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Editorial Preface

On behalf of Institute for Science and Technology Studies (ISTECS) Journal editorial team, we are pleased herewith to announce the publication of 2009 Special Issue: 17th Indonesian Scientific Meeting (ISM) and Indonesia-Japan Friendship Forum (IJFF).

ISTECS and Indonesian Student Association (ISA) Japan or PPI Jepang have decided to publish the peer-reviewed paper from the selected abstracts which were presented in ISM-IJFF 2008, August 25 – 26 2008. Year 2008 is the 50th anniversary of the establishment of bilateral diplomatic relationships between Indonesia and Japan. The Indonesian Scientific Meeting is an annual event that tries to gather most of Indonesian students all over Japan and also Japanese those have interest in Indonesia in such a scientific atmosphere, to share and discuss about their major and also about Indonesia. By publishing the selected paper, we hope can contribute in empowering Indonesia-Japan relationship in the field of science and technology.

Finally, we would like to thank to Mr. Muhammad Sahlan on behalf of Chair Person, Organizing Committee ISM-IJFF 2008 and Mr. Erkata Yandri on behalf of Scientific Publication Division ISA Japan, for their remarkable support to this special issue.

Mirwan Ushada

Editor

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Agriculture Profile and Sustainability in Okinawa Prefecture Japan and East Java Province of Indonesia and Its Future Development

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ABSTRACT

East Java Province's agricultural profile from the past 20 years identified the change in crop varieties which cultivate all over the rice field area. The accelerating agricultural intensification over the past 20 years raises concern about whether East Java farming is ecologically sustainable, and how about the future sustainability. Similar pattern on agriculture profiles was found in Okinawa's agriculture ecosystem. Monoculture was commonly practice and it is also hard situation for the Okinawa farmer to maintain the traditional crops cultivars. Highly intensive irrigated agriculture system was applied to produce main Okinawa agriculture commodity (Sugar cane) *Sacharum officinarum* (L) and Okinawa main horticulture product, Pineapple *Ananas comossus* (L). The objective of this paper is to analyze the comparison on agriculture downward growth on Okinawa Prefecture Japan and East Java Province of Indonesia using several indicators and offers some concept on agriculture revitalization for future development. Regression analysis and other descriptive statistics were employed to describe the change and agriculture performance. Intensification just for narrow crop species and high cropping intensity become the major threat for sustaining the agriculture practice in both Okinawa Prefecture and East Java Province. The classical perspective of agriculture as a production unit in East Java and Okinawa need to be improved to the more ecological sound agriculture based on local productive crops and as an agro-ecological system which both productive and ecologically sustainable.

Key Words: East Java, Okinawa, Agriculture, Sustainable

1. INTRODUCTION

Both East Java Province and Okinawa Prefecture now adopt intensive farming, which the system is characterized by the high inputs of capital, fertilizers, labour or labor-saving technologies such as pesticides and herbicides relative to land area. Modern day forms of intensive crop based agriculture involve the use of mechanical ploughing, chemical fertilizers, herbicides, fungicides, insecticides, plant growth regulators and/or pesticides. It is associated with the increasing use of agricultural mechanization, which has enabled a substantial increase in production

(Cassman, 1999).

In this paper, several analysis is conducted to analyze the profile of each agriculture performance of the region focusing on the ecological view, including statistical fact and descriptive. The regression analysis was performed to describe the growth and prediction to agriculture performance. Both of Okinawa Prefecture and East Java Province depend on agriculture sector as the main business and livelihood of the people. Rural landscapes are dominated by various agriculture landscapes which are now gradually decreasing.

In previous study conducted separately, Darmawan et al. (2006) and Oshiro et al. (1997) stated that intensive approach in agriculture in the long run, could effect the ecological balance which directly or gradually will effect economical threshold of agriculture business. However, intensive agriculture is needed to fulfill the demand of food, industry and livelihood of many people. Many ecologists like McCormack, 1988 suggest the traditional values, nature farming and promoting ecological service to increase the agriculture sustainability, however this idea still require some period for adjusting with the existing agriculture system.

The significant decrease of farmer, agriculture land and environment degradation due to unsustainable agriculture practice is the main driving force of agriculture downward growth while less government support and urban centre development style is the strong external factors to agriculture downward growth. In the future, agriculture activity should not change the existing environment, and preserve the unique agriculture landscape of Okinawa and East Java. The local products and environment services (scientific, recreational and ecological) of Okinawa and East Java also should be promoted to reach the entrepreneur level and giving benefit for economic and environment.

2. RESEARCH SITE AND METHODOLOGY

East Java

East Java Province is located between 111º0' to 114º4' East and 7º12’ to 8º48’ South, with the total area 47,157.72 km^2, which is divided into two main parts; the land which is almost 90% of the territory and the rest is Madura Island. Moreover, East Java Province has another 229 small islands and 2833.85 km coast line (fig.1).

As a part of Java Island which is located at the southern of equator, East Java Province has tropical climate with two distinct seasons based on the rain. The rain volume is ranging between 1500 and 2700 mm. The dry area (35.5% of East Java) has the annual precipitation rate below 1750 mm, the middle level (44% of East Java) has annual precipitation rate ranging between 1750 to 2000 mm and the wettest area (20.46%) has 2000 to 2700 mm. Most of the rain occurs between October to March and rarely precipitation on the following months. The temperature is ranging between 15.2℃ to 34.2℃ while the humidity is around 40% to 90% (East Java Statistics Indonesia, 2006).

Tropical climate with abundance of sun and relatively fertile soil make East Java Province suitable for agriculture sector development aside from industrial sector. The growth of this sector is increasing but not as high as industrial, commerce, and services sectors, which is now becoming the priority of Indonesian development program. East Java agricultural landscapes cover over 60% (24,777.51 km^2) of the total area (41,295.85 km^2). Those divided into rice field 12,034.46 of km^2, dry land agriculture 10,332.31 of km^2, mix agriculture of 913,26 km^2, plantation and orchard of 1,842.26 km^2 (East Java Statistics Indonesia, 2006)

Indonesian Agriculture Research Center (2006) stated that agriculture in East Java Province is currently modernized. Traditional practices were no longer applied since the Intensification Program in almost every crop in

1970. High intensity of fertilizer and pesticide were introduced to support the growth of modern crop variety. Therefore intensification is still the backbone of East Java agriculture development until recent day

East java is one of the six Provinces in Java Island which is known as natural producer of rice. Over 16% of national rice is expected produce by East Java Province. However, there is phenomena of continuous using very limited rice varieties for over 20 years and intensifying rice cultivation by many inputs to mantain and increase the harvest. This practice creates the degradation of agriculture environmental quality. On the other hand the intensive rice cultivation is needed due to the irrigation land conversion into other functions or agriculture land use change from irrigation area into urban and sub-urban area development, civil infrastructure development also industrial and commercial infrastructure (Verburg et al., 1999).

Moreover, like the other developing countries, the development stage in Indonesia is currently focusing more on commerce and industries which easily managed and less labor works. Agriculture sector is also following this trend. Farmers are generally older generation, and less labor working on this sector. On the other hand intensive agriculture is needed to meet the sustain production. Rice is being cultivated on the same field three times a year with the same variety over and over without crop rotation and on the very wide area. The application of pesticide is also intensive to make sure the savety of harvest (Indonesian Agriculture Research Centre, 2008).

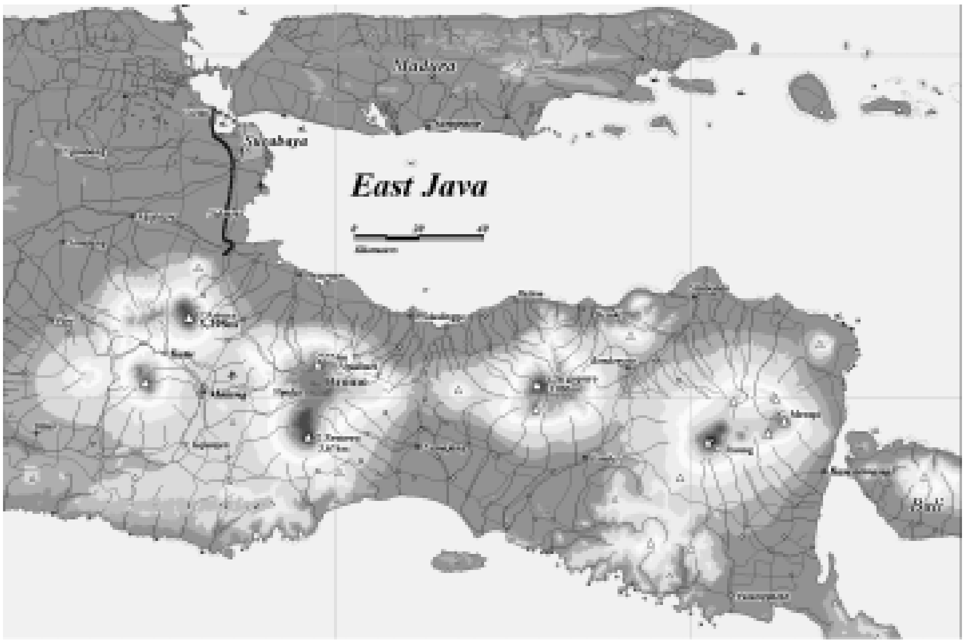


Figure 1. East Java Province Map (Prepared by East Java Statistics Indonesia, 2006)

According to Indonesian agriculture research center, (2008) agricultural landscapes in East Java Province show a wide range of agro-ecological conditions. Generally highland agriculture adopted dry land agriculture system and mix garden combine with trees and horticulture, while mostly low land agriculture is cultivated with food crops in the wide area of irrigated rice field.

Okinawa

Okinawa Prefecture is a chain of islands. Around 60 of them are inhabited to make up the Prefecture. Okinawa Island, stretch for 1,100 km along the Western Pacific between Japan's Kagoshima Prefecture and Taiwan. The two most northern islands are Tanegashima and Yakushima, which lie between 30º and 31º North, lightly further South, between 28º and 29º the island of Amami, and now administratively part of Kagoshima Prefecture (McCormack, 1998).

The main island of Okinawa is located between 26º and 27º North, but further lie the Miyako and Yaeyama Islands (Sakishima Group), between 24º and 25º South much closer to Taiwan than to anywhere else in Japan. With Okinawa islands, they constitute part of Okinawa Prefecture. Because of the distance and climate differences, from 'mainland' Japan, a distinctive Ryukyuan (for most purposes identical with Okinawan) developed their own cultural identity and agriculture system slightly different with mainland Japan (Fig. 2).

Ecologically, the islands are linked to the Asian continental landmass until a million years ago but now it is separated by a gulf which sufficiently deep and dangerous enough to allow migration of continental species. Because of the relative isolation from the continent, Okinawa Islands have a rich and distinctive botanical and zoological environment. As a comparison, each ten square kilometers of Okinawan territory is biologically more than twenty times richer in life-forms than its equivalent elsewhere in Japan. In purely botanical terms, the differential is probably greater, as much as 45 to 1 according to one source. Such are its richness that Okinawa is sometimes referred to as Asia's Galapagos (McCormack, 1998).

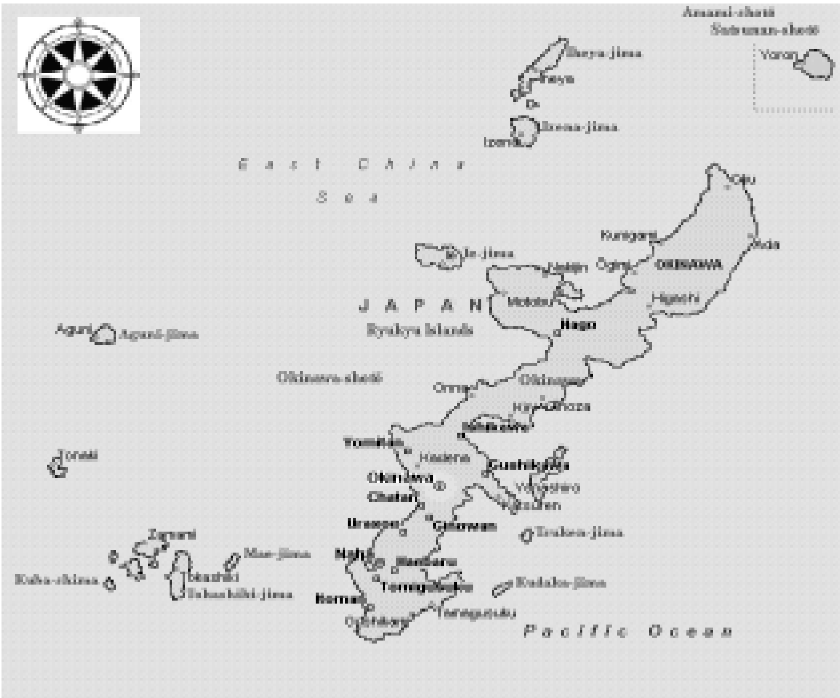


Figure 2. Okinawa Prefecture, Modified from McCormack, 1990

The Okinawa's climate is humid and sub-tropical, with an average year-round temperature is 22.4°C. The average rainfall is 2000 mm and 2200 mm in Naha and Nago city respectively, which considerably higher than the average for the rest of Japan. Half of it falls in the summer typhoon season between May and September. However the northern mountainous part has a lot of rainfall which has very changeable amount (Takagi, 1999).

In sub-tropical regions the winter is very mild and the numbers of insect species that are dormant during this season are comparatively few. The favorable climatic conditions which prevalent in sub-tropical regions, result on various stages of insect development occur simultaneously, which potentially become a destructive pest for the agriculture crops (Takagi, 1999).

Methodology

East Java Province of Indonesia and Okinawa Prefecture of Japan will be compared using several indicators including description statistics and regression analysis to describe the agriculture performance on each major commodity, for develop the prediction and solution to the future agriculture in both region. The comparison will formulate into the comparison table, which will be explained in the last part of this chapter.

3. RESULT

1. Agriculture policy and production of main commodities

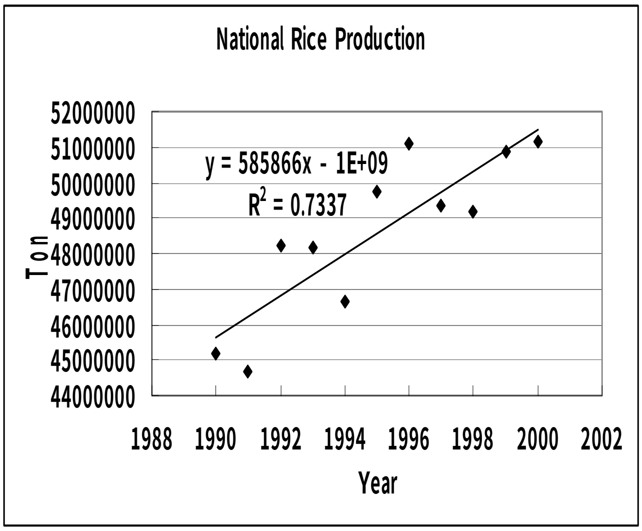
East Java

Food security is an ultimate goal of the East Java government because of increasing population and demand for basic commodities, especially rice. Increased agricultural production had been emphasized through the Long Term Development Plan (1969-1994) phase I (**PJPT**). The increase in food crop production was implemented through four major programs, i.e., intensification, extensification, diversification and rehabilitation. In the early years of **PJPT I**, the production of food crops (especially rice) was promoted through an intensification program known as **PANCA USAHA** or five efforts, i.e., soil tillage, better varieties, proper fertilization, better irrigation, and pest control (Wigenasentana and Waluyo, 2002).

Moreover the greatest intensification program occurred in the 1970's when the **BIMAS** Program (agriculture supervision and guidance) was begun. This program developed and the planted area increased significantly each year. To achieve the rice production goal, another special intensification program (**INSUS**) began in 1979, and eventually became highly developed version of **INSUS,** (**SUPRA INSUS)** in 1987. Implementation of the **INSUS** Program was based on guidelines about the role and function of local farmer's groups, whereas **SUPRA INSUS** encouraged cooperation among the farmers' groups in large geographical areas (Wigenasentana, 2002)

The advanced technology applied to the food crop sub sector through phase I of the Five Year Development Program (**Pelita** I, 1969) resulted in some positive developments. Rice production increased significantly from 17.7 million ton in 1969 to 38.2 million ton in 1984. This achievement transformed Indonesia from the largest rice-importing country in the 1960's to rice self-sufficiency in 1984 based only with variances of **IR rice** (Indonesian Agriculture Research Center, 2006).

Furthermore in 1992 (the fourth year of **Pelita** V), rice production was 46.6 million ton and East Java Province support 17% of it. After more then a decade on 2004, there are still significant increase of production up to 52 million ton and East Java still support 18.2% of total production.



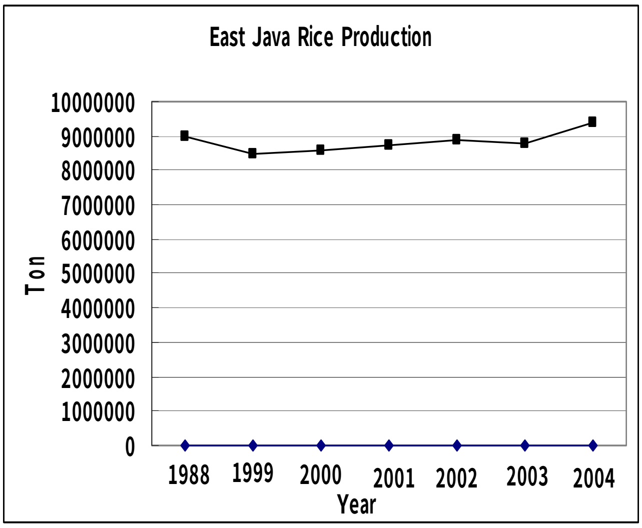


Figure 3. Measured national rice production and East Java rice production from 1988 to 2002; (Statistics Indonesia, 2004)

Despite the significant increase in rice production, the production is often fluctuated due to two major constraints which are pest outbreaks and unfavorable weather conditions. The major pests which frequently affect rice production are the brown plant hopper (**BPH**), rice stem borer and rats. **BPH** was one of the most devastating pests during the many planting season. Moreover, the **BPH** problem may become even more severe with the uniform variety in the wide area and with the appearance of new biotypes that could overcome resistant varieties. The peak outbreak of of rice stem borer occurred on the Northern coast of Java in 1988/1989, and rat problems are always present at any season in almost all parts of the Province until recent days (Wigenasentana, 1993).

According to Edwards (1989) the intensification program was successfully proven, the indicator was increasing food production. However, still there are many phenomenons on pest outbreak threat every year because of the imbalance of rice field ecosystem. In the future several programs are proposed to create environmental friendly agriculture. The main program is organic farming approach. Nevertheless, it is uneasy to match the food demand until now because of severe damage caused by pest attack.

Okinawa

Okinawa is the only sub tropic Prefecture in Japan and it has a different environment comparing to mainland Japan. Sub tropical climate is favorable for various sub tropical plant species and agriculture development (Alhamd et al., 2004). Further according to Japan Ministry of Agriculture, Forestry and Fisheries (MAFF) (2007), the main agriculture productions of Okinawa Prefectures are sugar cane, sweet potatoes, pineapple, taro, vegetables, flowers and fruits. Traditionally, livestock farming centered on pigs, but recently, beef and cattle are also being raised for shipment.

Sugar cane, *Sacharum officinarum* (L), particularly suited to cultivation in Okinawa, as it does not require significant infrastructure (such as irrigation). It can grows well in Okinawa's soil, and able to be left unattended for 18-month until harvest. Sugar cane is one of the commodity which the harvesting, refining, and butchering it are coordinated by the National Mutual Insurance Federation of Agricultural Cooperatives (JA), and the growers receive a share of the profits (Japan MAFF, 2007).

The history of sugar cane plantation is relatively a long story, reach the maximum benefits and it is a very good business in 1990–1995 (McCormack, 1998), but continuously declining until now. However, sugar cane business, still the important business for Okinawa since many products could be derived from sugar such as ethanol and other industrial chemical products (Ueno, 2000). The statistic of Sugar cane profile in Okinawa describe in the charts below.

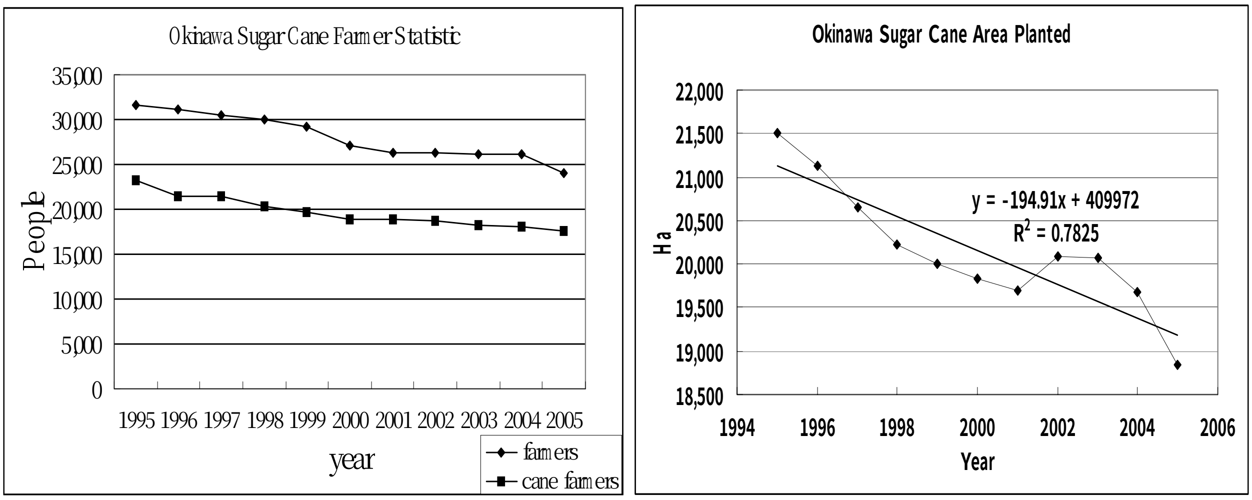


Figure 4. Reducing on farmer number and sugar cane area from 1995 – 2005 and Declining on sugar cane planted area, (Measured and graph generate using Japan MAFF, 2007)

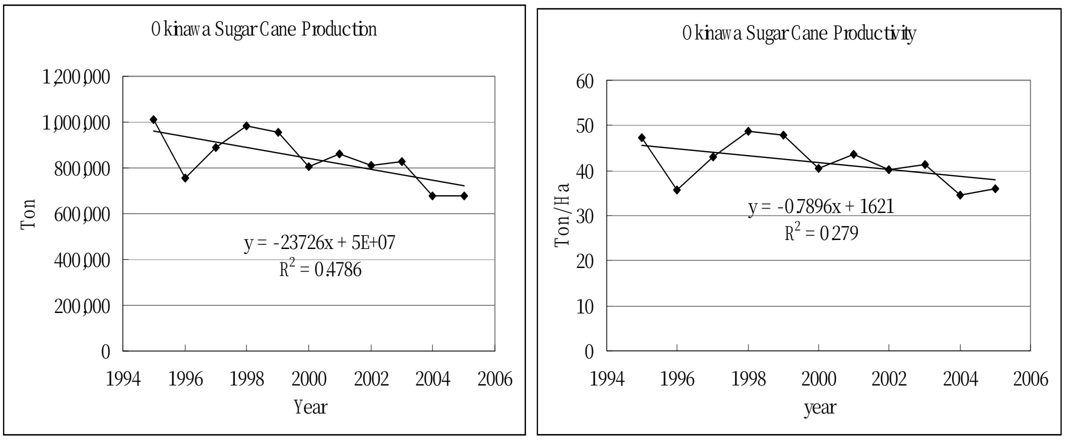


Figure 5. Okinawa sugar cane production and productivity (the trend regressions of production and productivity p <0,05 while R^2 0,4786 and 0,2648). (Measured and graph generate using Japan MAFF, 2006)

In the Fig. 4, there is a continuous reduction on the number of sugar cane farmers and area with the dramatic pattern. Furthermore, in Fig. 5, showed the decreasing of production, mainly due to reducing area of sugar cane, the production reduced from 1,03 million ton on 1995 to just 679,419 ton on 2005. Fukuda et al. (2002) stated that the Sugar productivity continuously fluctuate which indicate the variety of farming management or technology.

Another important crop in Okinawa is pineapple, *Ananas comosus* (L.). Okinawa is the only area of Japan where the pineapple is grown as one of main crops. The pineapple cultivation in Okinawa starts blooming on 1965, and has a short cultural history of cultivation. Okinawa is close to the north-end of pineapple culture, but it growing into a good business until now (Masui, 1993).

Pineapple production in Japan occurs exclusively only in Okinawa Prefecture, and over 90% of the pineapple production is intended for canned fruit or processed to other products (non fresh fruit). Imported frozen pineapple is also canned in Japan. However since Okinawa produce the better quality of pineapple, there are many demands of fresh fruit as domestic consumption. Pineapple production has been subject to the Basic Policy for the Fruit Growing Industry Promotion. In 1982, MAFF provided administrative guidance to the Governor of Okinawa to regulate the planting area of pineapple.

"Production control of canned pineapples" and "Stabilization of Demand and Supply of Canned Pineapples" urge the Governor of Okinawa to establish a planting plan for five year periods, with target cultivation acreages, and to report the results every year. This target cultivation acreage is allocated through municipalities and Agricultural Cooperative Associations to producers or groups of producers (Masui, 1993).

Moreover, since 1986 the Governor and concerned associations have been required to submit annual shipping targets of raw pineapple for canning for government approval. Farmers who cultivate and ship in excess of the target amount may be deleted from the list of those eligible to receive subsidies or loans from the government. This regulation mainly caused by GATT (General Agreement on Tariff and Trade) which required Japan to restrict the production on several crops including pineapple (Foreign Trade Information System, 1987).

Several important commodities in Okinawa Prefecture is describe in the charts below including pineapple which exclusive produce in Okinawa Prefecture. In 2003 the total pineapple production is 10,800 ton, which generated from summer production of 7,530 ton and winter production of 3,310 ton which 53% of it was used for flesh consumption and another 47% processed into other products (Japan MAFF, 2005).

Based on the total agriculture output by Japan MAFF, 2005, can be summerized that several Okinawa's agriculture commodities are important to Japan National Agriculture Output which giving significant contribution to total national production. Those products are: flowers and ornamentals crops, industrial crops (sugar cane), beef cattle and pigs.

Despite the agriculture development in Okinawa Prefecture, there are many disturbances in Okinawa's environment and natural ecosystem because of intensive agriculture practices. Takeuchi and Yamamoto (1977) stated that intensive cultivation of Pineapple on the hillside cause abrupt change on the landscape. Environmental deterioration in drainage basin has rapidly occurred by continuous artificial land reformation of Pineapple field by bulldozers. Furthermore, too many open spaces on the early Pineapple growth trigger serious soil erosion and sedimentation in the river basin.

This problem is getting worse when the reddish soil (**podzols**) which has the severe acidity is swept away from the mountains through the water body, channels and flow to the sugar cane, rice field, fish pound and seashore (Vestin et al., 2008). Moreover if it is continuously happen, the **podzols** concentration in the water body, could trigger the serious damage to many natural ecosystems. In the old days it was possible just to keep the problem in the northern part of Okinawa Island, but since there is an interconnection dam system in the 5 northern dams, the problems now spread along with water distributions.

2. Agriculture Ecosystem Change

Both Okinawa Prefecture and East Java Province shows similar pattern on agriculture ecosystem change.

Generally, there is a strong indication of the degradation of agriculture ecosystem which possible to become the serious threat of the agriculture sustainability in this area. Several indicators have been identified to describe this phenomenon, which are:

Land use change

East Java Province is now developing, the agriculture sectors become less important to the Industries and business sectors. These sectors can easily managed and absorb great number of labor. Morever, due to the urban and sub-urban planning, the Industrial and commerce location is projected outside the city and sub-urban area, which consumes a great number of agriculture land. High population growth demand for more public fascilities and settlement to build. The insufficient planning implemented by local goverment often create more problem which sometimes turn the most productive agriculture land into industrial and public facilities.

From the data of East Java Province statistic bureau, (2007) shows the decreasing trend of rice field area which is suspected because of Land use change into other functions. The trend is explained on figure 8, which explains the decrease of planting area from 1.77 M ha to just 1.67 M ha in six years.

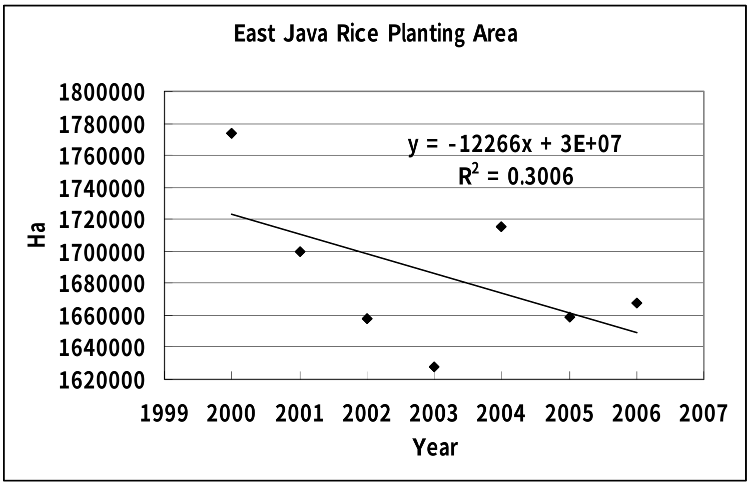


Figure 6. East Java Decreasing Pattern of Rice Field Planting Area from 1999 to 2006 (Measured and graph generate using East Java Statistics, 2006)

Similar trend happens in Okinawa Prefecture, which also shows the decreasing on the sugar cane planting area (Fig. 4.). This trend actually occurred not only on these two places but commonly occurred on highly developing area, which predicted mainly due to urban, industrial and commercial sectors growth. However the relationship of the agriculture land use change with socio-economic factor has not fully understood (Verburg and Bouma, 1999).

The excessive fertilizer and pesticide uses

During the early agriculture blooming, nitrogen and phosphorus were considered the two major plant nutrients needed by the high yielding varieties. However, the situation is little bit different. The farmer's minimal access to balance fertilizing practice creates many over fertilizing problem which disturbs the nutrient balance in the soil. In modern farming, additional plant nutrients are needed to sustain yields, including sulfate, potassium, and selection of micronutrients. The nutritional need of the crop and the availability of nutrients in soil should be measured to ensure the exact amount of fertilizer for each field. Matching the fertilizing time with the plant growth rate and method of fertilizer application are both important factors to avoid under or over fertilizing, which create the unbalanced nutrient levels in the soil. The utilization of natural or organic fertilizer is suggested to restore the natural nutrients balance in the soil (Pasandaran et al., 1999; Ikumo, 2005; Masuda; 2003).

In Okinawa Nitrate pollution in ground water has become a serious problem (Banzai et al., 2003) one of its causes is known to be the excessive use of nitrogen fertilizers in agricultural production. Furthermore Nitrate pollution has become much more serious in the past few years at Miyako Island, Okinawa Prefecture. 80% of Okinawa residents are entirely dependent upon subsurface dam water, which is currently polluted with nitrate. To solve the nitrate-nitrogen pollution of subsurface dam water in Okinawa Prefecture, it is necessary to control the uses of N-fertilizer to sugar cane by sufficient dosage and right application period.

Dorn et al. (1999) and Landis et al. (2001) stated that an agricultural field the food chain is much simpler than in a natural forest, since there are only a few kinds of plants (the types planted by the farmer and weeds that invade the field). This narrow diversity of plant life can only support a limited range of animals. Nevertheless, the plants and animals are still linked in a food chain, just as they are in the much more complex forest. But still categorized that as an agriculture ecosystem (Agro – ecosystem). This **pseudo** balance ecosystem ultimately needs pesticide to control the population of undesired species. Unfortunately, excessive uses of pesticide are commonly happen in most agriculture practices.

Focusing Only on High Yielding Varieties

The new varieties or improved local varieties together with intensive farming practices are indeed result on the maximum yields. Furthermore, breeding programs focusing only to improve the crop yield potential and crop adaptability. The main objective in rice breeding is to develop new high yielding crop type which performs optimum yields, resistance to major pests and tolerance to environmental stresses.

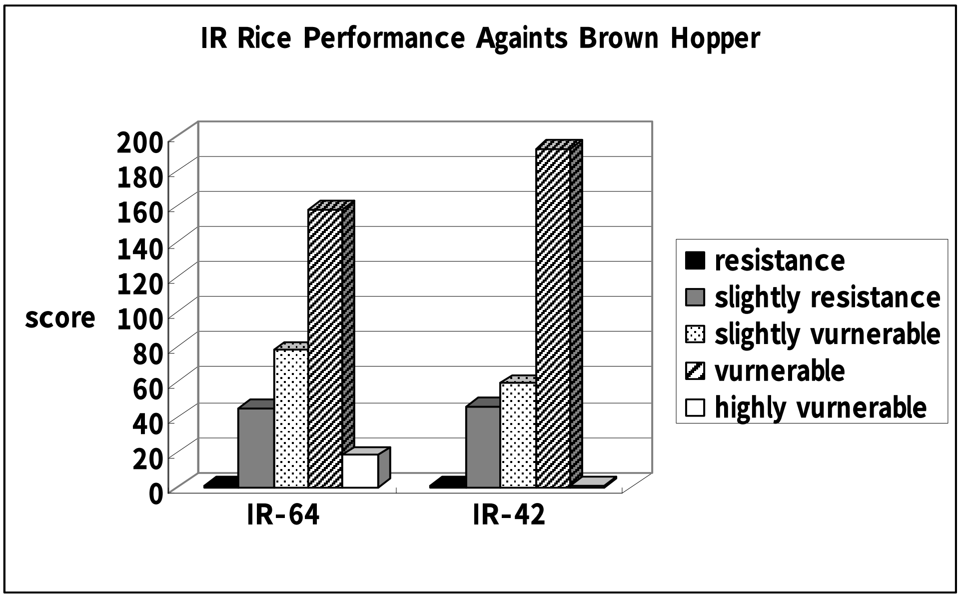


Figure 7. Performance of Modern Rice in Fourth Major Rice Centre of East Java Province

On the other hand, due to the narrow genetic variability in the planting material, and neglecting many local varieties resulted to the lost of precious germ plasma which highly adapted to the local environment. Moreover, due to uniformity of the rice variety creates the higher vulnerability towards the rice itself which occurred in several places in East Java (Fig.7). The agriculture practices based on the local variety and improving the yield quality is needed to reduce the intensive inputs into the natural agriculture ecosystem.

Amin et al. (1999) stated that for almost 20-year, East Java rice plantation was used very narrow varieties of rice. The mainly variety are IR 42 and IR 64, and their variance. On the other hand there are more then 200 local rice varieties which are neglected and kept unused. The similar case explained by happens with Okinawa's Sugar cane variety. According to Oshiro et al. (1997) and Fukuda et al. (2002) the traditional purple Okinawa's sugar cane is now rarely use, the new variety is developed and keep on improving to be just focus on the higher sucrose content, erect, thicker and wider stalk, erect canopy and shorter leaves, which specially design for adaptation to the strong wind.

High Cropping Intensity

Increased cropping intensity is look like the only solution to a fixed or limited agricultural land base. Currently, the cropping intensity in the East Java irrigated rice area close to 200 percent, while on the rain fed area, cropping intensity is almost 150 percent. It is simply means that the same field is cultivated with same crop and same variety more then 2 times in a year or rice – rice – rice / rice – rice – fallow. Hypothetically, the potential cropping intensity for the irrigated area is 300 percent and indeed some area practicing it; which should be avoided because of it will cause the excessive use of certain nutrient and very susceptible on pest and diseases outbreaks (Darmawan et al., 2006).

Similar case happened in Okinawa, sugar cane and pineapple orchard is occupied the agriculture field for a year (Ukita, 1980), and followed by next planting over and over without giving some fallow period for soil to rest and restore its natural nutrient cycle.

Lack of Agriculture Biodiversity

Cultivation on food crops and industrial crops are usually performs well in clean cultivation practice, since weeds or undesirable plants will compete for nutrients, water and solar energy. Clean cultivation using a single high yielding variety on a large scale has contributed significantly to maintain the crop production. However, increasing pest and disease problems have been observed under this kind of practices. In the end it also led to a decline in yield (Edwards, 1989). Furthermore, Edward, 1998 stated that the new breeds of variety have only one or few major genes of resistance and plant structure has resulted less diversity among insects. This has led to population growth of insect pests without any significant constraints. An outbreak of a major insect pest in an area which cultivates a single rice variety has often occurred in Indonesia with devastating results.

Table 1 displayed summarize of agriculture performance comparison between East Java Province and Okinawa Prefecture on term of several agriculture variable which discussed in this paper.

Table 1. **The East Java Province, Okinawa Prefecture, Indonesia and Japan agriculture profile and performance**

	East Java	Okinawa
1. Main Commodities	• Rice	• Sugar cane • Pineapple
2. Subsidies	Less	Less
3. Agriculture policy	• Intensification • extensification	• Production restriction • Area Restriction
4. Decree	• Intensification (INSUS & SUPRA INSUS)	• General Agreement on Tariff and Trade (GATT) • National Mutual Insurance Federation of Agricultural Cooperatives (JA)
5. Production	Fluctuate	Decreasing
6. Cultivation area	Decreasing	Decreasing
7. Crop biodiversity	low	Low
8. Cropping intensity	High (all year round rice)	High (13 – 15 Months Sugar cane without fallow)
9. Impact on water body	Nitrogen and Phosphate Pollution (Eutrification)	Nitrogen and Phosphate Pollution (Eutrification)
10. Issue	Sustainability	Sustainability

4. DISCUSSION

Generally, pest problems have been spotted on large-scale intensification areas in East Java and Okinawa, both rice and sugar cane. Yield losses due to major pests vary widely according to pest species, modern crop variety vulnerability and the farmer's ability to cope with the situation. Both Cassman (1998) and Edwards (1989) agree that in some way, intensification can also contribute to the increased pest problem, including continuous and staggered planting, increased application of nitrogen fertilizer, heavy use and dependence on pesticides, and decline of crop variety diversity over wide areas. These factors have probably contributed to the outbreak of a serious rice pest, **the brown plant hopper**, during the last few years. Pest management which is based on the manipulation of several effective components of the rice ecosystem should decrease the need for pesticides and able to reduce its application (Wigenenasentana, 1993 ; Wigenasentana and Waluyo, 1993 ; Edwards, 1989).

Furthermore Wigenasentana (1993) stated that intensification leads to increased pest infestation. When Indonesia began its intensification program by introducing high yielding varieties, chemical fertilizer, better irrigation, and cultural practices, pest infestations occurred coincident with those practices, and could only be controlled by applying pesticides. At that time, pesticides were used excessively to control pest infestations. This approach resulted in some serious adverse effects such as resistance of pests to certain pesticides, increased production costs due to pesticides and decreased farmer benefits.

To overcome this situation, integrated pest management has been intensively implemented. The main principle of integrated pest management is to manipulate the effective components of the agricultural ecosystem in maintaining pest populations below the economic threshold. The major components which play a role in maintaining low pest populations are ecosystem diversity, homogeneous planting to interrupt pest cycles, resistant varieties, balanced fertilizers and judicious use of pesticides (Cassman, 1998; Edwards, 1989)

Pest management is generally divided into two phases which are pre-planting and post-planting phase. The activities in the pre-planting phase are determination of planting time (late or early) and selecting resistant varieties to major pests. Post-planting activities are monitoring of plant growth, pest populations and their natural enemies, and pesticide applications when necessary. However, pesticides should be applied judiciously when other activities cannot suppress the pest population below the economic threshold (Mumford and Norton, 1984).

To support this approach, Dorn et al. (1999) and Landis et al. (2000) emphasize the importance of identifying the critical stage when a plant is most vulnerable to a certain pest. On the other hand, the life cycle of the pest itself must also be studied to identify the proper time of pesticide application so as to avoid adverse effects on natural predators. Natural resource-based cultivation as an alternative to current agricultural practices has the potential to sustain a stable, productive, profitable and environmentally sound agriculture for the future.

Moreover, agriculture is a human activity to manage natural resources for man's benefit. Agricultural activities are not always compatible with the interdependent nature of the major components of ecosystems. Therefore, the stability of agricultural ecosystems is quite different than that of natural ecosystems. The stability of agricultural ecosystems is artificial and man-made and requires continuous inputs of energy in the form of fertilizers, irrigation, and pesticides. To meet the food demands of growing population it requires more agricultural technology inputs which integrate with the natural resource base, but the artificial ecosystem is relatively unstable compare to the natural one (Edwards, 1989)

There is some indication that rice plants and sugar cane are more susceptible to certain pests due to excessive application of nitrogen fertilizers. The excessive use of chemical fertilizers such as nitrogen and phosphorus can lead to a nutritional imbalance in soils. A proper balance or combination of chemical fertilizer and organic fertilizer will help to maintain adequate soil fertility and enhance soil productivity. Therefore, the application of research on the appropriate use of organic materials as fertilizers should be considered.

There are many thesis concerning about **GAP**, sustainable agriculture, environment friendly agriculture have came up with one sentence which is an effort to minimize the excessive use of natural resources and maintain the biodiversity on the agriculture field. Since agriculture ecosystem consist of various genetic resources, habitats, and wild species within a coherent and comprehensive framework. The agriculture biodiversity also projected to provides a hierarchical framework of the socio-economic and environmental interactions in an agro-ecosystem which provide both commodities (food and non-food outputs) and environmental services (scientific, recreational and ecological).

Agriculture is part of landscape concept which is the spatial entity of human living space, biotic communities, natural environment and culture. Once formed, the agricultural landscape has close relationship to natural characteristics, culture and tradition of its own region (Nakagoshi and Ohta, 2001). Traditional forms of agriculture landscape provide tangibility, relatively sustainable, and also is a symbol of farmer in the past. Unique agriculture and biodiversity both in East Java and Okinawa region is important to maintain not only for production, but also to keep the structures of landscape (Nakagoshi and Ohta, 2001)

The application of **GAP,** better economic, social and environmental system will interact on the diversity of habitat types, production species (crops and livestock), wild species (include production supporting species) and environment services within the agro-ecosystem boundaries. Furthermore connection or interlink between supporting agriculture ecosystem, both terrestrial (forests) and aquatic (wetlands), is necessary to sustain the agro-ecosystem and avoid harmful effect to another ecosystem.

On the other hand, by opening the close agriculture system into agriculture landscape system may have both beneficial and harmful effects on biodiversity depending on the nature work. Therefore that is the reason why the boundary will be still in the corridor of agriculture management activities with many ecological adjustments.

In the future Okinawa's and East Java agriculture ecosystem will be also functioned as the indicator of biodiversity and the indicator of the agriculture practices itself, whether it perform the good practices or creating more damage in the environment. Hence relatively balance unit of ecosystem, with natural farming is possible to achieve when each components of system in agriculture is well function. Then, it is not difficult to achieve balance system in agriculture system, maintain the economical performance and still keeping the economical function without neglecting the environment biodiversity in Okinawa and East Java.

5. CONCLUSSION

1. Statistical indicators such as production, productivity, number of farmer and cultivation area shows the downward growth on agriculture performance both in Okinawa Prefecture and East Java Province. The significant decrease of farmer, agriculture land and environment degradation due to unsustainable agriculture practice is the main driving force of agriculture downward growth while less government support and urban centre development style is the strong external factors to agriculture downward growth.
2. Okinawa Prefecture and East Java Province have a good chance and momentum to improve their agriculture system not into just the cropping or planting technique but more on the ecological landscape which in the future should also perform as an ecological unit, which still strongly influenced by agricultural management activities within diversity of different habitats. Hence each habitat type should be reflecting local resources to achieve the social, environment, and economic balance.
3. The policy and decree on agriculture sector should be reestablish to promote the revitalization on agriculture and environment service, due to the existing policy not sufficient enough to keep the sustainability of agriculture mainly in Okinawa prefecture.
4. The Good agriculture practice (GAP) approach in cultivation technology, fertilizer, pesticide and cropping system in the boundary of establishing agro-ecosystem, in the short term is able to sustain the agriculture activity on both Okinawa Prefecture and East Java Province.
5. The agriculture activity should not change the existing environment, and unique agriculture landscape of Okinawa and East Java, or should preserve the natural resources and develop it based on the supporting environment. Therefore, local products and environment services (scientific, recreational and ecological) of Okinawa and East Java should be encouraged to reach the entrepreneur level to give the maximum benefit to the society and really represent the unique of the local environment.

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A Habitat Model for the Javan Hawk-Eagle (*Spizaetus bartelsi*) Using Multi-Scale Approach in Java Island, Indonesia

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ABSTRACT

The Javan Hawk-Eagle (*Spizaetus bartelsi*) is an endemic raptor and evergreen-forest specialist in the remaining original natural forests of Java Indonesia. Regarding to IUCN Red List of Threatened Species, the Javan Hawk-Eagle (JHE) is one of the world's rarest and most endangered raptor categories. Small population size, severe habitat loss, forest fragmentation, and illegal hunting have all contributed to the "endangered" status of the JHE. Few attempts have been made to model the habitat distribution of the JHE based on predictions formulated from their habitat requirements in multi-scale. Since it is not feasible to conduct complete field surveys for a landscape-scale, this paper proposes a GIS-based extrapolation model based on local-scale model in order to generate map of potential and present habitat suitability for JHE in the entire landscape. Remote sensing/GIS technologies, spatial analysis and modeling approaches can help to integrate the local-scale information based on the field investigations, to regional- and landscape-scale for development of habitat model for effective conservation and development planning, more accurate representation of habitat modeling. The objective of this study is demonstrate a multi-scale approach for modeling a habitat model of JHE in Java Island for effective JHE conservation planning. This study is conducted in three spatial-scales i.e. Gunung Gede-Pangrango National Park (TNGP) and its surrounding area as nest-site scale. Then, southern parts of West Java and Java Island as regional- and landscape-scale, respectively

Key Words: Autologistic regression, GIS and remote sensing, habitat suitability, multi-scale, *Spizaetus bartelsi*.

1. INTRODUCTION

Habitat modeling can be an effective approach to help organize information in the literature and assess habitat distribution and suitability (Mladenoff et al., 1995; Smith et al., 1997; Wiser et al., 1998). Importantly, all species are affected by ecological phenomena at multiple spatial scales (Mackey and Lindenmayer, 2001) and best understood if multiple scales are considered simultaneously. Multi-scale investigations have led to useful insights on the habitat distributions and requirements of single species, including plants (Wu and Smeins, 2000), mammals (Lindenmayer, 2000; Johnson et al., 2004), and birds (Store and Jokimäki, 2003; Piorecky et al., 2006).

The role of scale in ecology has been discussed extensively over the past three decades and is now widely recognized as being of vital importance for understanding ecological processes (Wiens, 1989; Levin, 1992). Apparently, many population processes operate on larger scales than usually considered, and require large-scale and multi-scale analyses to understand them. Although there has been many researches exploring and confirming the scale dependence of species-habitat relationships (Fuhlendorf et al., 2002; Lawler and Edwards, 2002; Thompson and McGarigal, 2002), many investigations are still conducted at arbitrary and often small spatial scales. This is less efficient in conservation practice.

The Javan Hawk-Eagle (*Spizaetus bartelsi*: JHE) is an endemic raptor and evergreen-forest specialist in the remaining original natural forests of Java Indonesia (Whitten et al., 1996). The JHE is included in the World Conservation Union (IUCN) Red List of Threatened Species (CITES Appendix 2) as one of the world's rarest and most endangered raptor categories. Small population size, severe habitat loss, forest fragmentation, and illegal hunting have all contributed to the "endangered" status of this species (BirdLife International, 2000, 2001). Although some studies have been conducted on JHE, there are no attempts have been made to model the distribution of JHE based on habitat requirements in multi-scale due to scarcity and lack of synthesized information on the ecology of JHE, lack of effective approaches for habitat assessment at multiple spatial scales., and lack of spatial data for relevant environmental attributes and scales.

Remote sensing/GIS technologies, spatial analysis and modeling approaches can help to scaling the local-scale information based on the field investigations, to regional- and landscape-scale for development of habitat models for effective conservation and development planning (Ortigosa et al., 2000; Wu and Smeins, 2000), more accurate representation of habitat modeling (Piorecky et al., 2006). Species respond to habitat attributes at various spatial scales and habitat modeling at single or inappropriate spatial scales can lead to misleading or erroneous results. Thus, incorporate multiple spatial scales in habitat modeling is important for successful biological conservation.

The objective of this study are: 1) to demonstrate a multi-scale approach for modeling a habitat model of JHE in Java Island for effective JHE conservation planning; 2) to use the modeling by combining the results obtained from the two previous studies i.e. nest-site scale and regional scale (Syartinilia and Tsuyuki, 2008) and landscape-scale (Syartinilia et al., 2009).

2. METHOD OF ANALYSIS

This study is conducted in three spatial-scales (Fig.1) i.e. Gunung Gede-Pangrango National Park (TNGP) and its surrounding area as one of the first five national parks in Indonesia which contains one of Java's few remaining larger habitat areas for JHE, as nest-site scale. Then, southern parts of West Java and Java Island were selected as regional- and landscape-scale, respectively.

The process of scaling composes of two techniques, i.e. up-scaling and downscaling. Up-scaling refers to generation of information at a broader scale based on the knowledge obtained from a finer scale, whereas downscaling is to determine the issues at finer scale using knowledge at broader scale. Aggregation and extrapolation are forms of up-scaling where one attempts to infer from known values and conditions inside current data extent towards estimations of data outside of it (Zhang et al., 2003).

If the data availability does not allow for such a multi-scale scenario approach for the entire region of interest, it still might be performed for a typical subset of the region where sufficient information on several scales is available. The results for the subset and their conclusion can be transferred to the entire region and give at least a first educated guess about the magnitude and importance of the scale issue in the region of interest (Cassel-Gintz et al., 2004). Based on this reason we used up-scaling technique for generating the landscape-scale habitat model of JHE in this study.

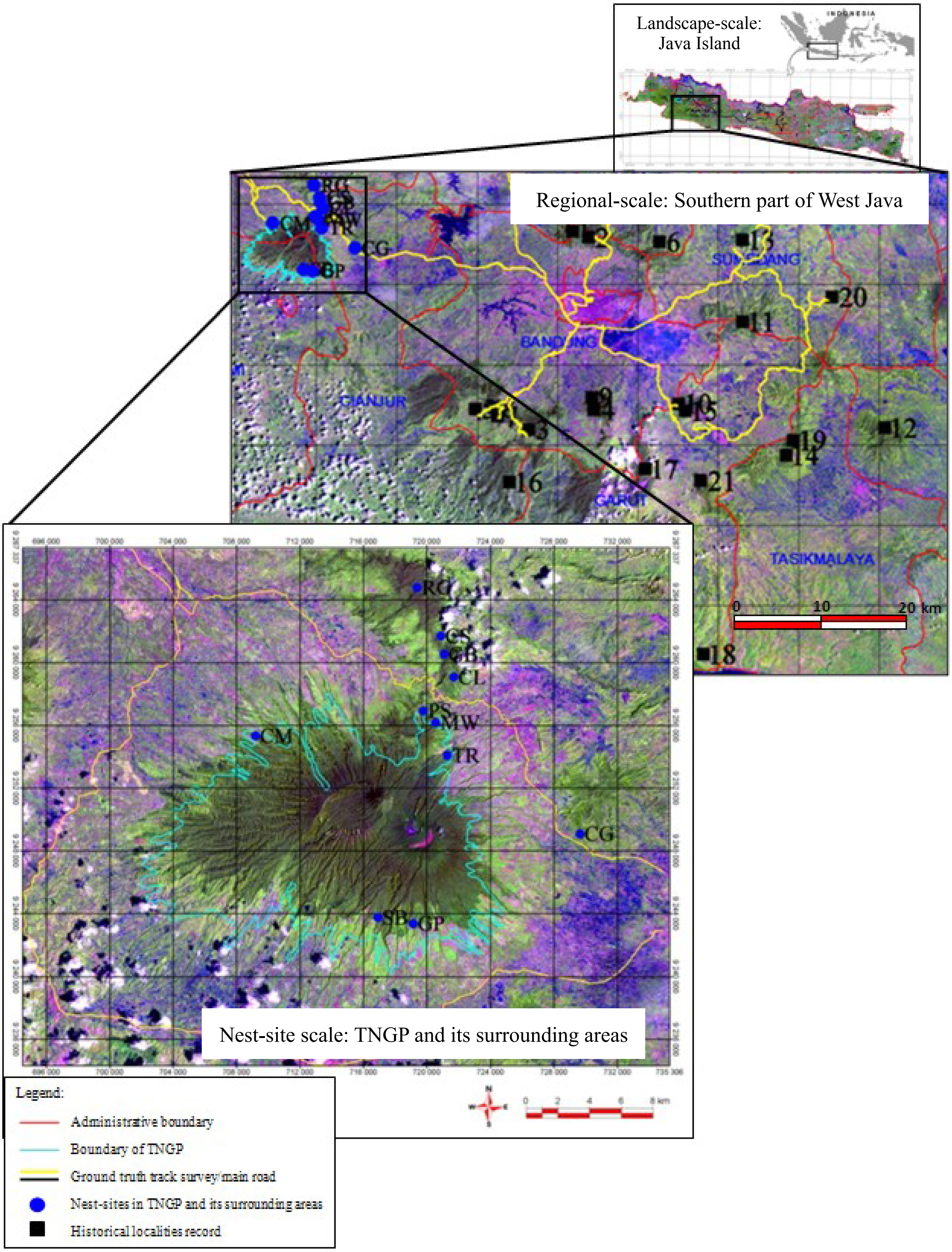

Figure 1. Location of the study area.

In order to generate the multi-scale model of JHE habitat distribution in Java Island, we used the best model that was obtained from the previous study (Syartinilia and Tsuyuki, 2008) that was an autologistic regression model using 1,500m of neighborhood size or 50×50 moving window size. This model is defined as ALR_50 model. Autologistic regression model accounted spatial autocorrelation through the addition of autocovariate variable. ALR_50 model was compared to another models i.e. one ordinary logistic regression model and four autologistic regression models using different neighborhood sizes ranging from 450 m (15×15 moving window size) to 1,350 m (45×45 moving window size) using 300 m interval. The result of the comparison analysis using statistical performance and visual comparison showed that ALR_50 model significantly increase overall accuracy and successfully removed misclassified pixels. The best model (ALR_50) retained the explanatory environmental variables, i.e. slope (SLP), elevation (ELV), normalized different vegetation index (NDVI) and autocovariate (AUTOCOV). Table 1 explains in detail about the environmental variables used for each scale in this study. Probability of the JHE habitat (Pi) using ALR_50 model is explained by the equation below.

$$Pi = \frac{1}{1 + \exp[-(0.2371SLP - 0.0070ELV + 0.0189NDVI + 19.8063AUTOCOV - 6.8592)]}$$

This model was developed in nest-site scale (Gunung Gede-Pangrango National Park (TNGP). Subsequently, it was validated in regional-scale (Southern parts of West Java). Finally the model was extrapolated to landscape-scale. Then, this model was compared with the historical localities record after 1980 (BirdLife International, 2001; Setiadi et al., 2000; van Balen et al., 1999, 2001) for model accuracy validation. The estimated population number of JHE also estimated by dividing the area of presumed suitable habitat by assumed home-range size. Suitable habitat was obtained from thresholding the predicted probability of JHE habitat at probability value of 0.5. In order to avoid the overestimate of the population size, we excluded the habitat patches with area below the 50 km^2 (Syartinilia et al., 2009).

Table1. **Environmental variables used in each scale**

Environmental variable	Unit	Scale	Pixel size (m)	Data source
Slope (SLP)	Degree	Nest-site	30*30	Topographic maps (National Coordination Agency for surveys and Mapping, Indonesia) at a scale of 1:25.000.
		Regional-scale	90*90	Shuttle Radar Topography Mission (SRTM) Digital terrain elevation data of 2000
		Landscape scale	250*250	Shuttle Radar Topography Mission (SRTM) Digital terrain elevation data of 2000
Elevation (ELV)	Meter	Nest-site	30*30	Topographic maps, SRTM DEM
		Regional-scale	90*90	Shuttle Radar Topography Mission (SRTM) Digital terrain elevation data of 2000
		Landscape scale	250*250	Shuttle Radar Topography Mission (SRTM) Digital terrain elevation data of 2000

Table1. **(continued)**

Environmental variable	Unit	Scale	Pixel size (m)	Data source
Normalized different vegetation index (NDVI) NDVI = (near IR band – red band) / (near IR band + red band)	-	Nest-site Regional-scale Landscape scale	30*30 90*90 250*250	LANDSAT ETM+ 2001/12/22 scene 122/65 (path/row) LANDSAT ETM+ 2001/12/22 scene 122/65 (path/row); 2003/1/19 scene 121/65 (path/row) MODIS NDVI 250m of 2002
Autocovariate (AUTOCOV) $AUTOCOV_i = \frac{\sum_{j=1}^{k} w_{ij} p_j}{\sum_{j=1}^{k} w_{ij}}$ where w_{ij} being the inverse of the Euclidean distance between i and j, while p_j represents the predicted probability estimated by LR	-	Nest-site Regional-scale Landscape scale	30*30 90*90 250*250	Average initial probability assigned to 50*50 window size Average initial probability assigned to 17*17 window size Average initial probability assigned to 6*6 window size

3. RESULTS AND DISCUSSIONS

This study integrated GIS and remote sensing technique for developing a multi-scale habitat modeling for effective JHE conservation planning. The important points of this study are to develop habitat distribution model of JHE from the nest-site scale and validated in regional-scale and finally extrapolated to entire Java Island. The multi-scale model of JHE habitat can be seen in Figure 2.

This approach will enable forest and wildlife managers to determine current areas of core habitat as well as model the effects of various conservation strategies of future habitat quality and distribution assessments. The most important result in this study was determining the 1,500 m neighborhood size or moving window of 50*50, 17*17, 6*6 pixels for nest-site-, regional- and landscape-scale, respectively as the appropriate operational scale in modeling habitat distribution of JHE by ALR models. The difference in the three window sizes used for nest-site, regional- and landscape- scale model is caused by different pixel sizes used in each scale.

a. Nest-site scale model

Nest-site scale models were developed for site-specific assessment of habitat requirement and habitat suitability of JHE based on fine-resolution data. Nest-site scale models are more accurate than the regional- and landscape-scale models but expensive to use. The data requirements make the application of nest-site scale models for large project areas cost-ineffective or even infeasible.

b. Regional-scale model

Regional scale models were developed to generate information on spatial distribution of suitable habitat for large regions which is based on validation of the nest-site scale model. The ALR_50 was successfully validated in southern parts of West Java with 20% omission error rate (Syartinilia and Tsuyuki, 2008). The validation of the model on data from the independent area of the southern part of West Java indicates that the model has a high degree of generality and could also be applied elsewhere.

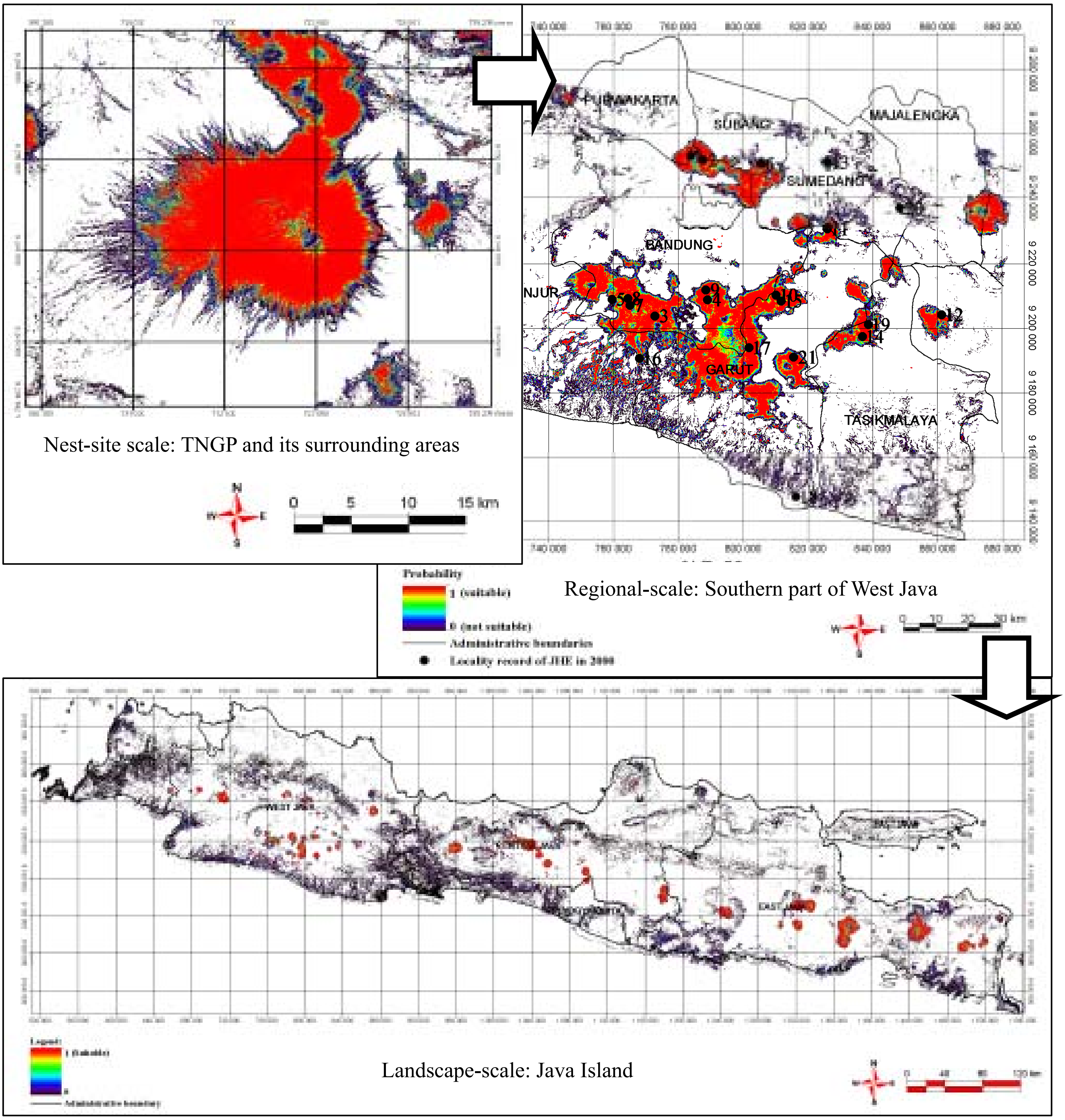

Figure 2. A habitat model of JHE in multi-scale.

Source : Syartinila and Tsuyuki, 2008 ; Syartinilia et al., 2009.

c. Landscape scale model

Compared to corresponding nest-site scale models, landscape-scale models use coarser information that is acquired from satellite remote sensed data such as MODIS NDVI 250 m of data resolution. The ALR_50 model was successfully extrapolated to entire Java Island and it covers about 3,107 km^2 after thresholding at probability value of 0.5 (Syartinilia et al., 2009) (Fig. 3). A habitat model of JHE in Java Island obtained in this study may be the most useful in the conservation planning process to help identify “hot spots” that are most likely to harbor JHE. A general trend in the habitat distribution of JHE can be seen with this model. Most of the predicted suitable habitats of JHE in Java Island are distributed in the mountainous area due to their high dependence on the presence of remaining natural forests. Natural forests in Java have been generally cleared, and remnants are now confined to mountain areas (above 1,200m asl), with only a tiny percentage of the natural lowland forest (below 1,200m asl) remaining (Whitten et al., 1996).

Comparing to the historical localities record after 1980, about 41 locations (85%) of 48 historical localities record were recognized as suitable habitat in this model and the rest of the locations (15%) were recognized as omission error, when the model predicts as an unsuitable habitat even though the species has indeed been found in that location that were Ujung Kulon National Park (locality number: 1), Leuweung Sancang Wildlife Reserve (No. 20), Mt. Tampomas (No. 23), Mt. Jagat (No. 26), Mt.Cupu/Simembut (No. 30), Meru Betiri National Park (No. 45), and Alas Purwo National Park (No. 48). Three locations (Leuweung Sancang Wildlife Reserve, Mt. Tampomas, and Mt. Jagat) located in southern parts of West Java were also recognized as omission error in model validation.

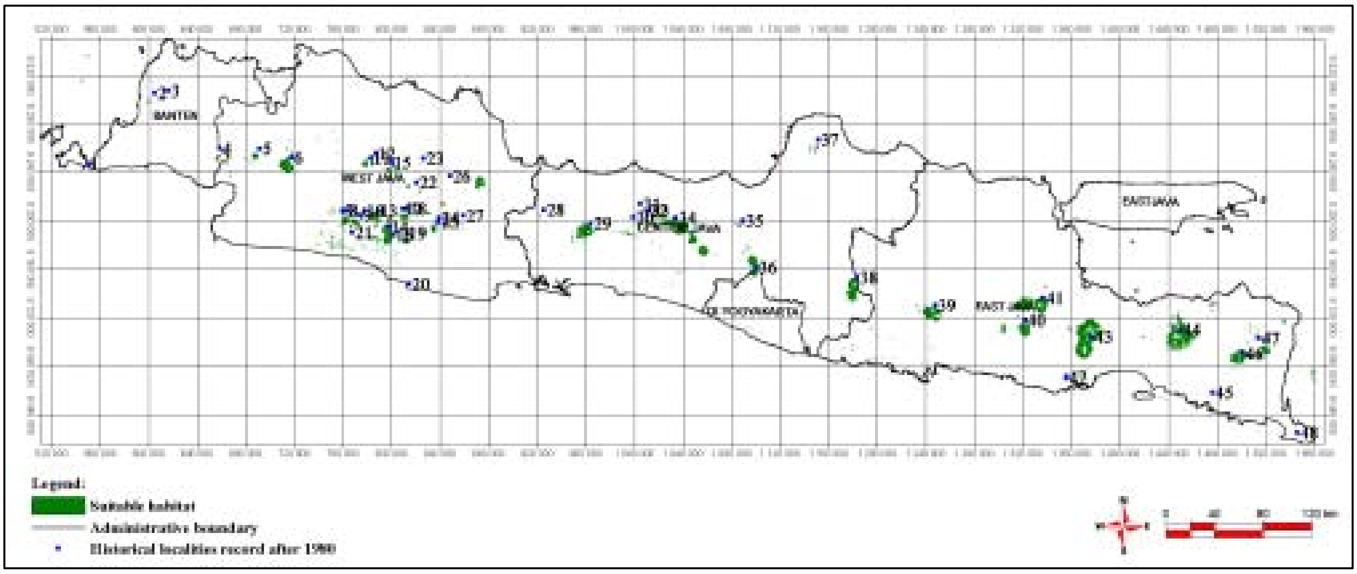

Figure 3. Habitat suitability model of JHE in Java Island (extrapolation) based on threshold of ALR_50 model at 0.5.

(Source: Syartinilia et al., 2009).

Totally about 16 patches (2,166 km^2) with a predicted probability of JHE presence > 0.5 and area > 50 km^2 were identified as habitat patch, and then the estimated number of JHE pairs based on this model would place the population size about 108-542 (median = 325) pairs (Syartinilia et al., 2009). However, other studies did not estimate similar population numbers, "Not more than 60 breeding pairs" (Meyburg et al, 1989) , "67–81 pairs" (van Balen and Meyburg, 1994), "81–108 pairs" (Sözer and Nijman, 1995), "137–188 pairs" (van Balen et al., 1999; 2000; 2001), "270–600 (median = 435) pairs" (Gjershaug et al., 2004). Previously, other studies reported the habitat distribution and population estimation of JHE based on historical records and habitat requirements determined by characterizing the area records. Only this study using the multi-scale approach based on the nest-sites as presence data that confirms breeding location; these data are more reliable than using localities' records to reflect the present natural distribution derived from a realized niche.

For conservation and development planning, it is necessary to evaluate a large area for possible alternatives/strategies. Landscape-scale model which was produced by multi-scale approach is effective for generating spatial distributions of potential and present habitat suitability for JHE over a large area using GIS and remote sensing-based data. The predicted probability of habitat model may not always be accurate at specific locations because probability itself does not mean present existence. However, they will provide critical information for research, planning, and management needs at landscape scales (Lindenmayer and Possingham, 1996; Wu and Smeins, 2000).

4. CONCLUSIONS

There is an urgent need of habitat modeling as an important component in conservation and development planning at multiple spatial scales. It is challenging, however, due to scarcity and lack of synthesized information on the ecology of JHE, lack of effective approaches for habitat assessment at multiple spatial scales, and lack of spatial data for relevant environmental attributes and scales. A multi-scale habitat modeling approach was developed to meet this need using nest-site, regional-, and landscape-scale habitat models. The nest-site scale models based on fine-resolution data provide accurate assessment of the potential and present habitat suitability of specific locations; the regional-scale models based on coarse GIS data generate information on spatial distribution of suitable habitat for large regions; and the landscape-scale models based on extrapolation of the site-scale model but using GIS-remote sensing based data provide spatial explicit assessment of the potential and present habitat suitability at the scales of the greatest practical needs. These models provide effective tools for conservation and development planning as well as monitoring and management of JHE habitat.

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