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VALUEABLE RICE STRAW IN DAKHALIA GOVERNORATE AS AID OF STRAW MANURE SITU.

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ABSTRACT

Lack of adequate nutrient supply and poor soil structure are the principal constraints to crop production under low input agriculture systems of Dakhalia Governorate. The burning of crop residues is one of national problems in Egypt especially after harvesting or threshing operations to the different crops. The distinctive feature of rice straw is that its silicon content of 4.53% is higher than that in wheat straw of 1.28% and it may be much more difficult to process the rice straw (Su *et al.*, 2002).

Animal compost, organic fertilizer and straw management are among the factors affecting soil fertility in organic cropping systems. However, few studies have compared the effects of organic amendments on soil fertility of organic paddy fields. We conducted a survey of organic farmers' paddy fields to compare soil nutrients *(N, P, K, Ca and Mg),* nutrient budgets and partial factor productivity of N *(PFPN),* and to relate them to organic amendments. This research concentrated on the possibility of using the burring amount of rice straw in Dakhahlia Governorate as field residue. And it will be a good deal situ to dig it through tillage operation to convert it as soil manure.

INTRODUCTION

Straws are basically free for the baling. About half of the above ground biomass of grain crops is wasted: the straw that bore the grain. Most of the nearly 2 billion tones of cereal straw produced annually in the world have a negative economic/ environmental value, Gressel (2008).

In Egypt, the cultivated area of rice is 1.534 million feddans which annually produces 6.38 million tons (RRTC, 2006). This produces about 4 to 5 million tones of rice straw. This quantity presents a sizable problem to the farmers, government and the environment. The management of agricultural wastes is also an important environmental issue in Egypt

California Agricultural magazine (1999) concluded that one tone of rice straw burning would produce about 56 kg of carbon monoxide (CO). Therefore, if only one million tones have been burnt each year, the total amount of carbon monoxide (CO) would have reached to 56,000 tones. This indeed, will cause increased the rate of air pollution which is considered the primary reason of infection by cancer disease. There are great efforts towards recycling rice straw to reduce the environmental pollution during rice threshing season and rapidly clear the fields from straw for useful applications as animal feeds and in paper and wood industry. Other utilization techniques may be represented in composting to produce organic fertilizers (Saher, 2008). Also, about 80% of the biomass burning now occurs in the intertropical zone, of which nearly half is from agricultural burning and use of wood for fuel. Most of the fires are deliberately started by humans. Biomass burning is a common practice in the tropics and subtropics. It affects Africa all year round, but particularly prevalent during the dry season (Sivakumar (2007).

One of the few advantages of not burning straw is an increase in soil organic matter, which would be abrogated by straw removal as a biofuel feedstock. Various soil scientists have a consensus view, which must be clarified under local conditions, that if straws are cut higher, removing only about 80% for biofuels, the extent of the damage to the soil will be negligible, at least in the temperate zone (Gressel, 2008).

The size of the soil organic carbon pool doubles that present in the atmosphere and is about two to three times greater than that accumulated in living organisms in all earth's terrestrial ecosystems. In such a scenario, one of the several ecological and environmental impacts of fires is that biomass burning is a significant source of greenhouse gases responsible for global warming. Globally, biomass burning is estimated to produce 40% of the carbon dioxide, 32% of the carbon monoxide, 20% of the particulates, and 50% of the highly carcinogenic poly-aromatic hydrocarbons produced by all sources (Levine, 1990).

The use of biophysical models may therefore be expected to play a crucial role in the future development of this methodology. The impacts related to human toxicity and eco-toxicity were disregarded by Gabrielle and Gagnaire (2008), although they might play a significant role, especially during the straw burning phase. It had decided such impacts lay beyond the scope of the present study, since it was focused on the agricultural production phase and the use of crop residues, which do not directly involve the use of agrochemicals.

Crop residues have recently regained attention as a potentially considerable source of renewable energy. Available residues are estimated at $10x10^{9}$ *Mg* worldwide, corresponding to an energy value of $47x10^{18}$ *J* (Lal, 2005). Among them, cereal residues are the largest source, making up two thirds of the total available amount. However, there is an on-going debate on the actual possibilities of straw removal from agricultural cropping systems. In addition, cereal straw, a by-product in the production of agricultural crops, is considered as a potentially large source of energy supply with an estimated value of $47x10^{18}J$ worldwide. However, there is some debate regarding the actual amounts of straw which could be removed from arable soils without jeopardizing their quality, as well as the potential tradeoffs in the overall straw-to-energy chain compared to the use of fossil energy sources, Gabrielle and Gagnaire (2008).

Rice straws rich in organic matter (80%) and oxidizable organic C (34%) and has a high C/N ratio, which can vary from 50 to 150 (Iranzo, *et al.*, 2004). While, Cai *et al.* (2007) indicated that the composting processes applied to the mixture of sewage sludge with rice straw at a low C/N ratio (13:1) met the duration of hemophilic phase and reached maturity. In addition, Kimura. *et al.*, (2004) indicated that C/N ratios of plant residues should decrease to around 20 after the decomposition of plant residues by 40–60%. Therefore, plant residues were decomposed actively by soil microorganisms, and those in the 1–2 mm size were regarded to have decomposed to nearly half of the original weight.

Compost may improve the stability of soil aggregates and applied as mulch may reduce the risk of erosion (Pinamonti and Zorzi, 1996). It may increase soil porosity and water holding capacity decrease soil acidification and it releases nutrients (Benitez *et al.*, 2003). However, compared with chemical fertilizer most compost contains relatively low levels of nutrients (1–2%N, less than 1%P). In addition, low mineralization rates from composts require high application rates to satisfy the complete N or P requirement of a crop.

Use of crop residue mulch has profound beneficial effects on soil properties, microclimates, and agronomic productivity. Mulching conserves soil and water, improves soil structure, content, adds captions to the soil, regulates soil temperature, and restores the productivity of degraded lands. Mulching dissipates raindrop energy and thereby decreases soil detachment. It also encourages infiltration rates by minimizing surface sealing, and thus reduces runoff and soil loss (Adekalu *et al.*, 2007). Moreover, mulching and reduced tillage significantly lowered soil and nutrient losses compared to conventional tillage. Soil nitrogen and organic matter losses, as particulate organic matter associated with eroded sediment, was quite high in conventional tillage. Rice straw mulch was found effective in conserving soil and nutrients, however, due to its limited availability and higher opportunity cost, farmers may not adopt this technology. Alternative mulch materials need to be explored, (Atreya *et al.* (2008).

Carbon released from crop residues contributes to increasing soil microbial activity and so increases the likelihood of competition effects in the soil. The placement of the residue in soil can lead to the displacement of the pathogen from its preferred niche diminishing the pathogen's ability to survive. The benefits of applying organic amendments for disease control are incremental, generally slower acting than chemical fumigants or fungicides, but may last longer, and their effects can be cumulative Bailey and Lazarovits (2003).

Some authors suggest that the *C/N* ratio is an extremely important property in the decomposition of organic matter by microorganisms (Marin, 2004), and for this reason, the organic matter added to saline soils plays an important role in the positive effect observed in microbial activity and enzymatic activities such as unease, alkaline phosphates and dehydrogenate. Tejada *et al.* (2008) demonstrated that an increase in the organic matter content of saline soils increases soil structural stability, soil bulk density and, therefore, soil microbial biomass.

Yu *et al.* (2008) showed that rice straw could be converted into a soil-like substrate *(SLS)* by biological (microorganisms, mushrooms and worms) processing. Rice straw could be treated better by aerobic fermentation and succeeding growth of the *P. stratus mushrooms*. In the conversion of rice straw to an *SLS*, the matter loss was 77.31%. The starting SLS containing high nutrition was gained and 8.7 7gm^{-2} day^{-1} (DW) edible part of lettuce was harvested on it.

Neve *et al.* (2004) indicated that there is scope for manipulating N release from N rich crop residues by the addition of both on- and off-farm organic materials, in order to reduce nitrate leaching risks, to better match crop N demand with soil N supply, and to increase overall N use efficiency. Both the intensity of immobilization and the time at which demineralization occurs seem to be manageable by the right choice of modifiers.

Soil microbial biomass and soil enzyme activities respond much more quickly to the changes in soil management practices as compared to total soil organic matter. Tejada *et al.* (2008) found that soil microbial biomass and soil respiration responds rapidly, in terms of activity, after the addition of different green manures to soil. This increase in soil microbial biomass carbon and soil respiration can be attributed to the incorporation of easily degradable materials, which stimulate the autochthonous microbial activity and to the incorporation of exogenous microorganisms.

Ravindran *et al.*, (2007) also observed that application of halophytic compost significantly reduced the NaCl concentrations in the soil. This was also evidenced by the reduction of pH and EC of the soil. This could be due to maturity of the finished compost. Maturity was determined by turning interval and age. When fresh organic compost was applied to the soil, the ongoing microbial activity causes reduction of pH due to production of organic acids. Furthermore, the microbial activity increases the CO_2 partial pressure and cause development of reducing conditions.

Tsujimoto *et al.*, (2009) indicated that soil fertility, represented by the soil available *N*, was likely to be the main factor for the high yields. Bakht *et al.* (2009) showed that retention of crop residues, inclusion of a legume in cropping systems and application of fertilizer *N* significantly increased the soil mineral, grain, straw and *N* yields of wheat. Residues retention on average increased the grain yield by 1.31 times, straw yield by 1.39 times and *N* uptake by 1.31 times in grain and 1.64 times in straw of wheat. The farmers who traditionally remove residues for fodder and fuel will require demonstration of the relative benefits of residues return to soil for sustainable crop productivity.

Hsu *et al.* (2009) concluded that soil organic matter *(SOM)* content would tend to increase irrespective of the nature of organic matter added. Observed data of *SOM* show that *SOM* content increased from 58.5% to 196.5% following addition of decomposed organic materials and from 16.4% to 34.0% following addition of fresh organic materials. Therefore, in a long-term paddy–upland rotation, decomposed organic materials proved more efficient than non-decomposed organic materials in increasing the quantity of *SOM.*

MATERIALS AND METHODS

Farmers usually burn their straw yield at the end of the rice harvesting season for the fields are prepared for the next crop. Burning rice straw may increase the soil surface layer temperature, causing a sharp drop in winter crop seedling emergence. The frequent straw burning may cause subsoil hard pan, which makes the drainage difficult, restricts seedlings emergence. In many other developing countries, rice straw is usually disposed of by in situ burning, which has a harmful impact on the environment (global addition of carbon dioxide) and on the local population (e.g. respiratory or allergic disorders). Recently, various approaches have been described for the utilization of rice straw such as paper production, construction materials, compost, animal food, etc. Until now, only a limited part of the produced rice straw is used for these purposes. Given that rice straw contains a large amount of organic material and nutrients. Its conversion into value-added compost, similarly to the sewage sludge, may have the potential to improve productivity of crops and reduce environmental pollution.

Data Collection

A 10 years surveying published data were collected around Egypt, analyzed colleted data in 12 sub sectors of Dakhalia Governorate, Ministry of Again, Ministry of Agricultural Research centers reveals that the most amount or rice straw were used in a form of: chopping, pressing, unused, silage, storage and compost.

Normalized data

The collect data were normalized in each sub sectors all over Dakalyia Governorate and grouped into chopping, pressing, unused, silage, storage and compost and this research concentrated well overview on the unused or remaining values in twelve sub sectors named: Meet Gamer, Aga, El-Simblewain, Temy El-Amded, El-Mansoura, Dekernase, Meet Sweed, Meniat El-Nasr, El-Mansala, Talkha, Shirbeen and Bilqas. In the same form or presentation of processing and unprocessing rice straw to reveal overview the possibilities of the pontifical usage of the unused rice straw amount in some aspection rather burning it.

RESULTS AND DISCUSSION

Rice is cultivated in summer season, and the second crop such as wheat, barley, soybean and often again rice is grown after the rice cultivation. Alternatively rice fields are left fallow until the next rice cultivation, during which weeds grow densely. Edible parts are less than half of total rice biomass, and large amounts of plant residues are left in rice fields in the forms of stubble and rice straw. In addition, organic materials such as compost, green manure and plant residues are applied intentionally to the fields for maintaining soil fertility. The rice field ecosystem, thus, is the ecosystem where production of plant biomass (crops and weeds) and decomposition of plant residues are very active

In many cropping systems of the Dakhalia Governorate zone, little or no crop residue is returned to the soils. This leads to a decline in soil organic matter content, and subsequently a decline in crop yields, biomass production and therefore results in environmental degradation. Due to the low decomposition rate of organic material and low fertility status of the soils, specially low phosphorous content, it is recommended that organic resources be first composted to increase nutrient availability and decrease the C/N ratio before application in the field. So, the addition of compost would be expected to affect soil characteristics and thus carbuncular mycorrhizal (AM) fungal growth in many ways. It would be hypothesized that compost would in particular enhance the soil water holding capacity, thus improving AM fungal growth.

The morphological observations of soil pits revealed a better soil structure with many voids and well developed aggregates having various sizes in receiving compost plots than in no-compost plots. Some voids were related to the activities of soil fauna (termites and earthworms). Elbanna et. al (1994). They also indicated that, compost amendment improves soil morphological and chemical properties. Soil organic matter was not significantly influenced by the compost application in this short-term on-farm experiment.

Figs 1.1 to 1.12 and Fig. 2 represented the total and average rice straw yield in time span from 2000 to 2009 of sub-sectors at Dakhalia Governorate . These figures show a huge amount of rice straw may be encouraged industrial sector on rice materials, such as paper, compost and silage and chemical fertilities.

Long-term experiments are necessary to show such an effect. However, the application of compost results in a significant increase in crop production and mitigates the negative effect of a delay in sowing. The use of compost, therefore, is a sound technology for compacting soil degradation and for alleviating food shortage and poverty in the Sahel. However, socio-ecological constraints need to be mitigated in order to increase the adoption of compost technology at a large scale. These constraints include land tenure security and lack of credit for investment in soil management.

Long-term application of chemical fertilizer together with compost accelerated the decrease in the organic P fraction, presumably due to promoting microbial activity in the plough layer, and then increased significantly inorganic P fraction. Compost application decreased the residual P and Fe–P fractions and then increased inorganic P fraction, in spite of continuous compost application, increase in total, inorganic and extractable P with time may be closely related to the increase in the availability of accumulated P for rice growth.

Figs 3.1 to 3.12 show the amount of processing and unused rice straw in Dakhalia Governorate. It can be remained that most of the unused amount have to be use as soil composting rather than burning it.

Multiple years of treatment with organic amendments could enhance the beneficial effects on soil fertility and crop productivity. Several studies have indicated that continuous application of organic matter increased or maintained crop yields by improving soil physiochemical properties . The effects of long-term organic amendments may be enhanced when combined with deep ploughing, rendering the soil even in deeper layers fertile. The effects of deep plowing also include accelerating soil nitrogen mineralization and facilitating the development of deep root systems in rice plants. Soil mineralized nitrogen and root length density in the deep soil layer increased with deep plowing, resulting in the increase of plant N uptake and rice yield.

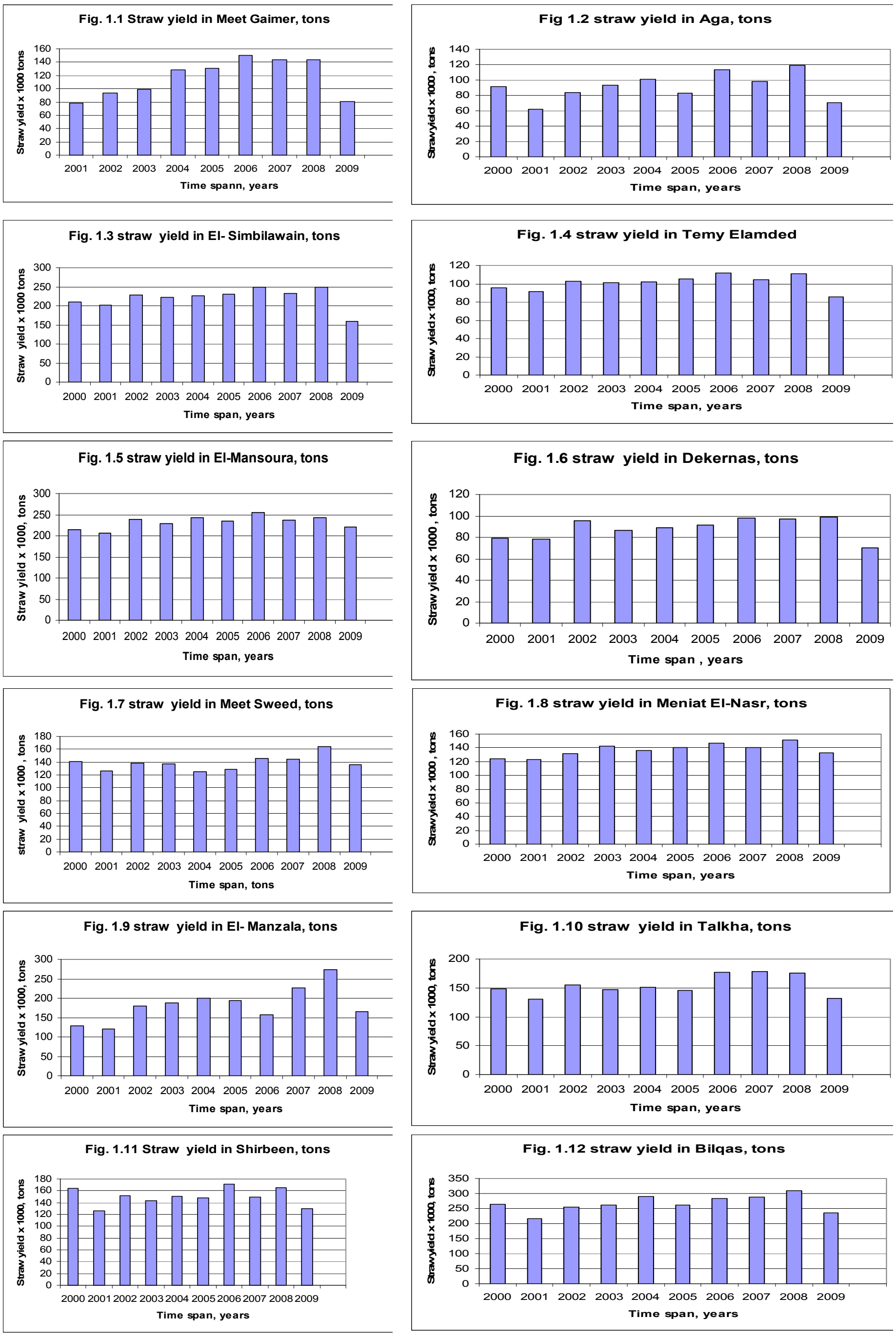

Fig. 1: Represented the straw yield in time span from 2000 to 2009 for Dakhalia Governorate.

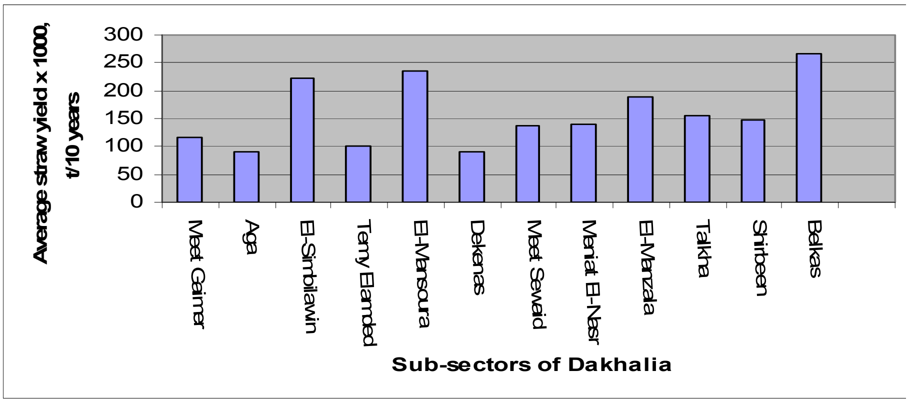

Fig. 2: Average rice straw in 12 sub-sectors of Dakhalia Governorate through 10 years.

Organic amendment is crucial for fertile soil in organic cropping systems. Organic amendments of continuous organic rice *(Oryza sativa L.)* cropping systems include animal composts, organic fertilizers and straw. Organic fertilizers refer to fertilizers derived from plant and animal residues. In a mixed cattle farming, rice straw is usually removed for feeding and bedding materials of cattle production, whereas cattle composts are returned to paddy fields. If other types of animal compost are available from on-farm or from neighboring farms, organic farmers could apply them to organic rice fields with straw incorporation. Organic fertilizers purchased off-farm are also applied, but their rates are dependent on inherent soil fertility and the availability of animal composts. Because animal composts, organic fertilizers and rice straw include all macronutrients in varying quantities, inputs and outputs (removals) of macronutrients need to be balanced so as to produce sufficient amounts of nutrients, to maintain (or improve) soil fertility, and to avoid adverse environmental effects.

Environmental problems have been considered as a serious situation in the construction. Waste management is pressing harder with the alarming signal warning the industry. Reuse, recycling and reduce the wastes consider as the only methods to recover those waste generated. However, the implementations still have much room for improvement.

Recently, various approaches have been described for the utilization of rice straw such as paper production, construction materials, compost, animal food, etc. Until now, only a limited part of the produced rice straw is used for these purposes. Given that rice straw contains a large amount of organic material and nutrients. Its conversion into value-added compost, similarly to the sewage sludge, may have the potential to improve productivity of crops and reduce environmental pollution.

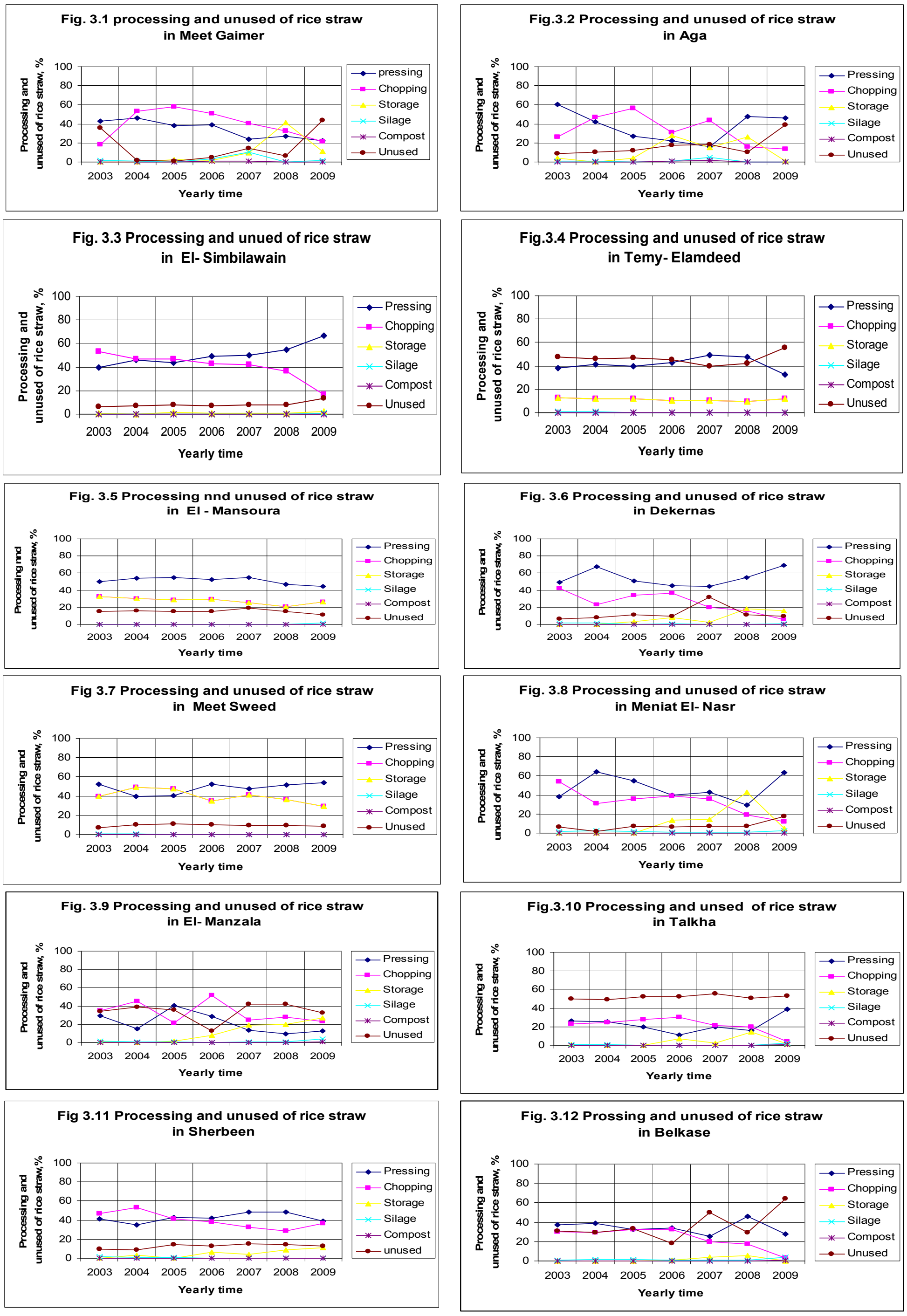

Fig. 3: Processing and unused of rice straw from 2003 to 2009 for Dakhalia Governorate.

Straw removal had little influence on simulated environmental emissions in the field, and straw incorporation in soil resulted in a sequestration of only 5–10% of its C in the long term (30 years). The life-cycle assessment (LCA) concluded to significant benefits of straw use for energy in terms of global warming and use of non-renewable energy. Only the eutrophication and atmospheric acidification impact categories were slightly unfavorable to straw use in some cases, with a difference of 8% at most relative to straw incorporation. These results based on a novel methodology thereby confirm the environmental benefits of substituting fossil energy with straw.

Conclusion

Environmental problems have been considered as a serious situation in the construction. Waste management is pressing harder with the alarming signal warning the industry. Reuse, recycling and reduce the wastes consider as the only methods to recover those waste generated. However, the implementations still have much room for improvement.

Application of an extremely large amount of compost increased rice yield only slightly compared to non-fertilization. This indicates that organic fertilizer may not represent the ideal substitute for mineral fertilizer as a nutrient source. However, it is generally recognized that the role of organic amendments is not simply to supply the nutrients but also to improve the biological and physical characteristics of soil.

Compost application mitigated the negative effects of a delay in sowing. The study showed that farmers were aware of the role of compost in sustaining yield and improving soil quality. However, lack of equipment and adequate organic material for making compost, land tenure and the intensive labor required for making compost are major constraints for the adoption of compost technology. It was concluded that compost application could contribute to increase food availability in Dakhalia Governorate and therefore, efforts should be made to alleviate the socio-economic constraints to the adoption of compost technology.

Soil organic matter plays a key role in the soil system and is an important regulator of numerous environmental constraints to crop productivity. Soil organic matter is a major source of plant nutrients and improves physical properties of soil, such as soil porosity, structure and water-holding capacity. Also, the organic matter added to soil, while greatly improving the physical properties of the soil, needs a certain time to mineralize and supply the nutrients needed by the crops. Moreover a large quantity of product is needed to fulfill the nutritional requirements of the crops. This is the reason why some authors suggest the addition of mineral fertilizers at the same time, to supply the nutritional nutrients that the plant requires in the early stages of development.

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قيمة قش الأرز في محافظة الدقهلية وحال تصنيعه أسمدة وفائدته

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جمعت بيانات ميدانية عن كميات مخلف قش الأرز بالإثنى عشرة مركزا بمحافظة الدقهلية، وتناولت الدراسة مساحات محصول الأرز في مراكز محافظة الدقهلية، وكميات القش المنتجة سنويا على مستوى المحافظة .. وتم التركيز على ما تم استخدامه من كميات القش في المجال الصناعي كصناعة الورق أو إنتاج الأسمدة العضوية أو ما تم كبسه أو تشوينه

وتوصلت الدراسة إلى أن متوسط كميات القش المنتجة بعد حصاد محصول الأرز بالألف طن فى مراكز محافظة الدقهلية كما يلى: ميت غمر(١١٠) ، أجا (٩٠) ، السنبلاوين (٢٣٠) ، تمى الأمديد (١٠٠)، مركز المنصورة (٢٧٠)، دكرنس (٩٢)، ميت سويد (١٤٠)، منية النصر (١٤٥)، المنزلة (١٩٠)، طلخا (١٦٠)، شربين (١٥٠) ، بلقاس ٢٦٠، بإجمالى 1,937,000 طن كمتوسط لعشرة سنوات لمحافظة الدقهلية.

في عام ٢٠٠٣ ما تم كبسه 831,913 طن، فرم 766,105 طن، تشوين 13,198 طن ، وما تم تنفيذه من كومات (أسمده عضوية 21,081 ، أمونيا 1,345 ، يوريا 3,043 وبمعلومية كميات القش المنتجة فى نفس العام 1,850246 طن وإجمالي المستفاد منه 1,085,062 أي أن الكمية التي تم حرقها 765,184 طن.

بالمقارنة بعام ٢٠٠٩ ما تم كبسه 830,759 طن، فرم 384,071 طن، تشوين 146,192 طن ، وما تم تنفيذه من كومات (أسمده عضوية 46,468 ، أمونيا 4,882 ، يوريا 30 وبمعلومة كميات القش المنتجة في نفس العام 1,618,652 طن وإجمالي المستفاد منه 1,412,402 أي أن الكمية التي تم حرقها 206,252 طن.

نجد أنه بالرغم من نقص كميه القش المنتجة في عام ٢٠٠٩ قلت بمقدار 231,594 طن (بنسبة %) 12.517عنها في عام ٢٠٠٣ . إلا أن كمية ما تم تنفيذه من كومات (أسمدة عضويه، وحقن بالأمونيا، ويوريا) في عام ٢٠٠٩ كانت 51,380 طن بالمقارنة بـ 25,469 طن في عام ٢٠٠٣ أي بزيادة 101,735% وهذا يدل اهتمام وزارة البئيه بمحاربة حرق القش بعد حصاد محصول الأرز من عام لآخر.

وركزت الدراسة على ما يتبقى بدون الإستفاده منه ممثلا في الكمية التي تحرق من القش بالحقول (765,184 طن في عام ٢٠٠٣ بالمقارنة 252 ,206 طن في عام ٢٠٠٩) أي بنقص نسبة 73,05%

ومن المعلومات المنشورة عن وزارة البيئة الأمريكية أن حرق ١ طن من قش الأرز ينتج ٥٦ كجم من أول أكسيد الكربون السام نجد أن كميه القش المحروقة في عام ٢٠٠٣ وحدها قد سببت تلوثا مقداره 42,850,304 كجم من أول أكسيد الكربون وقد نقص تلك الكمية كجم من أول أكسيد الكربون وقد نقص تلك الكمية إلى 11,550,112 كجم من غاز ك أ٢ في عام ٢٠٠٩ بفضل زيادة الاستفادة من مخلف القش المنتج.

قام بتحكيم البحث

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