

Impact of Rice Straw Development towards Agricultural Environment and Farmers' Socio-Economy in MADA Region, Kedah

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Abstract. This article aims to highlight the impact that threatens the agricultural environment and socio-economic activities of paddy farmers due to the practice of rice straw burning as a method of cleaning the farm. Burning of rice straw was found to cause further degradation of local air which lead to global warming and the deterioration of the health of the local community. This situation will undermine the high production of agricultural products since the agricultural sector is highly dependent on weather stability. Therefore, the impact of burning of rice straw need to be clearly shown because it is the most solid reason for MADA to promote the idea of the project of straw development in MADA's Region. The potential of rice straw as a renewable resource and its high nutritional value is a lost if this resource is not fully exploited. Furthermore, straw development overcomes the problem of pollution in the environment and increases the farmers' socio-economic activities in addition to generating an environmentally friendly farming system.

Keywords: Agricultural Environment, Crop Residue, Open Burning, Rice Straw, Socio-Economic, Sustainable Development.

1. Introduction

Rice is the most important cereal crop in Asia and nearly 90% of this region is undertaken to rice. It accounted for three quarters of world rice production thus making Asia as the world's largest producer of paddy crop residue which is the straw [1]. As a renewable natural resource makes it as an alternative energy source to replace the depleting fossil fuel [2-4]. Nutrient content of the rice straw is also high with 25% nitrogen (N) and phosphorus (P), 50% sulfur (S) and 75% potassium (K). Given the very high nutritional value and the economics, it is a big loss if the agricultural residue is not being exploited and utilized to the optimum. The reusable of rice straw can in fact increases the quality of agricultural environment and provides an opportunity to increase farmers' income and investment generation with the formation of upstream and downstream activities through the value-added of the crop residue [5].

Generally and traditionally, straw burning is done to eliminate sources of insect pests, rat infestation and control of rice diseases. This is because the rice is continuously worked on the farm which do not eliminate the life cycle of insects and hence the diseases. In fact, the burning of straw also facilitates plowing and leveling the ground which saves time for land management for the next crop season [6]. In essence, the burning of straw will cause air pollution, including producing 13 tons per hectare of carbon dioxide. Suspended particles harm the lungs and the main cause of respiratory disease. In addition, incomplete and inefficient combustion will produce carbon monoxide and carcinogenic hydrocarbons that can cause cancer [7]. Combustion of one ton of rice straw will produce 3 kg of particulate material, 60 kg of carbon monoxide, 1460 kg of carbon dioxide, 199 kg of dust and 2 kg of sulfur dioxide. These gases play an important role to affect the atmosphere and the environment and thus lead to global climate change [8]. In fact, the straw left for a long period in the field also lead to environmental problems with the release of methane gas, which is among the main cause of the greenhouse effect. Significantly, the effects of straw burning is the loss of almost all nutrients found in the straw which is more than 80% (N), 25% (P), 20-21% (K), 4-60% (S). The loss of these nutrients will have an impact on soil fertility levels and would threaten the consequent crop production [9-10].

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2. Research Methodology

A combination of quantitative and qualitative design is used to show the impact of straw development towards the environment and farmers' socio-economy in the MADA agricultural region. MADA region is the largest area of paddy production in Malaysia and contributes about 40% of the country's rice supply. Thus, the potential of straw production here is the highest in Malaysia.

A study on the farmers' community is important because they are the prime subjects which experienced the most impact of straw burning and development activities. Further, the farmers will determine the continuity of straw management once implemented, in an environmentally friendly way in the MADA Region. The number of farmers involved in the project when the study was first carried out were 267. The number was constantly changing in every harvesting seasons, depending on the condition such as the weather influence, logistic potential, time restriction and farmers' willingness to participate in the project.

Based on the determination of sample size, a total of 160 respondents were interviewed and involved 19 villages covering four regions of MADA management. Purposive sampling method used involved farmers who did not burn straw to allow parties to collect straws on the farms and farmers who used the straw as a downstream activity. Triangulation techniques (interviews, surveys and observations) were used to support and confirm the information obtained through interviews and field observations. Wilcoxon T tests were used to see the differences in terms of environment quality and farmer's socio-economic in the context of farmers before and after the development projects implemented in the MADA Region.

3. Discussion

3.1. The purpose of straw burning

Over the years, farmers only considered rice straw as agricultural waste which was often a problem when harvesting because rice straws should be removed and cleared from the fields for the next crop season. From the interviews, it was found that the presence of straw in the field would only complicate the process of plowing the land for straws often got caught or stuck in the plow machinery. This would cause damage to the machinery and hence increased farm operating costs. Thus, farmers resorted to take the easiest way out and the cheapest mean to clean up the fields. That is straw burning. This is acknowledged by the 102 respondents (63.8%). A total of 30 respondents (18.8%) state that the burning of straw is a traditional and the normal practice since long time ago. For the 19 respondents (11.8%), the problem of crop pests and diseases attack state the main reason for the burning of straw, while nine respondents (5.6%) state soil fertilization (Table 1).

Table 1. Farmers' Purpose in Straw Burning

Straw Burning's Purposes	Amount	Percentages
Easier and Cheaper Method to Clean Up a Field	102	63.8
Traditional Practices	30	18.8
To Eliminate Diseases and Pests Attack	19	11.8
Soil Fertilization Method	9	5.6

Source: 2010 Survey

3.2. The Impact of Straw Burning towards Agricultural Environment and the Farmers' Socio Economy

The interview results show that all respondents (100%) state air quality was affected when the straw open burnings were carried out during harvesting seasons. In fact, air quality was worst if the burnings were carried on a large scale by farmers simultaneously. Currently, the main problem faces by the people is the dispersion of the combustion ash spread by wind. This was recognized by most respondents, which were about 150 people (93.8%). The farmers reported highly of about dusty black floors, clothes and ornamental plants at their sites were covered with straw burning ashes. The air flow of their houses was affected because their windows had to be closed to prevent negative effects from burned ashes (Table 2).

Some straw burning that was not done properly (wet straws) would release more smoke into the air. It is approved by 126 respondents (78.8%) whilst only 8 respondents (5.0%) state that the smoke disruption is on moderate level (Table 2). Result from the interviews found that the smoke released from the burning straw

had affected the visibility of the road users (field that is located near the road). This situation had caused a number of major accidents, 21 vehicles at KM59.8 on January 25th, 2004 and another 21 vehicles at KM160.9 North-South Highway near Jawi, Seberang Perai on July 25th, 1999 [11].

During straw burning season, a total of 55 respondents (28.1%) state of health is very bad, while 91 respondents (56.9%) state the medical condition was average. Interview results found that patients with asthma were at high risk because of the low air quality. There were also other problems caused by straw burning including coughing, burning eyes, skin irritation and some cases of death in the field due to shortness of breath.

The result shows that a total of 60 respondents (37.5%) stated that field management is better than before the straw development was put into practice. Another 55 respondents (33.8%) stated that land management is much easier to do before the straw development. This is because the straws on the field burn easily and the burning process can be done efficiently. Before the straw development project was created at MADA's Region, most of the farmers would receive moderate income. This is stated by 110 respondents (68.8%) while the other 50 respondents (31.3%) receive good income.

Table 2. Effect of rice straw burning on the environment and socio-economic agricultural farmers in MADA's Region.

Aspect	Situation before (pre) development of straw									
	Very Bad		Bad		Moderate		Good		Very Good	
	Total	%	Total	%	Total	%	Total	%	Total	%
Air quality	160	100	-	-	-	-	-	-	-	-
Ashes burning dispersion	150	93.8	7	5.5	3	1.9	-	-	-	-
Smoke disruption	126	78.8	26	16.0	8	5.0	-	-	-	-
Level of Health	55	28.1	25	15.0	91	56.9	-	-	-	-
Field management	11	6.9	26	16.3	9	5.6	55	33.8	60	37.5
Farmers' revenue (income)	-	-	-	-	110	68.8	50	31.3	-	-

Source: Survey, 2010

3.3. Effect of Rice Straw Development on the Environment and Socio-Economy of Farmers

While looking at the critical impact of the straw burning on the environment and its community in the agricultural environment and the high potential at improving the socio-economy, rice straw has began getting attention from a small number of farmers to be developed. The research findings showed that in developing awareness among farmers on developing straw has successfully reduce air pollution problems in the agricultural environment. The interview result shows that the air quality of agricultural environment is very good as stated by 155 respondents (96.9%) (Table 3). The presence of downstream activities has reduced straw burning activities in the study area. This finding is supported by the reduction in the number of hotspots caused by open burning of rice straw in the district of Yan during the period 2007 to 2009. In the year of 2007, a total of 25 hot spots were detected and it was decreased significantly and with two and four hotspots respectively that were detected in 2008 and 2009. In fact, the air quality monitoring data that was obtained from the air quality monitoring stations at Sungai Petani has also proved that the development of rice straw has further improved the local air quality (Table 4) [12].

The findings also show that almost all respondents (98.1%) respectively state that the development of rice straw has been successful in reducing the scattering effect of burning ash and smoke disruption to local communities (Table 3). From interviews, it has found that straw development in the Region MADA significantly increased the quality of life for farming community since the reduction in open burning of rice straw during harvest season. The study proves that after the straw development implemented, the level of health and condition of the respondents have improved and are very good (78.1%) while 21.9% are found to be in good health, especially for asthma sufferers and dust allergy. This is due to lower dispersion of ashes and smoke from the burning straw.

The study also proves that after participating in development straw project, farmers' income has had increased. A total of 152 respondents (88.7%) states their income is very good, while 18 respondents (11.3%) good income (Table 3). The interviews found that the increment are due to incentives given to the farmers by

MADA for participating in this development project in the form of free straw stubble or the fee they receive according to the acreage which they have worked. Free rotation of stubble can reduce land management costs as the cost of hiring tractors for plowing land. An incentive of RM16 (Ringgit Malaysia) per niche is able to cover the costs for the purchase of additional input.

However, after the development of straw was implemented, a total of 19 respondents (11.9%) state that the work to clean up the fields for the next crop becomes more difficult and take considerable time. This is because the burning of stubble residues become more difficult since there was no straw to act as an agent to help the burning of stumps. Other than that, a total of 86 respondents (53.8%) found to be better management of land for straw to be removed from the farm had been collected by the other parties involved. Incentives for farmers to take the stump for free rotation by the MADA find field management work for the next crop becomes easier (Table 3).

Table 3. Effect of rice straw on the development of agro-environmental and socio-economy of farmers in MADA region.

Aspect	The situation after (post) the development of straw									
	Very Bad		Bad		Moderate		Good		Very Good	
	Total	%	Total	%	Total	%	Total	%	Total	%
Air quality	-	-	-	-	-	-	5	3.1	155	96.9
Ashes burning dispersion	-	-	-	-	-	-	3	1.9	157	98.1
Smoke disruption	-	-	-	-	-	-	3	1.9	157	98.1
Level of Health	-	-	-	-	-	-	35	21.9	125	78.1
Field management	-	-	19	11.9	25	15.6	30	18.8	86	53.8
Farmers' revenue (income)	-	-	-	-	-	-	18	11.3	152	88.7

Source: 2010 survey

Table 4. Status of air quality affected by straw development industry in the District of Yan, Kedah

Year	Good	Moderate	Not good
2005	107	245	4
2006	146	235	0
2007	183	181	1
2008	194	170	2

Source: Department of Environment, Kedah

In conclusion, the Wilcoxon T test analysis shows that there are significant differences on aspects of air quality, ash scattering, smoke problems, health, field management and acquisition of farmers' income before and after the straw development projects implemented in the MADA Region. Results of the analysis clearly shows the mean post-test ranking far higher than the mean pre-test ranking. The results shows that the straw development can increase the level of development in all aspects.

4. Conclusion

Potential new sources of power generation using local raw materials available on the basis of the importance of environmental protection, rural development and farming community should be given priority. All this time, rice straw is considered a major agricultural waste and the cause of air pollution to the environment during harvesting is actually has a high economic value. Therefore, the application of the concept of "climate-smart agriculture" through the application of reusable agricultural by-products in soil and nutrient management while the strengthening of agro-ecosystems in a holistic manner could shift the paddy sector towards a more sustainable management.

The call on farmers straw burning towards zero in farm management is timely as the results prove that the straw development to create sustainable development in the sub-sector through improving the quality of paddy farming environment and socio-economic activities for farmers. Advantages of straw as a renewable resource to replace fossil fuel sources and its high nutrient content can support agriculture development through the production of compost and animal feed. In fact, its potential ability to create linkages with other industries such as construction will make the sector more competitive rice crops extends its primary role as

food providers. Thus, the government and agricultural agencies involved need to create the perfect basic needs such as logistics facilities (straw and machinery storage centers and balers), courses and training, especially for farmers and officials as well as research and development for the straw development as a whole in the MADA region. However, farmers would be more interested in participating in straw development projects if the incentives provided worth the effort they do in rice plants. More attractive incentives will open up a wide range of farmers and community involvement in a holistic manner to the straw development and becomes more competitive.

5. References

- [1] S. Yadvinder, S. Bijay, and J. Timsina. Crop residue management for nutrient cycling and improving soil productivity in rice-based cropping systems in the Tropics. *Advances Journal of Agronomy*. 2005, **85**: 269-406.
- [2] M. Shyam. Agro-residue-based renewable energy technologies for rural development. *Energy for Sustainable Development*. 2002, **VI** (2): 37-42.
- [3] H. Kopetz. Biomass: A burning issue. *reFocus*. 2007, **8** (2): 52-58.
- [4] B. Gadde, C. Menke, and R. Wassmann. Rice straw as a renewable energy source in India, Thailand and the Philippines: Overall potential and limitations for energy contribution and greenhouse gas mitigation. *Biomass and Bioenergy*. 2009, **33**: 1532-1546.
- [5] Chamhuri Siwar. Issues and challenges in the agriculture industry in relation to waste management and utilization. In: Business opportunities in agricultural waste. *Proceedings of the Agricultural Waste Management Conference 2003*. 2005, pp. 1-13.
- [6] A. Bridhikitti, and K. Kanokkanjana. Sustainable Rice Straw Management for Urban Air Pollution in Bang Bua Thong, Nonthaburi. In: Ranjith Perera (eds.). Nonthaburi: Southeast Asia Urban Environmental Management Application Project. 2009.
- [7] P. Henderick, and R. H. Williams. Trigenation in a Northern Chinese village using crop residues. *Energy for Sustainable Development*. 2000, **4** (3): 26-42.
- [8] R. K. Gupta, and S. C. Garg. Residue burning in rice-wheat cropping system: causes and implications. *Current Science*. 2004, **87** (12): 1713-1717.
- [9] A. Dobermann, and T. H. Fairhurst. Rice straw management. 2002. <http://www.ppi-ppic.org/ppiweb> [16 Mei 2008].
- [10] K. G. Mandal, A. K. Misra, K. M. Hati, K. K. Bandyopadhyay, P. K. Ghosh, and M. Mohanty. Rice residue: management options and effects on soil properties and crop productivity. *Food, Agriculture and Environment*. 2004, **2** (1): 224-231.
- [11] Utusan Malaysia. 21 kenderaan berlanggar- terperangkap dalam asap tebal akibat pembakaran jerami dekat Kobah, Alor Setar. 26 Januari. 2004.
- [12] Jabatan Alam Sekitar Negeri Kedah. Outcome report: kajian kitar semula jerami padi dengan menggunakan cacing. Kementerian Sumber Asli dan Alam Sekitar. 2010.