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EDITORIAL

Jurnal Irigasi merupakan publikasi ilmiah yang memuat hasil-hasil penelitian, pengembangan, kajian atau gagasan dalam bidang ke-irigasi-an. Setelah berganti nama dari Jurnal Informasi Teknik yang terbit sejak tahun 1986, Jurnal Irigasi kini hadir kembali dalam edisinya yang ke-9 dengan penampilan yang baru dari edisi-edisi sebelumnya. Perubahan ini tidak lain ditujukan agar dapat memberikan sajian yang lebih baik kepada pembaca, oleh karenanya Redaksi terus menjaga dan meningkatkan kualitas dalam setiap terbitannya.

Berbicara mengenai pekerjaan pembangunan jaringan irigasi, tidak jarang timbul pertanyaan menyangkut apakah hasil (*output*) yang diharapkan dari pembangunan jaringan irigasi teknis baru sudah tercapai? atau apakah pembangunan jaringan irigasi baru akan sesuai dengan yang diharapkan bahkan lebih terjamin kualitasnya? Untuk mengetahuinya diperlukan suatu cara dalam menilai kinerja jaringan irigasi yang telah selesai dibangun, yaitu dengan menggunakan acuan indikator kinerja *output* jaringan irigasi teknis yang akan dibahas lebih jauh dalam naskah pertama pada Jurnal Irigasi kali ini.

Pengelolaan sumber daya air membutuhkan informasi yang cukup rinci. Umumnya dalam penentuan potensi aliran sungai menggunakan data debit dari AWLR yang nilainya sama untuk seluruh DAS, akan tetapi seiring dengan kebutuhan yang semakin meningkat diperlukan perhitungan potensi air yang lebih akurat misalnya melalui pembobotan. Naskah bertajuk "Potensi Ketersediaan Air untuk Mendukung Budidaya Padi Sawah" akan menganalisis pembobotan yang paling signifikan dalam mempengaruhi potensi air permukaan dengan studi kasus DAS Cicatih-Cimandiri, Jawa Barat yang memiliki potensi ketersediaan air permukaan sangat melimpah, berupa aliran sungai yang mengalir sepanjang tahun.

System of Rice Intensification (SRI) sebagai metode budidaya padi hemat air merupakan metode yang telah lama dikenal di Indonesia. Artikel mengenai SRI juga telah banyak dimuat dalam jurnal ini, meski demikian masih banyak dipertanyakan tentang produktivitas yang tinggi dari metode tersebut. Untuk mengkaji lebih dalam produktivitas metode tersebut, pada edisi ini Redaksi hadirkan sebuah analisis produktivitas pada intensifikasi budidaya padi organik dengan menggunakan analisis pendekatan permodelan di Kabupaten Sukabumi, Jawa barat.

Tujuan utama irigasi adalah mempertahankan kadar air tanah agar selalu berada pada kisaran yang tersedia bagi tanaman. Pemberian air irigasi yang tepat memerlukan suatu program yang dapat menjawab pertanyaan-pertanyaan kapan, berapa banyak dan bagaimana air irigasi diberikan. Salah satu cara untuk menghitung jumlah air yang tersedia dan yang diperlukan sebagai irigasi suplementer adalah dengan analisis kesetimbangan air. Naskah keempat pada Jurnal Irigasi ini mencoba membahas dan menguraikan komponen-komponen kesetimbangan air pada zona perakaran yang akan membantu dalam mengambil keputusan ke arah peningkatan efisiensi irigasi.

Keberhasilan produksi pertanian dalam pengembangan agroindustri memerlukan dukungan infrastruktur irigasi yang dapat menjamin kontinuitas produksi dan hasil yang tinggi serta penerapan metode irigasi yang tepat. Badan Penelitian dan Pengembangan Kementerian Pekerjaan Umum (Balitbang PU) melalui Balai Irigasi mengembangkan model Jaringan Irigasi Non Padi (JINP) dalam kawasan agropolitan di Provinsi Gorontalo dengan sistem irigasi sprinkler dan sistem irigasi alur yang akan dibahas lebih jauh pada naskah kelima edisi ini.

Penelitian lain yang juga menyediakan dukungan infrastruktur irigasi dalam menunjang keberhasilan produksi pertanian yaitu pengembangan pintu air irigasi GFRP (*Glass Fiber Reinforced Plastic*). Seperti diketahui bersama bahwa pintu air berfungsi cukup vital dalam pengaturan air irigasi baik pada musim hujan maupun musim kemarau. Kondisi yang ada saat ini, banyak dijumpai pintu air berbahan besi dan kayu yang rusak akibat lapuk (kayu) serta korosif dan dicuri (besi), hal ini terbukti dengan hasil pemantauan lapang di DI Cimanuk, dimana hampir 60 % pintu air dalam keadaan rusak. Penelitian yang disajikan dalam naskah terakhir edisi ini bertujuan untuk mencari alternatif desain dan bahan pintu yang lebih ekonomis, kuat dan tidak menarik untuk dicuri. Salah satu bahan yang dikaji adalah GFRP yang ternyata mempunyai beberapa keunggulan dibandingkan dengan bahan lainnya.

Semoga naskah-naskah yang kami sajikan dapat bermanfaat dalam menyumbangkan ilmu pengetahuan baru. Akhir kata Redaksi Jurnal Irigasi mengucapkan selamat membaca. (SL)

Redaksi

PRODUCTIVITY ANALYSIS OF ORGANIC RICE FARMING INTENSIFICATION

(ANALISIS PRODUKTIVITAS PADA INTENSIFIKASI BUDIDAYA PADI ORGANIK)

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Abstract

One of the possible solutions to overcome food crisis, especially in Asia, might be the utilization of the intensification system of rice production with high productivity and less water requirement. This method is popularly called SRI, which has been developed in some Asian countries including Indonesia. This system relies on the rooting management of paddy crop, which is based on the management of water, soil and plant. Basically, this system can utilize either organic, chemical, or combination of both types of fertilizer. The utilization of organic fertilizers in SRI has been widely conducted in Indonesia especially in West Java. However, the productivity of the organic rice farming using SRI is still questionable. This paper presents the analysis of the productivity of rice organic farming through modeling approach. District of Sukabumi in West Java was selected as the study area. The models developed are capable to predict nicely the production and productivity of organic rice farming using SRI.

Keywords: **rice intensification, organic farming, productivity, organic fertilizers, water management, modeling**

Abstrak

Salah satu solusi yang memungkinkan untuk mengatasi krisis pangan, terutama di Asia, adalah pemanfaatan sistem intensifikasi produksi padi dengan hasil tinggi dan hemat air. Metode ini dikenal dengan nama '*system of rice intensification*' atau SRI, yang telah dikembangkan di beberapa negara di Asia termasuk Indonesia. Sistem ini mengandalkan pengelolaan perakaran tanaman padi, yang didasarkan pada pengelolaan air, tanah dan tanaman. Pada dasarnya sistem ini dapat menggunakan pupuk kimia, pupuk organik, atau kombinasi dari keduanya. Penggunaan pupuk ogranik pada metode SRI telah banyak dilakukan di Indonesia, terutama di Jawa Barat. Walaupun demikian, produktivitas yang tinggi budidaya padi organik dengan metode SRI masih dipertanyakan. Tulisan ini menyajikan analisis mengenai produksi dan produktivitas dari budidaya padi organi melalui pendekatan permodelan. Kabupaten Sukabumi di Jawa Barat dipilih sebagai wilayah studi. Model-model yang dikembangkan dapat memprediksi dengan baik prduksi dan produktivitas budidaya padi organik dengan metode SRI.

Kata kunci: **intensifikasi padi, pertanaman organic, productivitas, pupuk organic, pengelolaan air, permodelan**

I. INTRODUCTION

Many observers have made forecast on the world food crisis in the near future due to the rapid population growth. The latter together with industrial development will cause problems in food as well as water supplies and other catastrophes especially in the developing countries (Yajima, 2002). Rice has long been very important for dietary source and fulfilling human food needs in Asia where the population is very high and the available arable land is very low. Growing rice has also been the central livelihood strategy and is in the blood of most of Asian farmers (Fresco, 2003; Rijsberman, 2004). There are two major challenges involving rice in Asia: (a) ensuring the ability of nations to meet their national and household food security needs and (b) eradication of extreme poverty and hunger. The important position of rice to the lives of most Asians makes any solution to global poverty and hunger have to include research that helps poor farmers earn a decent and reliable income by growing rice affordable to poor consumers (Cantrell, 2004). Other challenge for paddy rice farmers in Asia to increase their productivity is how to grow more rice with less water (Barker et al., 2004).

Increasing rice production in Asia, including Indonesia, is probably the key in order to keep up with the population growth. High productivity becomes an important factor. A new method of rice cultivation called as System of Rice Intensification (SRI), originally introduced in 1980 in Madagascar, gives the opportunity to produce more rice with less water. It is claimed that "SRI is a methodology that can contribute to food security by increasing rice yields to about twice the present world average, virtually without the need of improved seeds or chemical inputs" as presented by Norman Uphoff, director of the Cornell International Institute for Food, Agriculture and Development (CIIFAD), in his keynote on "The System of Rice Intensification (SRI) and its Relevance for Food Security and Natural Resource Management in Southeast Asia" (TROZ, 2002). It has been tested in China, India, Indonesia, the Philippines, Sri Lanka and Bangladesh with positive results (Berkelaar, 2006). Some scientists of the Consultative Group on International Agricultural Research (CGIAR) have been engaged in a long-term assessment of the potential to achieve water saving in traditional paddy rice production. This group has also recognized the high priority of growing more food, including paddy rice, with less water. Growing more rice with much less water is necessary and possible (Rijsberman, 2004).

The interesting thing about SRI is that almost no external inputs are necessary for a farmer to benefit from this method. This method should work with any seeds that are now being used. It is not necessary to use new seeds or new high yielding varieties (HYV), although some of the highest yields obtained using SRI have been from the HYVs of paddy. The introduction of SRI to farmers in Indonesia was conducted by non-government organizations (NGOs). The first trials were in small scales, where water requirement and organic fertilizers were still manageable. The sustainability of this rice farming method would still be in question if it is applied in large scale due to its promising future in intensive rice production. The change from the traditional to SRI system might cause some changes in socio-economic, technical, as well as environmental aspects of the rice production. It might take some years for farmers to get confidence that this method could consistently raise production so substantially.

The SRI practices for paddy cultivation conducted by farmers in Indonesia, particularly in West Java, mostly can be categorized as organic rice farming. As previously stated, the key factor in increasing rice production among others is productivity. The objective of this study was to make an analysis on the production and productivity of organic rice farming using SRI method through modeling approach. District of Sukabumi in West Java was selected as the study area.

II. METHOD

2.1. Modeling Framework on Sustainability

The study area covers the areas of Sukabumi District in West Java Province, Indonesia. The district lies between longitudes of 106°1'E and 107°E. The organic rice farming using SRI method studied in this research was that of practiced mainly by local farmers. Basically, the concept of SRI practiced in this area comprises certain management practices for intensive and efficient paddy rice cultivation. They involve method of transplanting and management of soil, nutrient and water, which provide better rice plants condition particularly in the root zone. The principles of SRI applied in this areas comprises transplanting of one seedling with 30 by 30 cm planting distance, application of organic fertilizers supplemented with local micro-organisms, and intermittent irrigation (Gardjito et al, 2006).

The term sustainability used is related to the definition used in the sustainable development in general, i.e., balancing the fulfillment of human needs with the protection of the natural environment so that these needs can be met not only in the present, but in the indefinite future. Conceptually, the field of sustainable development can be broken into four constituent parts, i.e., environmental sustainability, economic sustainability, social sustainability and political sustainability (Wikipedia Encyclopedia, 2007). In this research context, the emphasis was related to economic sustainability. Many studies concerning agricultural development, including rice production, have been conducted using modeling approach and systems simulation.

2.2. Modeling Approach

Based on the characteristics of agricultural systems and dynamic processes involved, system dynamics models have been widely used in the agricultural studies. A new challenge of how to find a new balance between agricultural development and the conservation of the natural resources is faced in increasing agricultural production by means of, e.g., land and water engineering (van Dongen and van Lier, 1999). In conjunction with systems simulation, a model is a representation, abstraction and simplification of real world phenomena as complex systems (Law and Kelton, 1982; Ford, 1999; Hannon and Ruth, 2001). Like other models, a system dynamics model is also a representative of a real world system that can be used to study the behavior of the system under various test conditions (Sushil, 1993). Therefore, some models were developed in this analysis and Excel Solver was used for simulation in the analysis.

Several models used in the analysis involve productivity and production models with some related parameters. Many variables have to be taken into account to characterize an agricultural type in a certain area more precisely. Some of the important variables in agricultural systems considered in this modeling approach, as compiled by International Geographical Union (Kostrowicki, 1976, as cited in van Dongen and van Lier, 1999), among others are social attributes such as percentage and size of land holding; operational attributes such as labor intensity, animal and mechanical powers, chemical and organic fertilizers and irrigation; and production attributes such as land productivity, labor productivity, and water productivity.

2.3. Productivity

Referring to the characteristics of agricultural systems (Kostrowicki, 1976, as cited in van Dongen and van Lier, 1999), the land productivity or yield can be formulated as follows:

$$Y_L = f(T, I, F, L) \qquad (1)$$

where:

Y_L = Land productivity (ton/ha)

T = power input

I = irrigation system

F = fertilizer

L = labor

Model for predicting the yield of organic rice farming production could be developed using Verhulst growth model (Burghes and Borrie, 1981). The following Equation (2) was used as the model for the prediction of the yield of organic rice production through time.

$$Y(t) = Y_m \left[1 + \left(\frac{Y_m}{Y_0} - 1 \right) \cdot e^{-\gamma t} \right]^{-1} \qquad (2)$$

Where:

$Y(t)$ = yield with respect to time (ton/ha)

Y_0 = initial yield (ton/ha)

Y_m = maximum sustainable yield (ton/ha)

γ = coefficient

t = time (year)

Equation (2) implies that the yield will level at its maximum value through time. How long the leveling condition will be reached depends upon the limitations on soil fertility and land area. Some historical data is needed to run the model in order to predict the yield.

2.4. Production

In more specific condition involving the productivity of the production factors, the models could be developed on the basis of Cobb-Douglas production function (Wikipedia, 2008). The functional form of production functions is widely used to represent the relationship of an output to inputs. In general form, the productivity (yield) model could be expressed as:

$$Y_{LD} = AS^{\beta} F^{\gamma} L^{\sigma} W^{\tau} \qquad (3)$$

Where:

Y_{LD}	=	yield of rice production (ton/ha)
S	=	seed (kg/ha)
F	=	organic fertilizer (ton/ha)
L	=	labor (person)
W	=	irrigation water (m³/ha)
$A, \beta, \gamma, \sigma, \tau$	=	constants

The production factors considered in the analysis were seed, fertilizer, labor, and irrigation water as included in Equation (3). The values of the constants A, β, γ, σ, *and* τ were determined through optimization process using Excel Server software.

III. RESULTS AND DISCUSSION

3.1. Production

Rice production data was collected randomly from farmers practicing SRI organic rice farming in the study area of Sukabumi District. In general, farmers in this area are small land holders (less than 0.5 ha). However, their lands are of technical irrigation paddy fields so that there is no problem for them to apply the SRI method. The Nagrak Organic SRI Center (NOSC), a private training center, is also located in this area (Nagrak Sub-district). The production data including some of the production factors is presented in Table 1.

Most farmers in the areas do not have good farm management practice. They do not have well recorded production data, particularly in water requirement. Consequently, the water requirement had to be calculated using the following Equation (4)(Tarjuelo and de Juan, 1999):

$$1 - Ya / Ym = \beta(1 - ETa / ETm) \qquad (4)$$

where:

Ya	=	actual yield (kg)
ETa	=	actual seasonal ET9MM0
Ym	=	maximum yield (kg)
ETm	=	seasonal ET for maximum yield (mm)
β	=	water yield sensitivity coefficient.

Cobb-Douglas production function was used to develop model for predicting the yield by conducting optimization the constant values of Equation (3). The optimization resulted in the following model:

$$Y_{LD} = 10.335 S^{-0.002} F^{0.00019} L^{0.002} W^{0.94} \qquad (5)$$

where the constants of A, β, γ, σ, τ are 10.335, -0.002, 0.00019, 0.002, and 0.94, respectively.

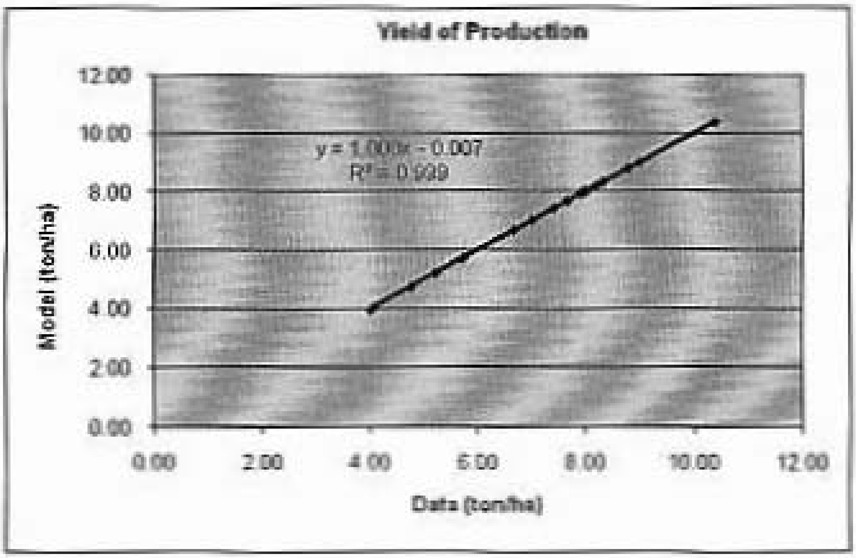

Fig. 1. Regression of observation data vs. model for rice production yield

Plotting the relation between production factors and yield resulted in trends as depicted in Fig. 2a, 3b, and 3c. It appears from Fig. 2a that the higher the yield, the lesser seed is required, which is agreed with the principles of SRI method. Fig. 2b shows that fertilizer tends to have positive effect, i.e., to some extend adding fertilizer will result in higher yield. Fig. 2c shows a little bit strange relation, i.e., less labor per hectare of paddy field is required. This might be due to some error in the data used. However, the relation of water requirement and yield is not plotted here since the values used in the model as supporting data were calculated based on the yield. It was difficult to get the real data from the farmers. They usually do not have any record for the water requirement data.

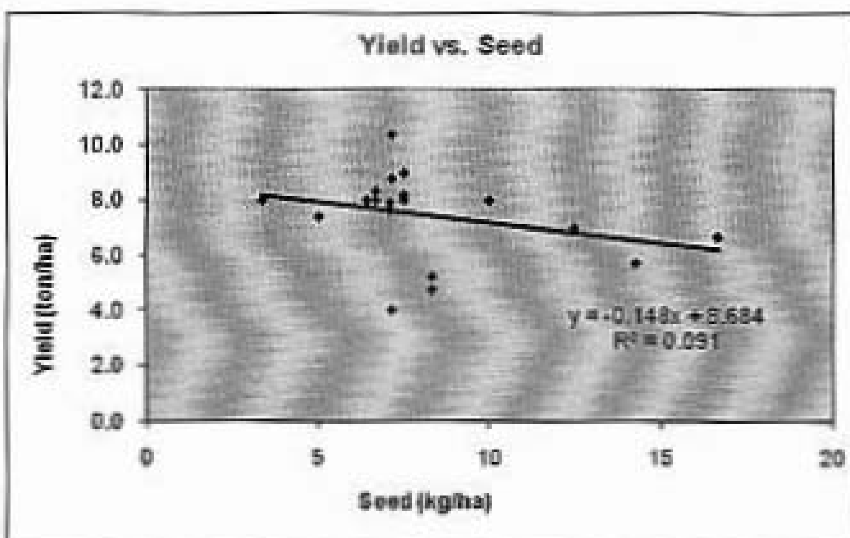

Fig. 2a. Seed vs Yield

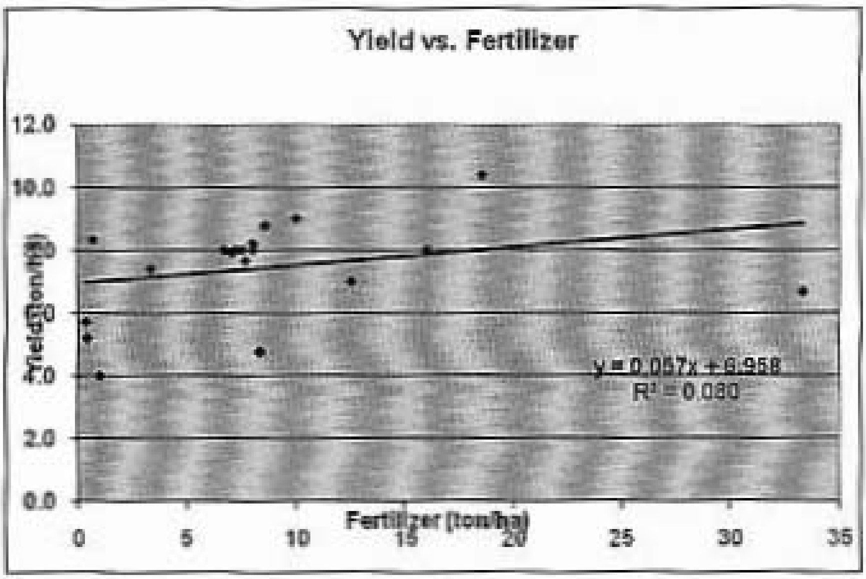

Fig. 2b. Fertilizer vs. Yield

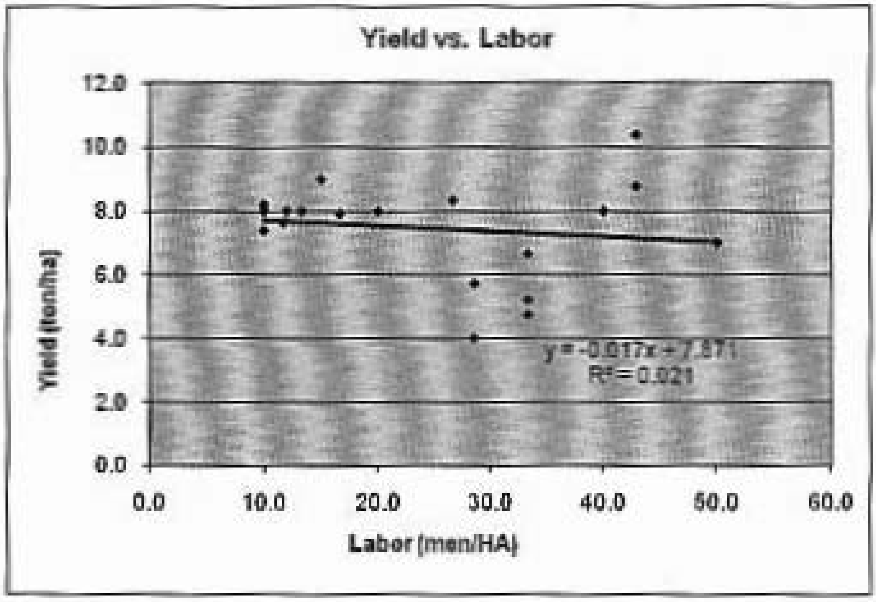

Fig. 2c. Labor vs. Yield

Furthermore, optimization of parameters of the production factors used in this model resulted in the following values as presented in Table 2. The yield components of the production factors was also calculated and presented in Table 3.

Table 2. Parameter values of the production factors

Parameter	Max	Min	Initial	Optimal
Seed (S) (kg/ha)	16,7	6,7	10,1	3,3
Fert (F)(ton/ha)	33,3	0,4	8,1	33,3
Labor (Lb)(men/ha)	50	26,66667	35,18519	50,0
Water (W)(fraction)	0,84	0,36	0,61	1,0
Yield (Data)(ton/ha)	8,8	4,0		
Yield (Target)(ton/ha)			6,510	10,386

Table 3. Yield components of the production factors

Seed	3,115718 ton/kg seed
Fertilizer	0,311572 ton/ton fertilizer
Labor	0,207715 ton/labor
Water	0,002454 ton/m3

3.2. Prediction of Yield

It has been claimed from many sources that the yields of organic and non-organic rice farming using SRI method in various countries vary from 8.75 to 17.5 ton/ha. However, the sustainability of the organic rice farming using SRI is still questionable. The high yields of the rice production might be due to the technique used for estimating the yield. Many experiments were conducted on plots of paddy fields of less than one hectare, and mostly smaller than 0.5 ha. The production was then converted to an area of 1 ha, resulting in a yield of rice production in ton/ha. Depending on the method used, the yield may vary from one method to another and it may result in fantastic yield as much as 17.5 ton/ha as stated above.

Many field experiments have been conducted in conjunction with the maximum yield of organic farming using SRI method. It is clearly understood that rice production is dependent upon, among others, the production factors such as seed (seedling), fertilizer, labor, and water, beside the climatic condition. In a certain point, the yield will reach a maximum, and then levels off or it may be fall down through time. Through a modeling technique, the yield in a rice production can be predicted.

Using simulation based on the Verhulst's growth model as expressed in Equation (2), a rice production yield with the application of SRI method in organic rice farming in the District of Sukabumi, West Java, was conducted. The maximum sustainable yield or target yield used in the simulation was 10.386 ton/ha, resulted from the optimization of the rice production as presented in Table 2. The parameters used in the simulation of the production yield through time, i.e., 8 years starting from 2006, are presented in Table 4. The result of the simulation (with an error of 2.4) is depicted in Fig. 3.

Table 4. Parameters used in yield prediction

Parameters	Values
γ	1,000
P_0	6,2 ton/ha
P_∞	10,386 ton/ha
Error	2,4
R^2	0,8449

DISIMP NTT. 2008. Analisis Usaha Tani SRI NTT. Nippon Koei and Associate. http//:tech.groups.yahoo.com/group/Ina-SRI/. June 7, 2010

Ford A (1999) Modeling the Environment: An introduction to system dynamics models of environmental systems. Island Press, Washington D.C. pp. 3 – 50

Fresco LO (2003) Mixing tradition and innovation for food security, poverty alleviation and improved natural resources management. Editorial Paddy and Water Environ 1: 157 – 158

Gardjito, Setiawan BI, Goto A, Kato T (2006) Sustainability of Organic Farming in Rice Intensification: A Case Study in Sukabumi, Indonesia. Proc. 5th Int. Conf. on Management of Paddy and Water Env. For Sustainable Rice Production (II). August 10 – 11, 2006. Utsunomiya University, Japan

Hannon B, Ruth M (2001) Dynamic Modeling. Springer-Verlag. New York Berlin Hidelberg. pp. 3 – 4

Law AM, Kelton WD (1982) Simulation Modeling and Analysis. McGraw-Hill Book Company. New York. pp. 1 - 2.

Nguyen VN, Ferrero A (2006) Meeting the challenges of global rice production. Editorial. Paddy Water Environ 4: 1 – 9

Rijsberman F (2004) Growing rice with less water. Editorial. Paddy and Water Environ 2: 181 – 183

Sushil (1993) System Dynamics: A Practical Approach for Managerial Problems. Wiley Eastern Limited. New Delhi, pp. 77

Tarjuelo JM, de Juan JA (1999) Crop Water Management. CIGR Handbook of Agricultural Engineering. Editors: van Lier NH, Pereira LS, Steiner FR. American Society of Agricultural Engineers, St Joseph, Michigan, USA, pp. 394

TROZ (2002) Research Focus: system oriented vs. commodity oriented? Special topic. Centre for Agriculture in the Tropics and Sub-tropics. TROZnews. http://troz.de. June, 2002, pp. 1 – 3

van Dongen MW, van Lier HN (1999) Balancing Agriculture between Development and Conservation. CIGR Handbook of Agricultural Engineering. Editors: van Lier NH, Pereira LS, Steiner FR. American Society of Agricultural Engineers, St Joseph, Michigan, USA, pp. 4 – 5

Wikipedia Encyclopedia (2007). Sustainable Development. http://en.wikipedia.org/wki/. August 10, 2007

Wikipedia Encyclopedia (2008). Cobb-Douglas Production Function. http://en.wikipedia.org/wki/. May 5, 2008

Yajima M (2002) Limited water resources and sustainable food production: Present status and future direction. Farming Japan Vol. 36-3, pp. 28-36

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Table 1. Rice production data of farmers practicing SRI organic rice farming in Sukabumi District

No.	Name of Farmer	Area (ha)	Water[1] m^3/ha	Seed Kg/ha	Fertilizer ton/ha	Labor Men/ha	Production ton	Yield ton/ha
1.	H. Baban	0.2	3221,65	7,5	7,5	10,0	1.6	8
2.	H. Ukar	0.25	3221,65	6,4	7,2	12,0	2	8
3.	Jalal	0.2	3306,38	7,5	8,0	10,0	1.64	8.2
4.	Maman	0.17	3072,13	7,1	7,6	11,8	1.3	7.5
5.	Baen	0.15	3221,65	6,7	6,7	13,3	1.2	8
6.	Oben	0.12	3186,35	7,1	7,0	16,7	0.95	7.9
7.	Barnas	0.05	3221,65	10,0	16,0	20,0	0.4	8
8.	Suhendi	0.2	3645,31	7,5	10,0	15,0	1.8	9
9.	Udin	0.15	3221,65	3,3	6,7	13,3	1.2	8
10.	Suparman	0.30	2967,46	5,0	3,3	10,0	2.22	7.4
11.	F. Sarifudin	0.07	4232,38	7,1	18,6	42,9	0.727	10.3
12.	Endang	0.1	3221,65	10,0	8,0	40,0	0.8	8
13.	Pahrudin	0.06	2656,77	16,7	33,3	33,3	0.4	6.6
14.	Neneng	0.07	2253,29	14,3	0,4	28,6	0.4	5.7
15.	Nanang	0.075	3362,87	6,7	0,7	26,7	0.625	8
16.	Usup Pakot	0.25	2038,94	8,3	0,4	33,3	1.2	7
17.	Iep	0.07	1527,02	7,1	1,0	28,6	0.280	4
18.	Romi	0.06	1844,76	8,3	8,3	33,3	0.285	6
19.	Hasan	0.04	2797,99	12,5	12,5	50,0	0.280	6
20.	Ujang Zaenal	0.07	3554,53	7,1	8,6	42,9	0.615	8

[1] Water requirement was calculated using formula of Equation (8).

Based on the data of the production factors (*S, F, L, and W*) and values of the constants, the model was used to predict the production. The results are presented in Table1. The values of the model agreed nicely with the data values as depicted in the following regression curve with an error of 0.002 (Fig. 1). The labor data in Table 1 is presented in physical number. For the purpose of financial farm analysis, which is not discussed in this paper, labor should be expressed in man-days with its unit price (DISIMP NTT, 2008). Labors are needed in land preparation, transplanting, fertilizing, weeding, harvesting, etc. One or more individual labor(s) as presented in Table 1 can perform more than one activities provided that the different activities are not done at the same time or period.

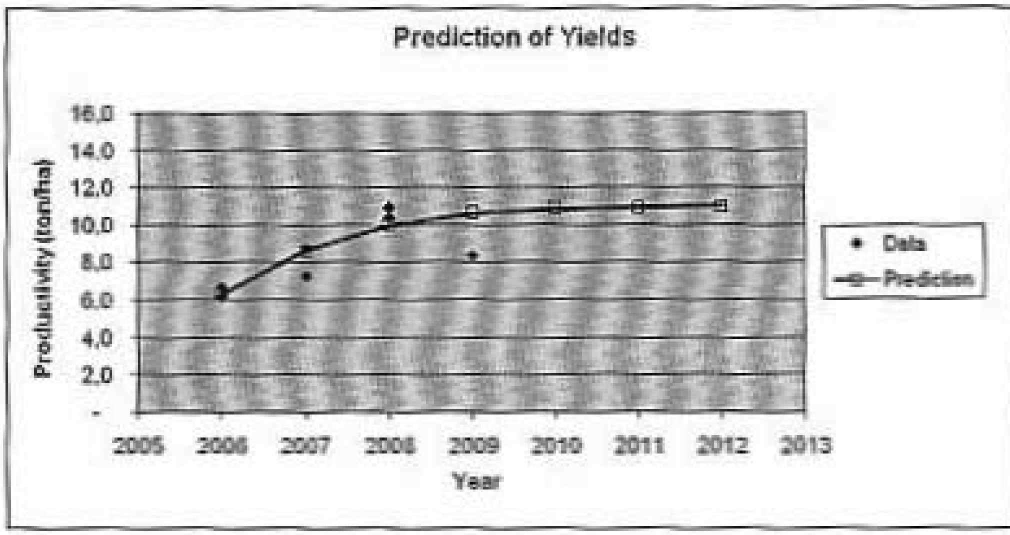

Fig. 3. Prediction of yield of SRI organic rice farming

It is shown in Fig. 3 that the maximum sustainable yield of 11.00 ton/ha is reached after approximately four years from 2006. The yield starts to level off at this point and remains at that level after that provided that all production factors are well maintained. Otherwise, the yield may fall down below the maximum possible yield.

IV. CONCLUSION

The models used in this study are quite well in analyzing the production and productivity of organic rice farming with SRI method and predicting the production yield through time. Based on the production factors (*S, F, L, and W*) and values of the constants, the production model gives values that are agreed nicely with the data values as depicted in the regression curve with an error of 0.002 and R^2=0.999. The prediction model for yield or productivity indicates that the maximum sustainable yield of 11.00 ton/ha is reached after approximately four years and starts to level off at the maximum value of yield, with an error of 2.4 and R^2=0.844.

However, there are some limitations that should be taken into account to the results of this study due to the limiting study area, i.e., District of Sukabumi. Errors may also have been encountered during data collection. Therefore, this conclusion may not be applied to other areas without considering data collection from those areas.

Further study will be conducted in analyzing the sustainability of organic rice farming using the SRI method, particularly those involving socio-economic and environmental aspects in more detailed. In that way, a more comprehensive result about the sustainability will be obtained.

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REFERENCES

Barker R, Tuong TP, Li Y, Castillo EG, Bouman BAM (2004) Growing Rice with less water: Research findings from a study in China. Preface. Paddy and Water Environ 2: 185

Berkelaar, D (2006) SRI, the System of Rice Intensification: Less can be more. ECHOs. Technical Network Site: http://www.echotech.org. May, 2006. pp. 1 - 10

Burghes, D.N. and M.S. Borrie (1981). Modeling with Differential Equations. John Wiley & Sons. New York

Cantrell RP (2004) Challenges and opportunities for rice-based farming in the International Year of Rice and beyond. Editorial. Paddy and Water Environ 2: 1 - 4