to 5.06 ton/ha in 2000, raising about 36.39 %. Pleasantly, the efficiency of usage of the cultivated land to produce biomass resources has increased in the Tamsui River basin in the recent years.

4. Forestry

Figure 4 shows that the ratio of reforestation area to total population (A_F/P_T) in the Tamsui River basin is about 0.1 ~ 7.5 ha/10^3 persons in 1986 ~ 2000 with 0.95 ha/10^3 persons in 2000. Considering the variation tendency of the ratio of reforestation trees to P_T (T_F/P_T), also from Fig. 4, its values are between 3,569.6 ~ 14,304.4 stock/10^3 persons in 1986 ~ 2000 with 4,083.7 stock/ 10^3 persons in 2000. Both the values of A_F/P_T and T_F/P_T are gradually decreasing. Some efforts need to be put on the reforestation in the Tamsui River basin.

5. Fishery

5.1 Fisherman to Total Households Ratio, Aquaculture Area per Fisherman Household and Aquaculture Area per Fisherman Household

For the fisherman to total households ratio (H_{Fi}/H_T) in the Tamsui River basin, we only analyzed its yearly variations between 1993 ~ 1995 and 1997 ~ 2000 because of the deficiencies of total household data in the Tamsui River basin between 1986 ~ 1992

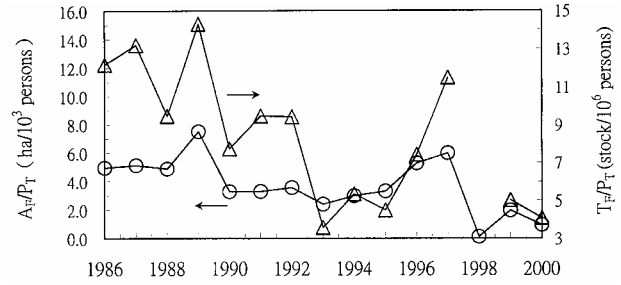

Fig. 4. Time variations of A_F/P_T (○) and T_F/P_T (△) in Tamsui River basin. A_F: reforestation area. T_F: reforestation trees. P_T: as specified in Fig. 1.

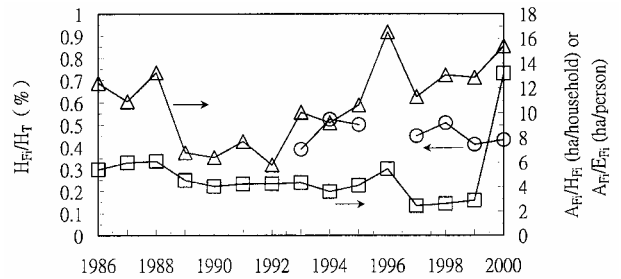

Fig. 5. Time variations of H_{Fi}/H_T (○), A_{Fi}/H_{Fi} (△) and A_{Fi}/E_{Fi} (□) in Tamsui River basin. H_{Fi}: fishermen household. A_{Fi}: aquaculture area. E_{Fi}: persons employed in fisheries. H_T: as specified in Fig. 1.

and 1996. From Fig. 5, the values of H_{Fi} and H_{Fi}/H_T in the Tamsui River basin are 3,914 and 4,878 families, and 0.39 and 0.44 % in 1993 and 2000, respectively. The increased households of H_{Fi} are 964 families and about 24.63 % from 1993 to 2000. For the chronic yearly variation tendency in the Tamsui River basin, the H_{Fi}/H_T values are between 0.39 ~ 0.53 %. For the aquaculture area per fisherman household (A_{Fi}/H_{Fi}), the values are between 5.78 ~ 16.53 ha/household in the Tamsui River basin in 1986 ~ 2000. Also, from Fig. 5, the value of A_{Fi}/H_{Fi} decreases from 12.39 ha/household in 1986 to 5.78 ha/household in 1992, then from the least value increases to 15.38 ha/household in 2000. The increasing ratio of A_{Fi}/H_{Fi} reaches 24.13 % from 1986 to 2000. As for the aquaculture area per fisherman employed (A_{Fi}/E_{Fi}) in the Tamsui River basin, from Fig. 5, it shows that the values of A_{Fi}/E_{Fi} are between 2.44 ~ 6.07 ha/person in 1986 ~ 1999. However, the value of A_{Fi}/E_{Fi} in 2000 is 13.16 ha/person with the increasing ratio of 144.16 % as compared to that (5.39 ha/person) in 1986.

5.2 Far-Sea Fisheries in Tamsui River Basin

In the fishery production, we considered the total production (F_{iT}) of the far-sea (FS), offshore, coastal and aquaculture fisheries. The far-sea fishery production (F_{iFS}) is not produced from the Tamsui River basin, although the far-sea fishes are captured by the

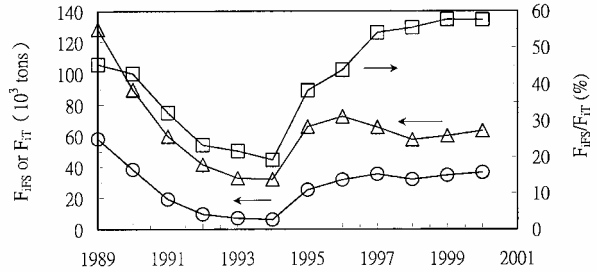

Fig. 6. Time variations of F_{iFS} (◯), F_{iT} (△) and F_{iFS} / F_{iT} (□) in Tamsui River basin. F_{iFS}: far-sea fishery production. F_{iT}: total fishery productions of far-sea, offshore, coastal and aquaculture fisheries.

fishermen living in the Tamsui River basin. Therefore, we separated the far-sea fishery production from the total fishery production and analyzed the amounts of far-sea fishery production independently. We only analyzed the variations of the far-sea fishery production between 1989 ~ 2000 because of the deficiencies of the far-sea fishery production data between 1986 ~ 1988. From Fig. 6, the value of F_{iFS} is 58,162 tons in 1989, then decreases to 6,151 tons in 1994. However, the far-sea fishery production increases to 36,593 tons in 2000 from the least value in 1994. Also from Fig. 6, the values of the ratio of F_{iFS} to F_{iT} are between 19.15 to 57.62 %.

6. Intensity of Use of Biomass Materials in Tamsui River Basin

We only analyzed the MPB (material production of biomass), including crop (C), forestry (F), fishery (F_i) and livestock (L) materials, in the Tamsui River basin between 1989 ~ 2000 because of the deficiencies of the data of MPB between 1986 ~ 1988. The items of crops consist of rice, common crop, special crop, vegetables, fruits, ornamental plants, forage crops and green manure crops. As for the forestry, the items include cattle, hogs, goats, yield of young antlers, poultry, eggs, milk, production of honey and production of royal jelly. The fishery materials contain far-sea fisheries, offshore fisheries, coastal fisheries and aquaculture fisheries. Finally, the items of livestock take into account for trees, bamboo and production of forest by-products. From Fig. 7, the value of the MPB in the Tamsui River basin is 499,559 tons in 1989 and slowly decreases with time. However, after 1991, the MPB in the Tamsui River basin increases from 280,407 tons in 1991 to 442,436 tons in 2000. This phenomenon indicates that the production of MPB in the Tamsui River basin has tended to increase recently. It shows that the variation trends of MPB may be due to the variation of industrial structure in the Tamsui River basin. Further examination of the effects of variation of industrial structure on the domestic wastewater generation in the Tamsui River basin would be helpful in future study. For the biomass ma-

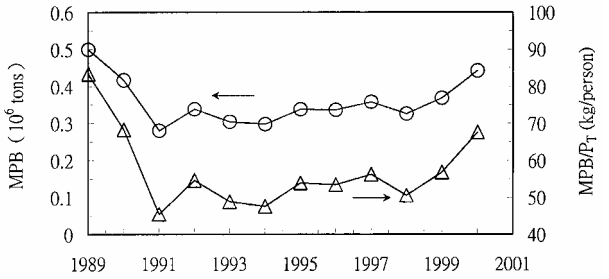

Fig. 7. Time variations of MPB (◯) and MPB/P_T (△) in Tamsui River basin. MPB: material production of biomass including crop (C), forestry (F), fishery (F_i) and livestock (L) materials. P_T: as specified in Fig. 1.

terial production per person (MPB /P_T), the values of MPB /P_T are 83.3 and 67.6 kg/person in 1989 and 2000, respectively, decreasing about 18.88 %. From the chronic variation tendency of MPB /P_T, the reduction is obvious in 1991 with a least value of 45.52 kg/person at that time. However, it gradually but slightly increases after 1992 (54.67 kg/person of MPB/P_T). Nevertheless, the conservation efficiency of biomass resources in the Tamsui River basin was good in 1991, but has decreased recently. On the other hand, from Fig. 8, the biomass material production per GDP (MPB/GDP), also called the intensity of use (IU), drops off from 22.5 kg/10^6 US$ of GDP in 1989 to 11.07 kg/10^6 US$ of GDP in 2000, decreasing about 50.78 %. Note that the value of MPB/GDP reflects the requirement of biomass production per dollar. Reversely, the value of GDP/MPB displays the economical efficiency of material production. The lowest value is 8.99 kg/10^6 US$ of GDP in 1998. The reduction is very apparent, indicating that the Tamsui River basin has efficient usage or conservation of MPB. Also from Fig. 8, we can analyze the variation of MPB per GDP_B (gross domestic product of biomass in the area of interest) (MPB/GDP_B). It is seen that the value of MPB/GDP_B decreases from 1.49 tons/10^6 US$ of GDP_B in 1989 to 0.8 tons/10^6 US$ of GDP_B in 1993, decreasing 46.17 %. This shows that the amounts of MPB used in the Tamsui River basin is not proportional to the economical growth in terms of GDP or GDP_B. Thus, the efforts, such as the efficient usage of MPB, development of biomass products with high added-value and establishment of concepts with quality better than quantity, would all contribute the reduction of the values of MPB/GDP_B and display that the biomass industries in the Tamsui River basin are

toward the goal with successful utilization and conservation of biomass.

CONCLUSIONS

This work examines the yearly variations of the biomass material productions (MPB), employees, population, GDP and other productivity items for the crop, forestry, fishery and livestock sectors in the Tamsui River basin. The information thus obtained is useful for the corresponding administration in policy making regarding the economical efficiency and environment protection. After the economical growth in Taiwan, the employment opportunities of the non-biomass industrial sectors are increasing. This phenomenon symbolizes the change of the role of biomass industries toward the growth of economy, and is also one of the contributions of the biomass industries. The lands in the Tamsui River basin are almost urbanized and the competitions of the land uses between agriculture and non-agriculture are drastically. Pleasantly, the efficient uses of the cultivated land resources are gradually increasing in the Tamsui River basin. It shows that the variation trends of MPB may be due to the variation of industrial structure in the Tamsui River basin. The efficient usage or conservation of MPB, development of biomass products with high added-value and establishment of concepts with quality better than quantity, may all contribute the reduction of the values of MPB per GDP_B (GDP of biomass industrial sector). The results of this study indicate that the biomass resources in the Tamsui River basin are successfully toward the goal of efficient utilization and conservation.

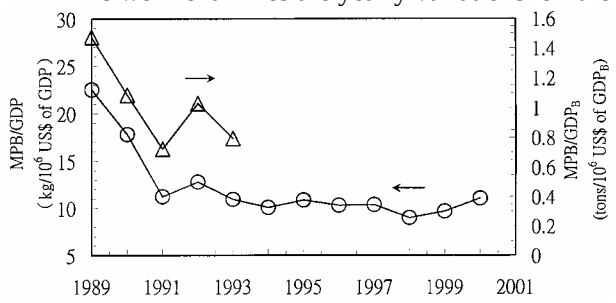

Fig. 8. Time variations of MPB/GDP (○) and MPB/GDP_B (△) in Tamsui River basin. GDP, GDP_B: gross domestic product and GDP of biomass in Tamsui River basin. MPB: as specified in Fig. 7.

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NOMENCLATURE

Notation Referred to Tamsui River Basin

A	agricultural land
A_c	cultivated land area
A_F	reforestation area
A_{Fi}	aquaculture area
A_H	harvested area
A_p	rice planted area
B	biomass including crop, forestry, fishery and livestock materials
C	crop
E_B	agricultural employees including all biomass sectors of crop, forestry, fishery and livestock materials.
E_{Fi}	persons employed in fisheries
F	forestry
Fi	fishery
F_{iFS}	far-sea fishery production
F_{iT}	total fishery productions of far-sea, offshore, coastal and aquaculture fisheries
GDP	gross domestic product
GDP_B	GDP of biomass
H_{Fa}	farm households
H_{Fi}	fishermen household
H_T	total households
IU	intensity of use
IUB	IU of biomass, MPB/GDP or MPB/GDP_B
L	livestock
MPB	material production of biomass including crop (C), forestry (F), fishery (F_i) and livestock (L) materials
M_R	rice production
P_{Fa}	farm household population
P_T	total population
PCU	per capita use
PCUB	PCU of biomass
T_F	reforestation trees

Notation Referred to Other Regions

C_T	total crop productions in Taoyuan County
C_{Ta}	crop productions of towns of Taoyuan County in Tamsui River basin
F_T	total fruit productions in Taoyuan County
F_{Ta}	fruit productions of towns of Taoyuan County in Tamsui River basin
MPB_{TWN}	MPB of Taiwan
M_{RTWN}	rice production in Taiwan
R_1	Ri_{Ta}/Ri_T
R_2	C_{Ta} / C_T
R_3	S_{Ta}/S_T
R_4	V_{Ta}/V_T
R_5	F_{Ta}/F_T

R_{ave} average value of R_1, R_2, R_3, R_4 and R_5
Ri_T total rice productions in Taoyuan County
Ri_{Ta} rice productions of towns of Taoyuan County in Tamsui River basin
S_T total special crop productions in Taoyuan County
S_{Ta} special crop productions of towns of Taoyuan County in Tamsui River basin
V_T total vegetable productions in Taoyuan County
V_{Ta} vegetable productions of towns of Taoyuan County in Tamsui River basin

Other Notation

WTO World Trade Organization

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台灣河流流域生產之生物資源物質計算與趨勢分析—案例 1:淡水河流域

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摘 要

本研究以台灣北部淡水河流域為研究對象，建置該流域生物資源(農林漁牧資源)善用資料及指標。研究中亦估算淡水河流域行政區內之生物資源物質之自產量，並計算區域物質使用密集度、及其他環境相關密集度等指標。此等資料與結果可做為地方施政相關行政及經濟效率及環境限制之依據參考。

綜合各個指標的結果，發現淡水河流域已成為一個高度開發的區域，已漸漸不發展稻作生產，係對台灣地區的稻作產量貢獻日趨減小的地區。但由稻作產量面積指標也顯示出近年淡水河流域地區已漸漸提高農地資源的有效利用。在生物資源物質自產量需求方面，於 1991 年（280,407 tons）之後逐年微幅上升，至 2000 年時淡水河流域生物資源物質自產量約 442,436 tons，顯示淡水河流域生物資源物質自產量需求日益增加。

就淡水河流域其生物資源物質每人平均使用值而言，1989 年時為 83.3 kg/person，至 2000 年降至 67.6 kg/person，減少約 18.88 %，然而在 1992 年（54.7 kg/person）後曲線有緩慢上升趨勢，但不顯著。因此可知淡水河流域生物資源物質使用之節約效率，雖然在 1991 年左右有顯著的成效，但於近幾年卻有成效遞減的傾向，值得注意。淡水河流域生物資源物質使用密集度由 1989 年的 22.5 kg/10^6 US$ of GDP（GDP 為全流域之總 GDP，GDP 計值之基期年為 1996 年）逐年下降至 2000 年的 11.07 kg/10^6 US$ of GDP，減少約 50.78%。此外，每單位農業 GDP(稱為 GDP_B)生物資源物質自產量需求由 1989 年之 1.49 tons/10^6 US$ of GDP_B 降至 1993 年之 0.8 tons/10^6 US$ of GDP_B，下降約 46.17 %。顯示淡水河流域之生物資源物質自產量使用並未隨著經濟成長而增加，淡水河流域境內民眾的生物資源物質善用效率非常顯著。