J Wood Sci (2013) 59:321–330
DOI 10.1007/s10086-013-1334-6

ORIGINAL ARTICLE

The regional economic impacts on the development of wood chip utilization in Maniwa city

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Received: 26 July 2012 / Accepted: 18 February 2013 / Published online: 10 March 2013

Abstract This paper reports on an empirical investigation about regional economic impacts by the promotion of wood chip utilization in Maniwa city, Japan. We clarify the estimated potential of regional economy development by using input–output analysis for Maniwa city. The result indicates that 315 million JPY of woody chip products can be estimated to generate roughly 448 million JPY of direct, indirect, and induced economic effects. The value of 448 million JPY was equivalent to about 0.2 % of total production value in Maniwa. It is also expected to create approximately 21 jobs by promotion of wood chip utilization. We examined the regional economic impacts on the woody biomass utilization, and evaluated to estimate direct, indirect and induced economic effects, and job creation to clarify the economic impact on Maniwa. We will leave the negative economic effects and the environmental impacts in the process of woody biomass utilization as a future task.

Keywords Woody biomass · Wood chip utilization · Regional economic impact · Employment impact · Input–output analysis

This study has been presented as "Akiko Isa, Tomoaki Minowa, and Tatsuo Yagishita (2012) Input–output Analysis of Induced Economic Effects on Maniwa Project for woody biomass. 7th biomass science conference (Poster), 1/18–1/19, 2012, Iwate prefecture, Japan, pp 128–129".

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Introduction

Recently, many Japanese local governments have started a new local project to promote biomass utilization. These projects aim to develop production and supply of biomass feedstock, and to build renewable energy system of their own region. Especially, woody biomass is produced from two specific sources: waste wood from sawmills, and logging residue left in forest land. As a resource of renewable energy, woody biomass has the potential to reduce the region's wood-related waste and to promote its utilization toward realizing a sound material cycle society.

Many studies have been done in association with the environmental impact of woody biomass utilization, such as contribution to reducing GHG emissions by Hitoe and Hattori [1], Kayo et al. [2], and Akita et al. [3]. There are also studies focused on the feasibility assessment of woody biomass as useful energy products by Yamaguchi et al. [4], Terada et al. [5], Uragami et al. [6], Futawatari et al. [7], and Lyudmyla et al. [8]. In addition, approach to assess the regional economic impacts is one of the important goals to promote woody biomass utilization. Gan and Smith [9] indicated that energy from forest biomass is generally not cost-competitive with fossil fuels under current technology and market conditions in the US through their comparative analysis of woody biomass and coal. Though doubt remains about how effective woody biomass is compared to fossil fuel as a source of energy, Hall [10], Gan and Smith [11], and Ikegami and Niitsuma [12] suggested that the production of forest biomass and bio-energy will also produce a variety of co-benefits such as developing renewable energy, and employment creation, in regional terms.

From this point of view, this study attempts to examine the impacts of woody biomass utilization in a local region.

We selected Maniwa city, which is well known for timber industry in Japan and has been trying to encourage woody biomass utilization since 2006, as a study area. For this study, we focused on the regional economic impact in regard to wood chip which is produced from waste wood, e.g., logging residue and sawmill waste in Maniwa. Our specific objects were firstly to quantify the total sales volume of wood chip from logging residue and sawmill waste. Then, we estimated total increased final demand for wood chip, and categorized it into each industrial sector: forestry sector, pulp, paper, and wooden products sector and transport sector. Finally, we produced the Maniwa's total economic impacts in terms of direct, indirect, induced impact, and job creation using input–output analysis, and we considered the import and export balance with the result of gross demand.

Promotion of wood chip project in Maniwa city

Background in Maniwa

Maniwa is located in Okayama prefecture, the western region of the main Japanese island of Honshu. This city was formed by merger of 9 counties in 2005 as in Fig. 1. It has an area of 828.43 km^2 which constitutes approximately 11.6 % of all area of Okayama prefectures. The total forested area of Maniwa is 656 km^2, which is about 80 % the size of the city [13]. Almost 60,000 m^3 of log harvest and approximately 200,000 m^3 of log are traded within this city in a year. Many kinds of wood products such as lumber, bark, and sawdust have been shifted to many surrounding regions. Currently, the number of employees in Forestry sector is 56, about 0.3 % of total employees of 20,689 in Maniwa in 2006 [14]. This is more than 10 times the Okayama prefecture rate of approximately 0.04 %.

Fig. 1 The map of Maniwa

Approaches for woody biomass utilization

Figure 2 explains spreading effect of the use of woody biomass resources. Here, woody biomass resources can be divided into two types: one is logging residue, log itself cut for thinning the forest and left in the forest, and the other is sawmill waste which is by-products from wood processing industries. As the use of logging residue and sawmill waste increased, waste products from forestry or sawmill can be decreased. It affects the environmental impacts such as forestation, reducing the amount of waste wood, and GHG emissions. Woody biomass utilization also can be effective in stimulating job creation through expansion of woody biomass-related industries. And finally, these effects can lead to regional economic growth within Maniwa.

There are many methods to improve the use of woody biomass: firewood, wood chip, and pellet for energy use, pulp, and board manufacture for material use. Among these, wood chips are used in many ways such as paper, fuels, and board manufacture. Maniwa has been engaged in various efforts to promote woody biomass utilization since 2006. In particular, Maniwa wood chip collection facilities (wood chip facilities) have been constructed to promote wood chip industry using woody biomass resources in Maniwa in 2006–2009. Now, 2 wood chip facilities are operated: one by Maniwa lumber business cooperative association (lumber cooperation), and the other by Forestry cooperative association (forestry cooperation). The wood chip facility of lumber cooperation uses both logging residues and sawmills waste to manufacture paper chip and board chip, and logging residues for wood chip for fuel are produced by Forestry cooperation. But, finished products from two facilities are collected and sold through the chip facility of lumber cooperation to inside and outside of Maniwa. Especially, wood chips for fuel are used in public facilities, manufacturing factories, and general offices in the city as fuel of the boiler.

In 2005, before implementing the woody biomass project, the utilization of woody biomass was rated at 39 % of total amount of resources in Maniwa as shown in Fig. 3 [15]. At that time, logging residue was not considered a resource due to the difficulties of carrying out, while sawmill waste has been widely used in Maniwa. The utilization rate of logging residue and sawmill waste was 0 %, and nearly 78 %, respectively, in the same year. However,

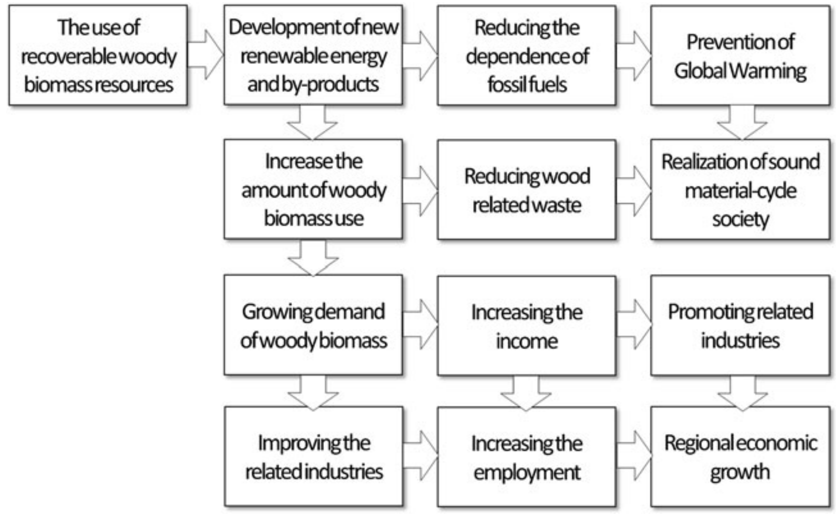

Fig. 2 Spreading effect of woody biomass utilization

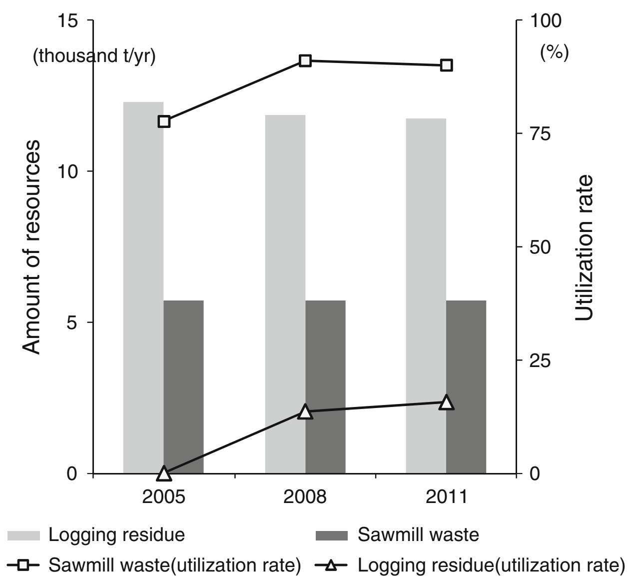

Fig. 3 The amount of resources and the utilization rate of woody biomass in Maniwa city

as the range of woody biomass utilization increases, the utilization rate of logging residue and sawmill waste has also risen since 2006. Therefore, the utilization rate of logging residue has grown to about 16 % by 2011, and sawmill waste has also enlarged to 90 % in Maniwa.

Methodology

Scope of this study

We set the scope of analysis in material flow for wood chip products to estimate the impact of wood chip utilization in Maniwa, as shown in Fig. 4. This figure shows the whole process for producing wood chips. First, woody biomass resources such as logging residues and sawmill wastes are collected to wood chip facilities in Maniwa. Three types of wood chip, which are wood chips for fuel, wood chip for paper, and wood chip for board manufacture, are produced and transported to two wood chip facilities. Then, these wood chips are carried out to demand regions. wood chips for fuel and for board manufacture are generally used inside Maniwa, and wood chips for paper are trucked to outside Maniwa. Lastly, these are consumed for their purpose. We divided these flows into 3 stages, collecting, chipping, and transport, and attempted to estimate the economic impact by wood chip utilization. Here, we assumed that manufactured wood chips are supplied from their own facilities.

Data collection

We obtained quantitative information related to wood chip production, the cost of raw material, and the price paid for wood chip through interview with executives of lumber cooperation and person in charge at the Maniwa city hall in May, 2012. We also refer to reports analyzed by NEDO [16] and Japan federation of wood-industry associations [17] in order to get detailed information about wood chip facilities.

Table 1 presents the release data for sales volume of wood chips at wood chip facilities in 2011. For this year, wood chips have been sold approximately 19,300 t:830 t for board manufacture, 1,500 tons for fuel, and 16,970 ton for paper at the wood chip facilities. Then, we set the unit of price paid at each process based on information obtained from interview and reports, as shown in Table 2. Finally, we calculated total annual sales of wood chips using the data of annual sales volume and the unit of price paid for wood chips in Maniwa as shown in Eqs. (1), (2), (3), and (4). The total annual sales for wood chip are the sum of

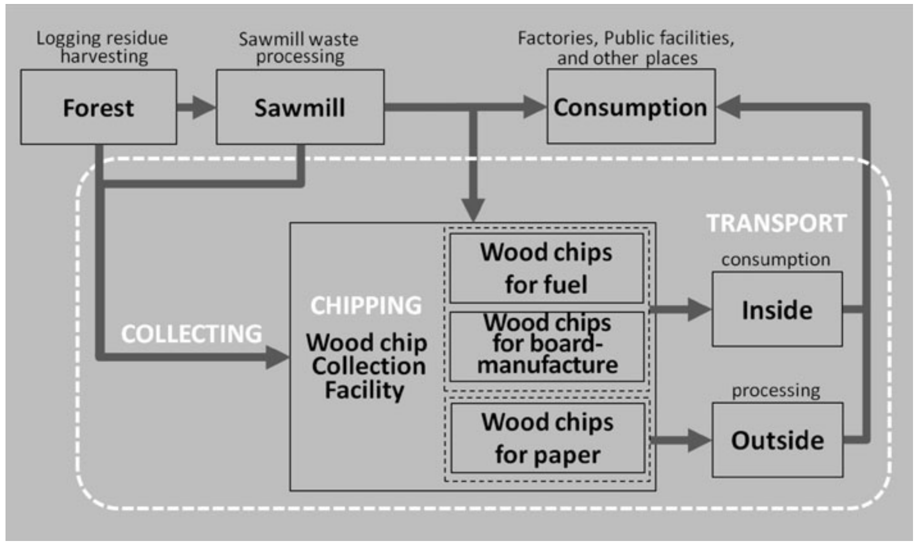

Fig. 4 Material flow for wood chip products in Maniwa city

Table 1 Total sales volume of wood chip (unit: t/year, 2011)

Items	Total volume for sale	Type		Destination	
		Logging residues	Sawmill waste	Inside	Outside
Total	19,300	8,970	10,330	–	–
Wood chips for board manufacture	830	0	830	°	–
Wood chips for fuel	1,500	1,500	0	°	–
Wood chips for paper	16,970	7,470	9,500	–	°

Table 2 The unit price paid in each resource type and process for wood chip production (unit: JPY/t)

	Collecting	Chipping	Transport	
			Inside	Outside
Logging residue	4,400	5,263	3,000	5,736
Sawmill waste	2,200	9,800		

annual sales in three stages, collecting stage, chipping stage, and transportation stage as in Eq. (1). When we figured out annual sales in collecting stage and chipping stage, we used the annual sales of two types of resources, e.g., logging residue and sawmill waste, as shown in Eqs. (2), (3). And for the annual sales in stage of transportation, we evaluated the sum of annual sales for delivering wood chips to inside and outside of Maniwa, as in Eq. (4).

$$S = S^{C} + S^{P} + S^{T} \quad (1)$$

$$S^{C} = \left(L^{C}_{SV} \times L^{C}_{U}\right) + \left(W^{C}_{SV} \times W^{C}_{U}\right) \quad (2)$$

$$S^{P} = \left(L^{P}_{SV} \times L^{P}_{U}\right) + \left(W^{P}_{SV} \times W^{P}_{U}\right) \quad (3)$$

$$S^{T} = \left(IM^{T}_{AT} \times IM^{T}_{UT}\right) + \left(OM^{T}_{AT} \times OM^{T}_{UT}\right) \quad (4)$$

where, S is the total annual sales for wood chip; S^{C} is annual sales in collecting stage (C); S^{P} is annual sales in chipping stage (P); S^{T} is annual sales in transportation stage (T); L_{SV} is annual sales volume (SV) of wood chip by logging residue (L); L_{U} is the unit price paid (U) of wood chip by logging residue (L); W_{SV} is annual sales volume (SV) of wood chip by sawmill waste (W); W_{U} is the unit price paid (U) of wood chip by sawmill waste (W); IM_{AT} is annual amount of transportation (AT) to inside Maniwa (IM); IM_{UT} is the unit price paid for transportation (UT) to inside Maniwa (IM); OM_{AT} is annual amount of transportation (AT) to outside Maniwa (OM); OM_{UT} is the unit price paid for transportation (UT) to outside Maniwa (OM).

Input–output table for Maniwa

Input–output table (I/O table) is an index which shows the annual flow of goods and services produced and consumed by a certain region. By using I/O table, we can estimate economic impacts and trace the flow of money in a specific geographic region, such as nation, state, country, called input–output analysis (I/O analysis). It is capable of measuring regional direct, indirect, and induced impacts of an event or policy change and incorporating intersectional linkages [18]. Japan has compiled I/O tables at the provincial or state level every 5 years since 1955. However, I/O table for municipality level has not been published by the national government. 2004 I/O table for Maniwa was developed by combining intra-industry and inter-industry trade data for Maniwa industries obtained from questionnaire survey and telephone survey in Maniwa by Chugoku regional research center, with a 2004 I/O table for Okayama prefecture [19]. The 2004 I/O table for Maniwa comprises a matrix of 35 industrial sectors, and we used it to evaluate Maniwa's economic impact on the promotion of wood chip utilization.

First, we set the amount of increased demand in related industrial sectors using the total annual sales and related values for wood chips, as in the above four equations. We divided annual sales amount of each stage into three industrial sectors, forestry sector, pulp, paper, and wooden products sector, and transport sector, by two types of resource and delivery distance of each stage. Specifically, total sales in all stages of wood chip for fuel, which mainly uses logging residues as a resource, are classified into forestry sector. And total sales in all stages of wood chip for board, which mainly uses sawmill waste, are categorized into pulp, paper, and wooden products sector. For wood chip for paper, total sales in collecting stages using logging residues is classed as forestry sector, and total sales in transport stage using both resources is labeled as transport sector, while total sales in collecting stages using sawmill waste and in chipping stage using both resources are sorted into pulp, paper, and wooden products sector.

Then, we input the increased demand of three industrial sectors to I/O table, and estimated the regional economic impact of Maniwa. The precondition for I/O analysis was defined as given below.

1. We use a 35 industrial sector I/O table for Maniwa, which is released in 2004.
2. This paper suggests that I/O table reflects the current economic condition in Maniwa. Based on I/O table, we calculate the regional economic impacts by wood chip utilization.
3. And we use actual sales data of wood chip in 2011 to calculate increased demand by sales of wood chips.
4. We suppose that the market changes by alternative products do not affect in a short period.
5. We selected competitive-import type of the Leontief inverse matrix.
6. It is presumed that the ripple effect from value-added is only distributed to the "compensation of employees".
7. We set the self-sufficiency ratio of forestry sector from 0.44 to 0.95, and the self-sufficiency ratio of pulp, paper, wooden products sector from 0.72 to 0.95. Besides, for the transport sector, the self-sufficiency ratio remained 0.64.

Lastly, we input final increased demand in three industry sectors by the promotion of wood chip utilization into I/O table, and estimated the regional economic impacts in order to process as shown in Fig. 5. There are three types of regional economic impacts can be analyzed: direct impact, indirect impact, and induced impact. Here, direct impact (D) presents gross domestic output which is directly affected by business development in specific region. Indirect impact (I_i) expresses gross output caused by inter-industry exchanges, which is also affected by direct impact. And induced impact (I_u) includes impacts on additional

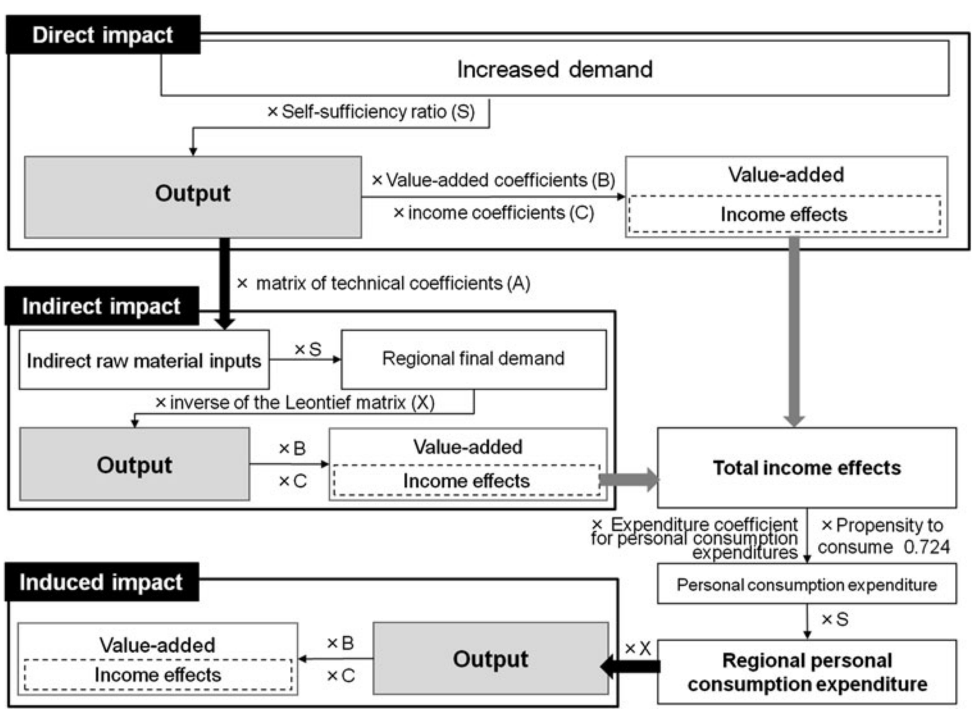

Fig. 5 The flow for estimating regional economic impacts by promoting the wood chip utilization in Maniwa

industrial activities associated with the spending of employee's income earned through direct impact and indirect impact. The following Eq. 5 is usually used for I/O analysis,

$$X = (I - (I - M)A)^{-1}Y \quad (5)$$

where, Y is the vector of final demand; A, the matrix of technical coefficients; I, the identity matrix; M, the diagonal matrix; $(I - M)A^{-1}$; S, the self sufficiency ratio; X, the vector of total output; $I - (I - M)A^{-1}$ is usually referred to as the Leontief multipliers matrix.

The vector of total output (X) can estimate for Leontief multipliers matrix ($I - (I - M)A^{-1}$) by putting in the vector of final demand (Y), as shown in Eq. (5). By using this method, direct impact (D), indirect impact (I_i), induced impact (I_u) can be evaluated as in Eqs. (6), (7), and (8). Here, we can calculate output, value-added, and income effects through multiplying final demand by the value-added coefficient and the income coefficient.

$$D = (I - M)X \quad (6)$$

where, D is the direct impact.

$$I_i = (I - (I - M)A)^{-1}A(I - M)D \quad (7)$$

where, I_i is the indirect impact.

$$I_u = (I - (I - M)A)^{-1}(I - M)C \quad (8)$$

where, I_u is the induced impact; C, the personal consumption expenditure [20].

Using with the total output of regional economic impact, we also can assume the job creation. The employment impact (EI) can be calculated by multiplying the total economic impact (T) by employment coefficient (E) as shown in Eq. 9. Through this equation, we can estimate the number of new employees in all sectors of industry in Maniwa. Here, we reduced the number of industrial sectors to 18 sectors in order to meet the statistical data of the number of employees.

$$EI = T \times E \quad (9)$$

where, EI, the employment impact; T, the total economic impact (final increased demand, million JPY); $T = D + I_i + I_u$; E, the employment inducement coefficient; $E = No_E/RD$; No_E, the number of employment (number of person) [21]; RD, the regional domestic demand (million JPY) [19]; E in each industrial sectors are as follows; agriculture: 0.0386, forestry: 0.0098, fishery: 0.0079, mining: 0.0714, construction: 0.0725, manufacturing: 0.0557, electricity, gas, and heat supply: 0.0006, information and communications: 0.0055, transport: 0.0513, commerce: 0.01774, financial and insurance: 0.01774, real estate: 0.0029, personal services: 0.1118, medical service, health and social security and nursing care: 0.0980, education and research: 0.0147, total services: 0.0472, others: 0.1023.

Table 3 Total sales of wood chips in Maniwa (unit: million JPY)

	Collecting		Chipping		Transport	
	Logging residues	Sawmill waste	Logging residues	Sawmill waste	Inside	Outside
Total	39.5	22.7	47.2	101.2	7	97.3
Wood chip for fuel	6.6	0	7.9	0	4.5	0
Wood chip for board manufacture	0	1.8	0	8.1	2.5	0
Wood chip for paper	32.9	20.9	39.3	93.1	0	97.3

Forest (51.9mil. JPY)

Pulp, paper and wooden products (165.8mil. JPY)

Transport (97.3mil. JPY)

Results

Promotion of wood chip utilization

Table 3 shows the result of total sales volume of wood chips. About 315 million JPY could be produced by selling 19,300 tons of wood chip in Maniwa. And each sales of wood chip for fuel, board manufacture, and paper were calculated at 19 million JPY, 12.5 million JPY, and 283.5 million, respectively, as shown in Table 3. Total sales of wood chips were also divided into 3 industrial sectors. Total sales were distributed to each sector, 51.9 million JPY in forestry sector, 165.8 million JPY in pulp, paper, and wooden products sector, and 97.3 million JPY in transport sector. These ratios were 16.5, 52.6, and 30.9 %, respectively.

Regional economic impacts

The results of total economic impacts of wood chip promotion utilizing logging residue and sawmill waste are summarized in Table 4.

269.5 million JPY can be produced as direct impact by sales of 315.0 million JPY of wood chips in Maniwa. In direct impact, it is expected to generate 109.1 million JPY of value-added and 49.2 million JPY of income effect. Indirect impact, which is caused by inter-industry exchanges from direct impact, has estimated to create 133.8 million JPY. And it is expected to produce 66 million JPY of value-added and 30.2 million JPY of income effect in indirect impact. For induced impact which reflects the additional spending by the employees, it has determined to generate 44.4 million JPY. In induced impact, it is also

Table 4 Total economic impacts by promotion of wood chip utilization (unit: mil.JPY, number)

Variable	Direct impact	Indirect impact	Induced impact	Total	Total impact	Multiplier
Total output	269.5	133.8	44.4	178.2	447.7	1.7
Value-added	109.1	66.0	32.9	98.9	208.1	1.9
Income effect	49.2	30.2	11.2	41.5	90.6	1.8
Increased salary per person					4,381	
Increased employment	12.5	6.3	2.1	8.4	20.9	1.7

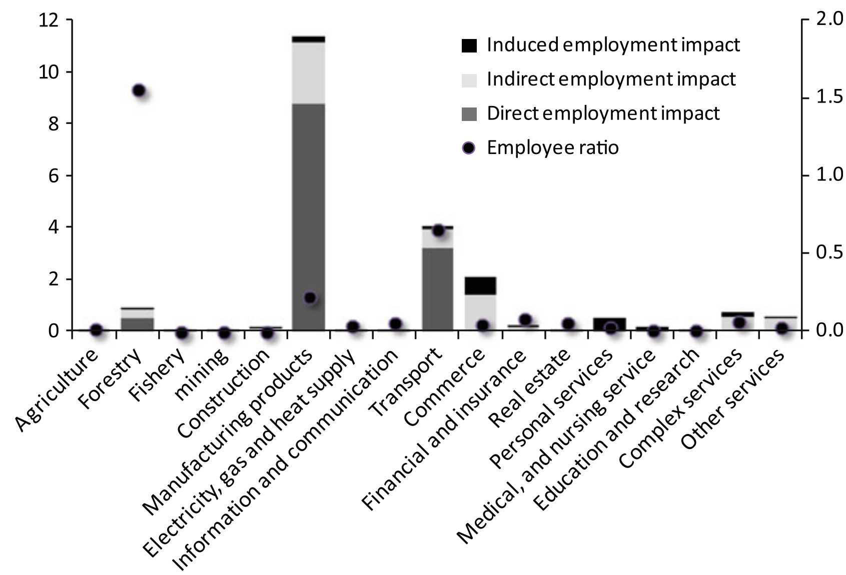

Fig. 6 Employment impact by promoting the wood chip utilization in Maniwa

expected to measure 32.9 million JPY of value-added and 11.2 million JPY of income effect.

This obviously presents that the promotion of wood chip for effective utilization of logging residue and sawmill waste is expected to create about 447.7 million JPY of total economic impact in Maniwa. It is nearly 1.7 times more than 269.5 million JPY of direct impact. These total economic impacts make up 0.2 % of 294,916 million JPY of gross domestic products (GDP) in Maniwa. Moreover, 4,381 JPY per employee of rising income can be expected through these economic impacts.

Job creation

We also estimated the employment impact associated with the promotion of wood chip utilization in Maniwa, as shown in Table 4. The analysis showed that total economic impact by wood chip promotion would create approximately 21 job opportunities, out of which about 12.5 employees from direct impact and about 8.4 employees from indirect impact. It is accounting for 0.1 % of total current employment in Maniwa. Promotion of wood chip also can stimulate employment in various industries not only related sectors such as forestry sector, pulp, paper, and wooden products sector, and transport sector but also other sectors, such as commerce sector, and services sector in Maniwa. Figure 6 shows the number of jobs created in industrial sectors. It could produce 1 job in forestry sector, about 11 jobs in manufacturing products sector, and about 2.1 jobs in commerce sector and services, by promotion of wood chip utilization. Employment impact in forestry sector would be much smaller than other affected sectors when looking at the number of jobs. However, the employment impact to current number of employee ratio was 1.56, it was the highest value among all sectors. This figure indicates that forestry sector has the highest employment growth of industrial sectors.

Import and export balance

As explained above, about 315.0 million JPY will be demanded to promote 19,300 tons of wood chip utilization. Concretely, 283.5 million JPY for 16,970 t of wood chip for paper, 12.5 million JPY for 830 t of wood chip for board manufacture, and 19 million JPY for 1,500 t of wood chip for fuel are provided as gross demand. And amount of import and export can be calculated using gross demand as in Eqs. (10) and (11).

$$I = G - R \quad (10)$$

where I is the amount of import; G, the gross demand; R, the regional demand; $R = G \times S$; S, the self-sufficiency ratio; S of each industrial sector is as following, forestry sector: 0.95, pulp, paper and wooden products sector: 0.95, and transport sector: 0.64.

$$E = G \times (1 - R_c) \quad (11)$$

where E is the amount of export; R_c the ratio of regional consumption; R_c of each wood chip type is as following, wood chip for fuel and wood chip for board manufacturing: 1, and wood chip for paper: 0.

As wood chip utilization is promoted, it will affect the import and export conditions in Maniwa. For wood chip for paper which is consumed outside Maniwa, the amount of export and the amount of import are increase to 283.5 million JPY and 43.9 million JPY, respectively. And for wood chip for board manufacture, there is an increase in the amount of import of 0.62 million JPY without exporting.

In the case of wood chip for fuel, as the use of wood chip for fuel increases, the demand for oil-products such as Bunker A will be reduced. As Bunker A is replaced by wood chip for fuel, the amount of import for Bunker A, which is depended entirely on imports, can be reduced. So, we can find sales volume and the total gross demand for Bunker A which is an equivalent amount to wood chip for fuel, by using Eqs. (12) and (13).

$$G_A = U_A \times SV_A \quad (12)$$

where, G_A is the gross demand for Bunker A; U_A, the unit cost for Bunker A; $U_A = 73.2$ JPY/L [22]; SV_A, sales volume for Bunker A is the equivalent of sales volume for wood chip for fuel.

$$SV_A = SV_W \times AE \quad (13)$$

where, SV_W is the sales volume for wood chip for fuel; AE, the amount of Bunker A is the equivalent of 1 ton of wood chip for fuel; $AE = CV_W / CV_A$; CV_W, caloric value of wood chip for fuel; $CV_W = 9{,}000$ MJ/t [23]; CV_A: caloric value of Bunker A; $CV_A = 39.1$ MJ/L [24]; $AE = 230.2$ L/t; $SV_W = 1{,}500$ t

These calculations produced the results that for 1,500 ton of wood chip for fuel can be substituted around 345 kl of Bunker A, and it is worth about 25.3 million JPY. When Bunker A is used as fuel, 100 % of Bunker A is dependent on imports, while the amount of import for wood chip for fuel is increased to 0.95 million JPY without exporting. Therefore, we can expect 24.3 million JPY of substitution effect, by replacing Bunker A with wood chip for fuel.

Overall, the balance of import and export (I/E) will change with the promotion of wood chip utilization as shown in Fig. 7. We expected to increase the total value of exports amounted to 283.5 million JPY, whereas 20.2 million JPY for the total value of imports are produced, and eventually 263.3 million JPY of positive balance can be estimated by the promotion of wood chip utilization in Maniwa.

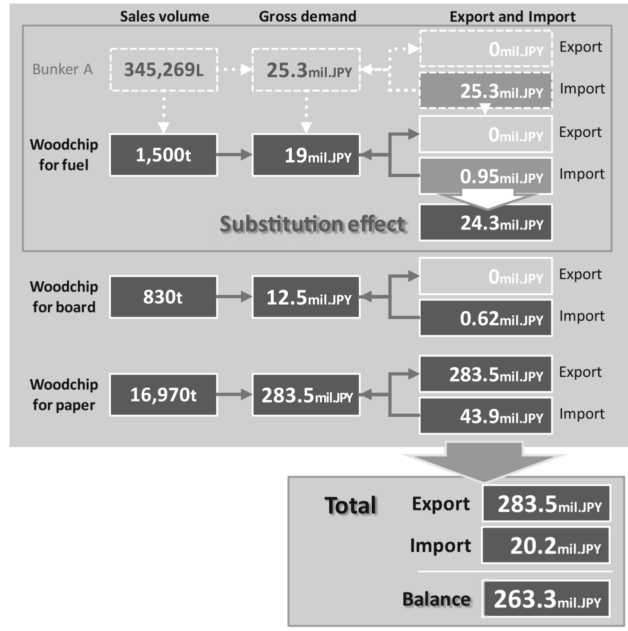

Fig. 7 Changes of I/E balance by promoting the wood chip utilization

Discussions

In this paper, we examined the economic impacts from the promotion of wood chip utilization in Maniwa. We used Maniwa input output table for 2004 and estimated the direct, indirect, and induced economic impact and the number of jobs in the Maniwa. The result showed that it is estimated to rise by around 0.2 % of gross domestic products in Maniwa. And it also can create 21 job opportunities, among them was 1 job for forestry sector. On the other hand, at least two persons are required for wood chip in the mountains according to the report of NEDO [16]. Then, there will be a gap between the real numbers of workers and the estimated number of job creation by I/O analysis, the former may be more than the latter. We consider that these workers are hired not only for the wood chip producing, but also for other forest-related works.

Woody biomass business is commonly characterized as lack of markets and infrastructure, uncompetitive pricing, unprofitable industries, and public unconcern in the viewpoint of economic aspects (Becker et al. [25], Sundstrom et al. [26]). However, utilization of wood chip which is based on waste wood resources in local area is significantly in connection with regional economic impact. 19,300 ton of sales volume of wood chip can produce 447.7 million JPY. Moreover, wood chip utilization was estimated to generate 263.3 million JPY of positive balance, as wood chip sales for paper increases exports and converting Bunker A to wood chip for fuel decreases imports in Maniwa. As wood chip utilization promoted, it could provide a strong contributions to the regional economy and employment from forestry and related industries.

Woody biomass resources also can contribute to create a new business related to woody biomass in Maniwa. Biomass tour is one of good examples. Biomass tour is the program that tour guide explains about the manufacturing process of woody chip and related products to people, who visit in Maniwa city, with leading the sites such as factories, lumber mill, and wood chip collection facility, for 1 or 2 days [27]. As participants of biomass tour stay for a certain period of time, they use various kinds of amenity or service such as restaurants, hotels, souvenir shops in Maniwa. Eventually, this program derived from woody biomass project can also provide a chance of economic benefits to other related industries in Maniwa.

Many local areas including Maniwa are trying to improve the woody biomass-related industries for the purpose of regional generation. We examined the regional economic impacts on the woody biomass utilization, and evaluated to estimate direct, indirect, and induced economic effects, and job creation to clarify the economic impact on Maniwa as mentioned above. Meanwhile, we did not consider the negative economic effects and the environmental impacts in the process of woody biomass utilization. We will leave these tasks as a future research.

Acknowledgments This work was funded by Japan Science and Technology Agency (JST) and The Environment Research and Technology Development Fund (K2364).

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