CHALLENGES IN THE IMPLEMENTATION OF SOLID WASTE MANAGEMENT STRATEGY IN THE CENTRAL HIGHLANDS OF VIETNAM

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ABSTRACT

The Central Highlands of Viet Nam has a large area of 56,638.44 km² and is characterized by owning different types of topography, a thin population density (95 people/km²), a limited literacy level but rather high economic growth rates (average of 12.84 %/year for the last few years). Besides, the municipal model for solid waste management (SWM) currently practiced in the Central Highlands appears to be ineffective due to, among other reasons, the limited capability of solid waste collection and transportation in the rural areas. Results of this study show rather poor collection rates in the region, ranging from 25.8 % in Dak Nong to 77.6 % as highest in Lam Dong. These figures have obviously not met the targets set for 2015 as required by the “Vietnam National Strategy for Integrated SWM till 2025, with a vision to 2050”. Based on the characteristics of natural environment, socio-economic and local culture values of the study area, a combination of regional SWM and ecological modernization theory (EMT) has been analyzed in this research. As a result, this study points out the way for improving the current SWM in the Central Highlands by, among other measures, rerouting the regional solid waste collection and transportation; Last but not least, the study concludes that in order to improve HDI in the Central Highlands to the average nationwide value of 0.753, it is unrealistic to be based only on GDP growth. Instead, however, it could be realistic if \( I_{\text{GDP}} \) increases at only 2 - 3 % with an increase of \( I_{\text{education}} \) and \( I_{\text{life time}} \) at about 5 %.

Keywords: Solid waste management, sustainable development, Central Highlands.

1. INTRODUCTION

The Central Highlands of Viet Nam has a large area (56,638.44 km² occupying 16.5 % of the country’s area), with a thin population (5,281,000 or 6.07 % of the country’s population) and
a rather low GDP per capita ranging from VND mil 22.22 to 32.6 per year which is below the national average figure of VND mil 36.947/year [1]. The limited social economic condition is a challenge for SWM in this region.

Solid waste generation in the Central Highlands is rather low, of only 952,584 ton/year (2010) [2] (still about twice of the official figure by MONRE which was 468,660 ton/year [3]). Though, due to its large area, thin population density, far distance between communities and limited social economic conditions, the collection, transport and treatment of solid waste has so far been rather poor. Consequently, the coverage currently ranges from 25.8 to 77.6 %, typically 40.7 % for the whole area [2]. Applying the regional SWM approach in a combination with EMT and sustainable development measurement, this study aims at assessing the challenges of and subsequently seeking ways for improving the current SWM in the Central Highlands.

2. MATERIALS AND METHODS

Study area of this research is the Central Highlands of Viet Nam including five provinces of Kon Tum, Gia Lai, Dak Lak, Dak Nong and Lam Dong. Input data have been collected primarily from field surveys. In addition, supportive data are extracted from official sources such as the recently published Annual Statistics Books. Relationships between economic development and solid waste generation have been assessed by extrapolation and construction of linear correlations [4] for the collected data.

Criteria for regional SWM have been employed from a previous research [5], including (1) 50 km limit radius area for municipalities; (2) access to a favorable transport system; (3) availability of flexible and eco-friendly transportation means; and (4) availability of an operating regional SWM organization. Sustainable development can be linked with the economist’s traditional concept of optimal economic growth [6] which is traced out in the following form:

\[
\int_{t=0}^{\infty} U(C_t)e^{-\delta t} dt
\]

where \( U \) is utility (wellbeing), \( C \) is real consumptions per capita, and \( \delta \) is the utility discount rate.

In function (1), the \( U \) is wellbeing of consumers in the real consumptions per capita in available income. Its general linear form is

\[
C_t = C_0 + Cm*Yd
\]

where \( C_0 \) is self-consumption, \( Yd \) is available income (or GDP per capita), and \( Cm \) is marginal consumption tendency. In this study, \( Cm = 0.75 \) and \( C_0 = Yd \) (in case the saving is zero) were applied.

The change of social indicators is assessed using the change of Human Development Index (HDI) which is calculated based on the function below [7]:

\[
\text{HDI} = \frac{I_{\text{life expectancy}} + I_{\text{education}} + I_{\text{GDP}}}{3}
\]

where \( I_{\text{life expectancy}} \) (from 0 to 1) is life time index which was calculated for each province by General Statistics Office of Viet Nam, \( I_{\text{education}} \) (from 0 to 1) is education index calculated by using the rate of literate adults and the rate of schooling at all education levels (from elementary to under-graduate school, including non-formal education), and \( I_{\text{GDP}} \) is GDP per capita index (in USD) using purchasing power parity.
3. RESULTS AND DISCUSSION

3.1. Status and challenges in solid waste management in Central Highlands

The average volume of solid waste in the Central Highlands is rather low, with only 530 ton/day, ranging from 214 ton/day (in Kon Tum) to 639 ton/day (in Lam Dong). Though, the amount of collected solid waste is limited with only 245.3 ton/day as average for the whole area, ranging from 56.2 ton/day (25.8 %) in Dak Nong to 496 ton/day (77.6 %) as highest in Lam Dong (Table 1), where GDP per capita is highest in the area and which is of 88.2 % compared to the national GDP per capita (Table 2) [1].

Table 1. Solid waste collection in the Central Highlands’ provinces.

| Collection rate (%) | Kon Tum | Gia Lai | Dak Lak | Dak Nong | Lam Dong |
|---------------------|---------|---------|---------|----------|----------|
|                     | 29.6    | 26.5    | 46.2    | 25.8     | 77.6     |
| Collection volume (ton/day) | 63.4 | 158.5 | 452.2 | 56.2 | 496 |

Although the increase of solid waste volume is rather low (average 1.51 %/year) [2], the waste collection rate in the area remains low and reaches only about 50 % of the target set by the “Vietnam National Strategy for Integrated SWM till 2025, with a vision to 2050”. This is due to 1/ poor economic conditions and low GDP per capita; 2/ low standards of living, literacy level and HDI (average HDI of 0.6866, which is only of 91.2 % to the national HDI) [7, 8]; and 3/ disorganized solid waste management system and low investment [2].

Despite different conditions, the SWM system is structured similar in all the five provinces in the area. As for example, at district level solid waste is managed directly by the district’s Economic Infrastructure Division and indirectly by the provincial Department of Natural Resources and Environment and Department of Construction [2]. This is the one of the key challenges which has to be solved in order to improve the effectiveness of SWM in the Central Highlands.

Table 2. GDP and HDI in the Central Highlands’ provinces.

| Indicator | Kon Tum | Gia Lai | Dak Lak | Dak Nong | Lam Dong | Average |
|-----------|---------|---------|---------|----------|----------|---------|
| GDP 2014  | 27,524,000 | 32,606,000 | 29,986,000 | 34,106,000 | 40,158,000 | 34,900,000 |
| GDP VN    | 43,403,000 | 43,403,000 | 43,403,000 | 43,403,000 | 43,403,000 | 43,403,000 |
| Ratio (%) | 60.1 | 70.8 | 67.7 | 73.7 | 88.2 | 72.1 |
| HDI 2008  | 0.6521 | 0.6657 | 0.6959 | 0.6959 | 0.7233 | 0.6866 |
| HDI VN    | 0.7530 | 0.7530 | 0.7530 | 0.7530 | 0.7530 | 0.7530 |
| Ratio (%) | 86.6 | 88.4 | 92.4 | 92.4 | 96.1 | 91.2 |

Note: GDP values of each province is extracted from Viet Nam Statistical Yearbook 2015 [1]; Average GDP of Central Highlands was published by Central Highlands Steering Committee in 2015 [9].
3.2. The regional solid waste management solution

One of the advantages in regard to transportation for the Central Highlands is that there are three National Highways (NH) passing this area, including NH No. 20 (in Lam Dong, 189 km long), NH No. 27 (Lam Dong – Dak Lak, 240 km long) and NH No. 14 (Dak Nong - Dak Lak – Gia Lai – Kon Tum, 428 km long). Moreover, all main urban centers located along those national roads are less than 50 km apart. Therefore, the regional SWM is proposed to focus on the following actions:

1/ Define recycling and pre-treatment centers (RPTC) which are located between two towns and are less than 50 km apart. As such, there will be three RPTCs located alongside NH No. 20, four alongside NH No. 27 and five alongside NH No. 14;

2/ Plan a solid waste treatment center (SWTC): Buon Ma Thuot is proposed to handle a SWTC for the Central Highlands because of its central location, rather good transportation system, land availability and high market potential. The current Hoa Phu SWTC in Buon Ma Thuot is suggested to expand to respond all solid waste treatment demand of the Central Highlands. The segregated recyclable factions are kept at the local RPTCs;

3/ Plan collection routes:

- Route 1 – NH No. 14: covers 13 districts/cities including Dak To, Kon Tum (Kon Tum province); Chu Pah, Pleiku, Chu Se, Chu Puh (Gia Lai); Ea H’Leo, Buon Ho, Buon Ma Thuot SWTC (Dak Lak province); and Cu Jut, Dak Min, Gia Nghia, Dak Rlap (Dak Nong province).
- Route 2 – NH No. 27: covers 4 districts/cities including Lam Ha, Dam Rong (Lam Dong province); Lak, Cu Kuin, Buon Ma Thuot SWTC (Dak Lak province).
- Route 3 – NH No. 20: covers 5 districts/cities including Da Huoai, Bao Loc, Di Linh, Duc Trong, Da Lat (Lam Dong province).

3.3. Ecological modernization theory and sustainable development assessment for integrated solid waste management in the Central Highlands

![Figure 1. Sustainable development in the Central Highlands during the period 2010 – 2016.](image)

As seen in Figure 1, sustainable development corresponding to the U value (Utility) has a linear positive correlation with the real consumptions corresponding to the change of CPI (Correlation coefficient $R^2 = 0.7$) and an exponential correlation with the change of GDP. As projected, while GDP growth decreases and CPI increases, sustainable development in the Central Highlands will decrease.
According to form (1), towards sustainable development, the real consumptions per capita \((C_t)\) should be decreased and the utility discount rate \((\delta_t)\) should be increased, meaning that consumptions should follow a pattern that could reduce waste emission and increase people’s income generation. As a result, based on EMT the following solutions can be proposed:

- Restructure the current SWM system: The units of district (and/or commune) level will only do the collection and transportation; while the local RPTCs will do the recycling and pretreatment before transferring the remaining waste to the SWTC in Buon Ma Thuot which will solely be doing the treatment only.
- Increase income and reduce natural resource exploitation towards sustainable development.
- To ensure sustainable development, the decrease of \(U – utility\) should be maximized to reach an optimum value.

As calculated, sustainable development and a high level of consumer satisfaction will both be achieved if comprehensive solutions for economic development (GDP growth above 10 %) and waste emission reduction (CPI under 3 %) are applied.

3.4. The effectiveness of the regional SWM and EMT

When both regional SWM and EMT are applied, the following benefits for the Central Highlands are expected:

- The SWM system will be refined and consist of only 22 district level collection and transport units; 5 RPTCs; and only 1 (or maximum 2) modern SWTC(s) instead of 61 scattered and polluting units that do all collection, transport and treatment as before.
- During the period 2016-2020, if CPI is controlled in the range 1 - 3 % and GDP growth in the range 10 - 12 %, the \(U – utility\) will considerably decrease (66 %) compared to the period 2010-2015.
- Besides, with unchanged \(I_{education}\) and \(I_{life\ time}\) and a 10 %/year growth of GDP, the social index or HDI in the Central Highlands is expected to significantly increase.
- Following EMT in SWM [3, 5], the increase of GDP will lead to the increase of waste treatment costs and, in its turn, will result in the increase of consumptions. Therefore, GDP growth with unchanged consumptions through a sustainable consumption pattern will contribute to the improvement of the social index. As calculated, under unchanged \(I_{education}\) and \(I_{life\ time}\), in order to improve HDI in the Central Highlands to the average nationwide HDI (which is 0.753), \(I_{GDP}\) of the area would have to increase about 17 %, leading to an impossible GDP increase of a dozen times. This means that it is unrealistic to increase HDI based only on GDP growth. On the other hand, however, HDI = 0.753 for sustainable development requirements could be realistic in the Central Highlands if \(I_{GDP}\) increases at only 2-3 % with an increase of \(I_{education}\) and \(I_{life\ time}\) at about 5 %.

4. CONCLUSIONS

The main challenges in SWM in the Central Highlands are related to economic and management problems. Those problems could be solved if EMT and regional SWM approach are both employed. As the result of the improvement, not only environmental pollution will be minimized, but also both sustainable development index and HDI will significantly be improved. The current SWM in the Central Highlands can be improved by, among other measures, rerouting the regional solid waste collection and transportation; Last but not least, in order to
improve HDI in the Central Highlands to the average nationwide value of 0.753, it is unrealistic to be based only on GDP growth. Instead, however, it could be realistic if $I_{GDP}$ increases at only 2 - 3% with an increase of $I_{education}$ and $I_{life time}$ at about 5%.

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