PROCEEDINGS

2015 3rd International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

ICAIA 2015





August 3rd - 4th, 2015
IPB International Convention Center
Bogor, Indonesia

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Welcome Message from The General Chairs of ICAIA 2015

On behalf of the organizing committee, it is our pleasure to welcome you to International Conference on Adaptive and Intelligent Agroindustry, Bogor, Indonesia. This is the 3rd conference on the topic that is held by the Department of Agroindustrial Technology, Bogor Agricultural University, Indonesia.

The conference is expected to provide excellent opportunity to meet experts, to exchange information, and to strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry. In addition, the conference committee invited five renowned keynote speakers, i.e. Prof Irawadi from Bogor Agricultural University; Prof Kenneth De Jong from George Mason University, USA; Dr Yandra Arkeman from Bogor Agricultural University; and Dr Guillermo Baigorria from University of Nebraska-Lincoln, USA.

The conference committee also invited Prof Noel Lindsay from University of Adelaide, Australia; Kiyotada Hayashi from National Agricultural Research Center-Tsukuba, Japan; Prof Margareth Gfrerer from Islamic State University of Jakarta, Indonesia; Dr Barry Elsey from University of Adelaide, Australia; Dr Gajendran Kandasamy from Melbourne University, Autralia; and Imperial College London-British, Prof Allan O'Connor from University of Adelaide, Australia; Dr Wisnu Ananta Kusuma from Bogor Agricultural University ,Indonesia; and Dr Frank Neumann from University of Adelaide, Australia, as invited speakers.

This conference was organized by Department of Agroindustrial Technology, Bogor Agricultural University and Asosiasi Agroindustri Indonesia, and technically sponsored by IEEE Indonesia Section. Furthermore, it was supported by Departement of Computer Science, Bogor Agricultural University; Surfactant amd Bionegergy Research Center; PT Bogor Life Science and Technology; Indonesian Ministry of Industry; PT Pachira Distrinusa; and PT Kelola Mina Laut.

I would like to take this opportunity to express my deep appreciation to the conference’s committee members for their hard work and contribution throughout this conference. I would like to thank authors, reviewers, speakers, and session chairs for their support to participate in the Conference. Lastly, I would like to welcome you to join ICAIA 2015 and wish you all an enjoyable stay in Bogor.

Sincerely,
Dr Yandra Arkeman
General Chairs, ICAIA 2015

WELCOMING ADDRESS

Prof. Dr. Ir. Nastiti Siswi Indrasti
Head of Agroindustrial Technology Department
Faculty of Agricultural Engineering and Technology
Bogor Agricultural University

on

3rd International Conference on Adaptive and Intelligence Agroindustry (3rd ICAIA)

Bogor, August, 3 – 4, 2015

Assalamu'alaikum Warohmatullahi Wabarokatuh
In the name of Allah, the beneficent and the merciful,

Distinguish Guest, Ladies and Gentlemen
Let me first thank you all for accepting the invitation to participate in this 3rd International Conference on Adaptive and Intelligence Agroindustry (ICAIA). In particular I would like to thank Rector of IPB (Institut Pertanian Bogor/Bogor Agricultural University) Prof. Herry Suhardiyanto for supporting this event as part of the series academic event in celebrating the 52nd Anniversary of Bogor Agricultural University.

We are certainly proud to have been able to assemble this event in IPB, Bogor. The range of participants and audience at this conference is precisely something I would like to stress. Participants who followed the event more than 150 people, coming from various countries including the USA, Australia, Japan, Vietnam, Philippine, Germany and Indonesia. The main goal of the conference is to provide an effective forum for distinguished speakers, academicians, professional and practitioners coming from universities, research institutions, government agencies and industries to share or exchange their ideas, experience and recent progress in Adaptive and Intelligent Agroindustry.

The 2015 3rd International Conference on Adaptive and Intelligent Agro-industry (ICAIA) is the third forum for the presentation of new advances and research results on various topics in all aspects of innovative agro-industry that highlights the development and improvement for today and tomorrow's global need for food, energy, water and medicine. The aim of the conference is to stimulate interaction and cohesiveness among researchers in the vast areas of innovative agro-industry. Innovative Agro-industry has the ability to adapt intelligently to future global challenges, i.e. food, energy, water, and medical. Global challenges needs a new breed of Agroindustry which could produce innovative products to fulfill the needs through advanced processing technology, production systems and business strategy supported by cutting-edge information and communication technology.

The topic for this event is "Empowering Innovative Agroindustry for Natural Resources, Bioenergy and Food Sovereignty". The topics clustered into four main parts:
Track 1 : Innovative Agroindustrial and Business System Engineering

Track 2 : Frontier Approaches in Process and Bioprocess Engineering
Track 3 : Frontier Approaches in Industrial Environmental Engineering
Track 4 : Intelligent Information and Communication Technology for Adaptive Agroindustry of the Future

This event also hosts four (4) workshops: (1) Strategies for Agroindustry Development (2) LCA for Agroindustry (3) Innovation and Technopreneurship for Agroindustry and (4) Agroindustry Informatics.

Distinguish Guest, Ladies and Gentlement,
Agroindustry transforms agricultural commodities into high value-added products. Agroindustry is industry that process agricultural products to increase their value added significantly by using technology and by considering environmental aspect and sustainability. However, with changing global demand and technology advancement, innovative agroindustry is needed in order to be competitive as well as sustainable. The challenge of future agroindustry is not merely efficiency and productivity anymore, but also the challenge to appropriately apply frontier technology as well as meeting future global demands.

Agroindustry needs to deal with the application of advance technologies and cope future global issues. Current global issues which arise and expected to exist in the future are food sovereignty, renewable energy, sustainable water management and pharmacy. The ability of agro-industry to respond the future global issues and the undoubtedly substantial increase in demand in future decades will be highly dependent on the increased application of existing technologies as well as the exploitation of new and innovative technologies.

The emergence of high technology could be applied in the agro-industry are: nanotechnology, biotechnology, bioinformatics, food processing, food packaging-waste, state-of-the-art computation and many others. The aforementioned high-technology along with computation technology could greatly advance agro-industry from a traditional system into a smart-intelligent and innovative technology. Therefore, in the new millennia, adaptive-intelligent and innovative agro-industry will contribute to solutions to global problems and brings agriculture into perfection.

Hope this conference will also discuss this issue in more detail as it is an important matter for all of us. We should no more think just how to produce high value product but it is also necessarily important how to keep our live in good quality by understanding following old saying… “You do not live at once. You only die once and live every day”.

I do not to take up any more of your time with these opening remarks. Let me simply thank you once again for sharing your thoughts with us. Here’s wishing every success for the conference. May Allah bless all of us.

Thank you for your kind attention,
Wassalamu’alaikum Warohmatullahi Wabarokatuh

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AGENDA

Time	Activities
Monday, August 3rd 2015	
08.00 - 09.00	Registration
09.00 - 10.00	Opening Ceremony • Welcoming Address: Prof. Nastiti Siswi Indrasti (Head of DAT, Fateta, IPB) • Welcoming Speech Head of Bogor Regency • Conference Opening: Prof. Herry Suhardiyanto (Rector of IPB) • Opening Speech and Conference Opening : Minister of Industry Indonesia * • Launching Expose International program DAT
10.00 – 10.05	*Photo Session*
10.05 - 10.15	*Coffee break*
 10.15 - 10.45 10. 45 - 11.30 11.30 – 12.00 12.00 – 12.30	Keynote Speech : 1. Prof Irawadi (Bogor Agricultural University, Indonesia) 2. Prof. Kenneth De Jong (George Mason University, USA) 3. Dr. Yandra Arkeman (Bogor Agricultural University, Indonesia) 4. Dr. Guillermo Baigorria (University of Nebraska, Lincoln, USA)
12.30 – 13.30	Lunch break
 13.30 – 13.50 13.50 – 14.10 14.10 – 14.30 14.30 – 14.50 14.50 – 15.10 15.10 – 15.45	Plenary Session 1 : Prof. Noel Lindsay (University of Adelaide, Australia) Dr. Kiyotada Hayashi (National Agricultural Research Center, Tsukuba, Japan) Prof. Margareth Gfrerer (Islamic State University of Jakarta, Indonesia) Dr. Barry Elsey (University of Adelaide, Australia) Ir. M. Novi Saputra (Marketing Director KML Food Group) *Discussion*
15.30 – 15.45	*Coffee break*
15.45 – 18.00	Parallel session A, B and C
18.00 – 21.00	Welcome Dinner

Time	Activities
Tuesday, August 4rd 2015	
08.30 – 09.00	Registration
 09.00 – 09.20 09.20 – 09.40 09.40 – 10.00 10.00 – 10.20 10.20 – 10.45	Plenary Session 2 : Dr. Gajendran Kandasamy (PhD in Physic, Melbourne University ; PhD in Innovation Imperial Collage, London) Prof. Allan O'Connor (University of Adelaide, Australia) Dr. Eng. Wisnu Ananta Kusuma, ST, MT (Bogor Agricultural University, Indonesia) Dr. Frank Neumann (University of Adelaide, Australia) *Discussion*
10.45 – 13.00	Parallel Session A, B and C
13.00 – 14.00	Lunch break
14.00 – 15.30	Parallel Workshop • Strategies for Agroindustry Development • LCA for Agroindustry • Innovation and Technopreneurship for Agroindustry • Agroindustrial Informatics
15.30 – 15.45	Coffee Break
15.45 – 16.15	Closing remark

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Design of Web-Based Information System with Green House Gas Analysis for Palm Oil Biodiesel Agroindustry

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***Abstract*—The scarcity of fuel is one of the serious problems in Indonesia because it can disturb people daily activities. One way to prevent the increasing fuel usage is by providing information about biodiesel as an alternative energy source. This information is served in the form of web base information for palm oil biodiesel agroindustry with Green House Gas (GHG) analytical module. This research is aimed at providing information about data production and area of oil palm plantation, data production of biodiesel and GHG analysis module to perceive GHG emission. This information system has some main features including graph of data production, area of oil palm plantation, biodiesel data production, page editor, and shown results of GHG analysis. Using this information system, it can be decided whether an area has a high GHG emission or not. This system, therefore, can be used as a region reference for emission reduction.**

I. Introduction

THE limiting availability of fossil fuel has brought people attention to the use of plant oils as alternative sources of fuel. Biodiesel is an alternative energy people use to fulfill their energy needs for transportation, household, and industry. These need can be fulfilled easily if there is sufficient information available for public.

The need for quick, appropriate, and accurate information is an important aspect in human's life. As information develops very quickly, a better information system is needed. Designing or developing a web is a way that can be done in order to provide public with access to information.

Indonesia is a country with 98.56 million hectares of forest area (Ministry of Forestry, 2012). One of the commodities potential to develop in this country is oil palm that can be utilized as an alternative energy in the form of biodiesel. However, limited centralized information on oil palm and biodiesel has hampered biodiesel development. There are only a few websites available today providing information on biodiesel and oil palm. Latest advancement in technology has driven the use of web-based information system in which all information available is presented by using Internet medium.

Information system of biodiesel and oil palm is made to provide the public with information on oil palm production, oil palm plantation area, and biodiesel production. The development of this information system is aimed at assessing the integrated and latest information about biodiesel, oil palm, and analysis of greenhouse gas effect as a tool to determine the gas emission value resulted from the land use changes.

The aims of this study is to design web-based information system on data of oil palm production and land area and biodiesel production in Indonesia by presenting them in forms of tables and graphs depicting results of greenhouse gas effects analysis in detail as a result of land use changes..

II. METHODS

A. *Rationales*

Fuel oil scarcity is one of the serious problems faced by many countries including Indonesia. This country, however, is a developing country in which most of its land is a forest area. This area provides oil palm, a commodity that can be used to produce biodiesel as an alternative energy source.

Oil palm production is significantly increasing over years. This has created a land use change which

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brings a negative effect in the form of increased emission of greenhouse gasses. Providing information about oil palm biodiesel is a way that can be done to avoid fuel oil scarcity.

The advanced technology can be used to create a centralized and integrated information system. An information system designed in a web form is more accessible for public and provides information related to oil palm and biodiesel with an analysis module of greenhouse gasses in web. The concept framework of biodiesel industry management in order to optimize feedstock procurement is depicted schematically in Figure 1.

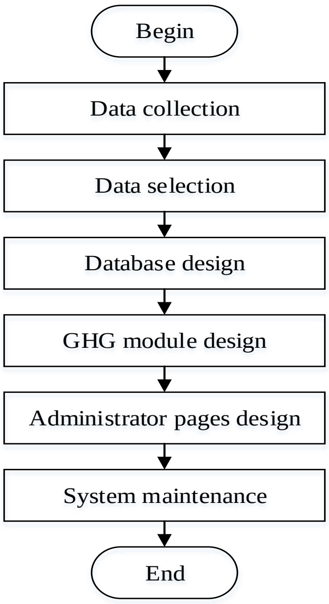

Fig. 1. Framework of thought

B. System Development

Web-based information system of oil palm biodiesel agroindustry is developed by using a System Development Life Cycle (SDLC) methodology. Stages of the development include planning, system analysis, system design, system implementation, and system maintenance (O'brien, 1999).

The advantages and disadvantages of SDLC system development are listed in Table 1.

C. Planning

System planning is done to get a description of the objectives and scope of system development, define existing problems and ways to overcome them, and evaluate strategies to be used in system development. The planning stresses on system feasibility study.

D. System Analysis

In system analysis, there are two stages done, namely analyzing and defining problems and finding solutions to the problems in an information system. In a system development, system analysis is important as it results in best solutions to problems, new needs, and improves overall system performance.

System analysis is a critical and very important stage as any mistakes made in this stage may result in other mistakes in the next stage. In general, the activity done in system analysis stage is an elaboration of feasibility study.

TABLE 1
ADVANTAGES AND DISADVANTAGES OF SDLC

No	Advantages	Disadvantages
1	Easy control	Longer time of development
2	Clear stages	System has to be defined from the beginning
3	Easy monitoring for big projects	Higher development fund
4	Good fund evaluation and work plan accomplishment	Rigid
5	Good documentation	Difficult fund estimation
6	Good definition of customer needs	Limited inputs by users
7	Easy maintenance	
8	Easy system planning and development	
9	Ability to tolerate changes in information management system	

E. System Design

There are three main activities in this stage, namely interface design, data design, and process design. System design stage is a procedure of converting logical specification to a design that can be implemented in an organizational computer system.

According to Whitten *et al.* (2001), interface design is a prototype in which a work model is designed and modified repeatedly by using feedbacks from end users. The activity in interface design focuses on interaction support between end user and computer-based application. Data design is done in database structure design that will be used by system. Process design focuses on software design in the form of proposed programs and procedures.

F. System Implementation

System implementation is a stage that takes longer time and a complex process. Activities done in this stage include software and hardware acquisition, software development, database development and testing, data conversion, and various other programming activities.

G. System Maintenance

System maintenance is the last stage in SDLC. In this stage, monitoring, evaluation, and modification are done to make repairs which are important or compatible to end user needs. System maintenance is done by an administrator who is appointed to keep the system operate well as needed.

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III. RESULTS AND DISCUSSION

A. Planning

This web-based information system with greenhouse gases analysis is selected as an effort to avoid fuel oil scarcity. The solution given is the provision of information about biodiesel as an alternative energy source and oil palm as a potential feedstock for biodiesel production.

Web technology is used as the basis of this information system development as the scope of this information system users is wider and centralized. Important things needed in this system development include data, time, cost, hardware, and software.

Data are one of the main things that need to be reviewed in information technology. Data utilization covers many aspects. Data describe a representation of facts composed structurally (Vercellis 2009). This information system is developed by using database as the main source of information which is presented to users. Data about oil palm are taken from the Statistic Bureau (BPS) and data about biodiesel production are taken from the Directorate of New Renewable Energy and Energy Conservation (EBTKE). In this stage, data are highly required as they are to be converted into information in the system.

The development of this information system takes time for data selection, data input, and data conversion to the form that fitted the system needs, data correction, and appearance design. Extra power and thought are also needed to get the optimum results.

The cost of this information system development consists of direct and indirect costs. According to Al-Fatta (2007), several things needed to be considered in designing an information system. These include performance analysis, information, economical value, efficiency, and service that can be given by the system. Higher measurement in economical aspect of a system is an indication that the system is worth developing.

The availability of hardware in this information system development is highly required to allow the required software operate optimally.

B. System Analysis

System analysis process in the development of an information system is a procedure done to assess any problems that may occur, develop alternative problem solutions, and develop specifications of new, proposed, or modified systems (Sutabri, 2004). System analysis is aimed at synchronizing user needs and the operational system being developed.

The information system being developed is dynamic meaning that it is able to interact with visitors of the site, it can show information originating from database, and pages on the web can change automatically (Sutisna, 2007).

World Wide Web (WWW) or commonly known as web is an information net using a Hyper Text Transfer Protocol (HTTP) that can be accessed through a simple interface. Bowo (2005) stated that a web is a component or a group of components consisting of texts, images, sounds, and animations making it as an interesting information medium.

System analysis is done through the stage of identification functional and non-functional needs. In this study, the problem found in system analysis is the finding that the availability of centralized information about oil palm and biodiesel is public functional need. This need just appears as there is a land utilization change into oil palm plantation area. This change in land function has resulted in the increased greenhouse gases emission so that the analysis of greenhouse gases emission measurement in the system is required. Meanwhile, interesting and consistent interface appearance that made it easy to use by users is found to be a non-functional need.

C. System Design

System design is a stage that describes how the system fulfills the users' need of information. System design stage plays an important role in creating a good quality system. System design consists of interface design, database design, and process design.

1) Database Design: Database is a group of data stored systematically in a computer and can be changed, deleted, erased, and added by using software to produce information. Data are stored in the form of tables and the stored tables are interconnected. Database design is affected by the sharpness of the system analysis to be produced and the result of this design will give significant effect on the resulted system (Sidik, 2005).

This web-based information system is developed to present information on oil palm production, oil palm plantation areas, and biodiesel production data in graphs or tables. The database developed for this web-based information system consists of 100 tables. The tables which are stored based on the category of the information needed by the system consist of oil palm production tables, biodiesel production tables, oil palm plantation areas tables, and values of greenhouse gases analysis tables. Each table has different identities, for example, latpb, latpr, ppb, ppr, admin, etc. Not all tables have relation one to another.

2) Process Design: The process design of this information system is made by using a contextual diagram as shown in Figure 2.

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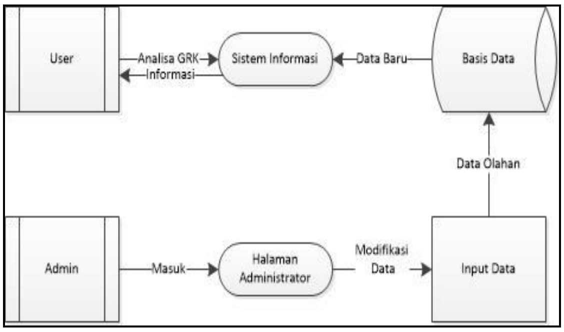

Fig. 2. Contextual diagram of process design

It is shown in Figure 2 that there is an interconnection between user and administrator. In this system, user is one who obtained information from the system and administrator is one who controlled and renewed information including the database in the information system. Users involved in this system are public.

3) Interface Design: Interface design in an information system is divided into two displays: an interface for administrator and another for users. The function of interface is to show the location of information needed by users.

The displays of each interface, user and administrator, are made as interesting as possible for their easy operation. For user interface, for example, the display is made interesting so that it would be easy for users to get the information they needed (Figure 3). Meanwhile, for administrator interface, the display is made in such a way so that it would be easy for the administrator to enter, erase, or change data.

On the user home page there are the image and logo of the information system. The navigation menu consists of Home, Oil Palm, Biodiesel, GHG (greenhouse gases), and Contacts (Figure 3). On the first user page, there are paragraphs about oil palm in both Bahasa Indonesia and English. Oil palm menu provides information on oil palm and biodiesel menu provides information on biodiesel. GHG menu is available for users who would conduct the analysis of greenhouse gases emission value.

The oil palm page provides information of data on production of state-owned, people, and private plantations, plantation areas of major estates in provinces and regencies, and number of major plantations.

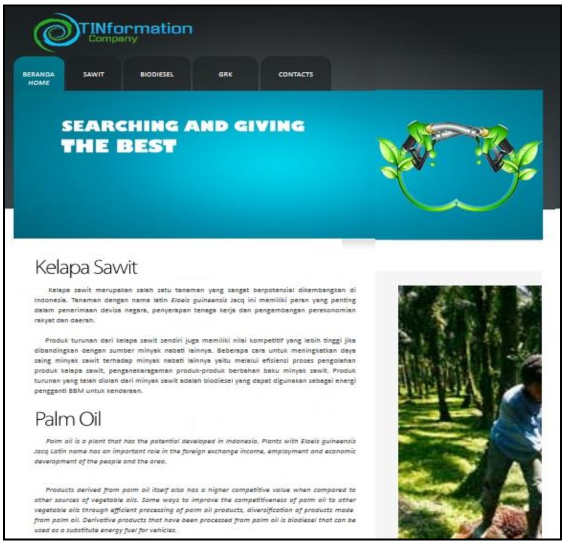

Fig. 3. User interface page

On oil palm interface page, there is a graph button that allowed users to short displays of graphs and tables according to the options of information category on oil palm interface page as shown in Figure 4. The bar graphs shown in Figure 34 are the result of jQuery plugin. jQuery is a collection of codes or Javascript functions that can be directly used to allow programmers make Javascript codes in an easier and faster way (Hakim, 2010).

Fig. 4. Oil palm interface page with information category options

The information category options on oil palm interface page can be selected by users to get more detailed information as needed. For example, detailed information on oil palm plantation areas is shown in Figure 5. On the right side there is an option menu for oil palm plantation area in the province needed.

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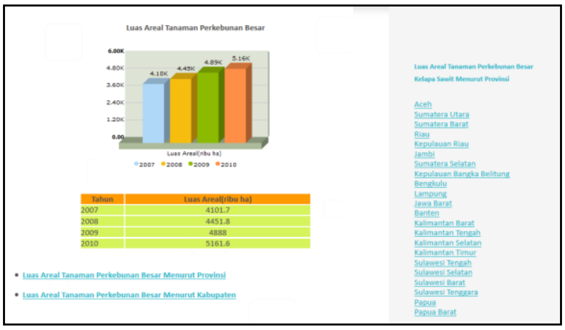

Fig. 5. Detailed page according to the information category selected by user

The displays on other pages such as those displaying production of major state-owned plantations, major private plantations, and people plantations, have similar layout and contents. There are only the data in each information category which are different. The option menu on planting areas of major plantations based on provinces is made to display data on plantation areas in provinces in Indonesia.

Biodiesel page provides information on biodiesel production and how it is made from oil palm. There are 4 options on biodiesel interface page. These contents include biodiesel making, overall and domestic biodiesel production, and biodiesel export.

Graphs and tables are also shown on biodiesel interface page to make it easier for users to get information. The graphs and tables are in the similar forms to those on oil palm interface page. Data on biodiesel production are obtained from Directorate General of New Renewable Energy and Energy Conservation. However these data are not ready for publication as there are part of the data that are not yet collected. This information system is made for EBTKE for update of data and content on the web. The availability of this web-based information system is expected to assist public and government in acquiring information.

The information on biodiesel and oil palm pages is obtained from the summary and references as the result of literature study. Palm oil production process consisting of transesterification, washing, drying, and filtration, is briefly described. Interesting information display such as biodiesel process graphs makes it easier for users to understand the content of a web page

The next page is greenhouse gases (GHG) page on which analysis of GHG emission value as a result of land use changes can be found. There are six calculation stages on this page. Each stage has its value in accordance with the options given.

This GHG analysis is the analysis of the integration result of GEF (Global Environment Facilities) calculation which is originally made in excel and then implemented in web form. The interface page of GHG analysis is shown in Figure 6 and 7.

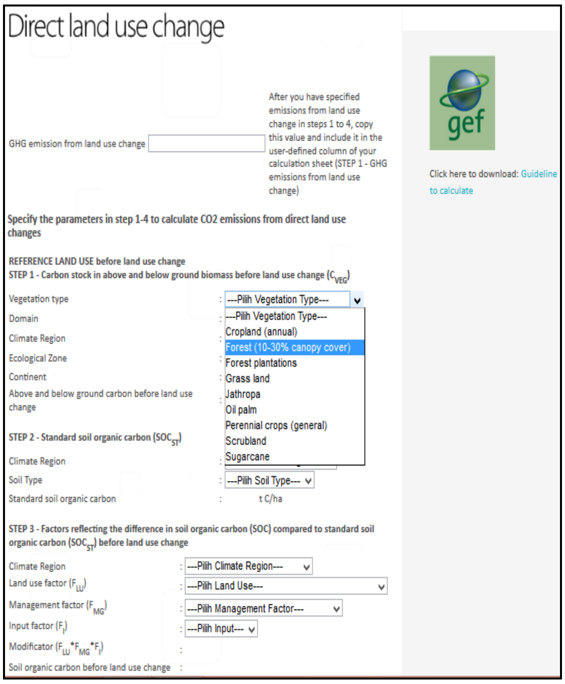

Fig. 6. GHG analysis page

As shown in Figure 6, there are 2 stages of GHG emission value analysis. In stages 1 to 4, the determination of CO_2 emission value from land direct use is done. In each stage, the option boxes are to be filled in. Each option box is provides in accordance with the rules for GFE calculator.

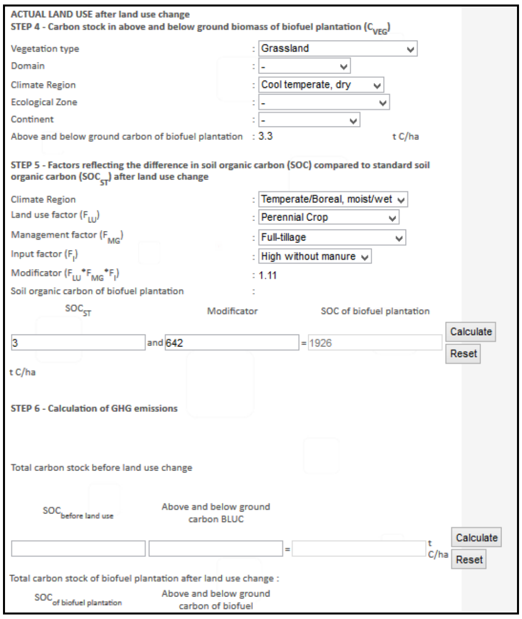

Fig. 7. Interface page of GHG-continued

In stage 5 and 6, as shown in Appendix 1, the calculation of the difference between soil organic carbon content and standardized soil organic carbon content after land use change is done. Stage 6 is the last stage in the analysis to result in GHG emission

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value from land use change.

The next page is interface display on the administrator page. Administrator is one appointed and trusted to monitor and update data in an information system. The updated data are used as input on user pages. Prior to login to the administrator home page, an administrator has to put in an identity and password (Figure 8).

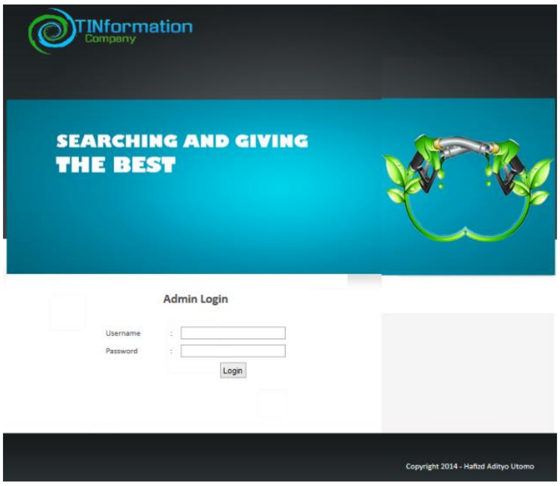

Fig. 8. Administrator login page

The administrator then selects data to be updated. Brief information about oil palm is also available (Figure 9). The category of information shown on the administrator page is synchronized with that on user page. Administrator can also select Oil Palm and Biodiesel menu to monitor or update data existing in each menu offered.

Fig. 9. Administrator home page

The display of Oil Palm menu page on the administrator page is similar to that on the user page. However, the information category here is used to select data to be manipulated (changed, erased, and added).

There are the options of the plantation areas of major state-owned plantations and major private plantations. Each is presented in provincial and regent basis. The next option is the oil palm production of major state-owned plantations, major private plantations, and people plantations and each is presented in provincial and regent basis. The displays on this page are not far different from those on the oil palm user page. The only difference is that on user page there is a “See Graphs” button which is not available in the oil palm administrator page.

Data to be updated can be changed by selecting the category available on oil palm and biodiesel administrator page. Data display can then be seen in one of the information categories as shown in Figure 10. On the right side of the table there are options of data manipulation (change, erase, add).

The Add Data button on each oil palm and biodiesel administrator page is used to update data. The box form in Add Data tables is shown in Figure 11.

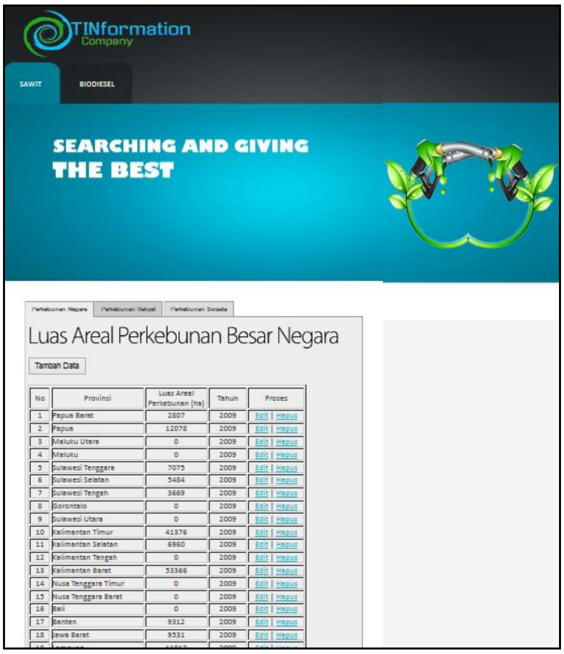

Fig. 10. Oil palm administrator page

Tables in Administrator Biodiesel menu are similar to those in Administrator Oil Palm menu. Yet, biodiesel data are taken from the whole country. Edit and Erase options in ‘process biodiesel production’ columns are used to modify data. This function is also available in the administrator page.

Add Data form in Figure 11 has 4 boxes to be filled in with name of province for plantation area and oil palm production on the provincial basis and name of regency and oil palm production on the regent basis. There are also Plantation Area (ha), Production (ton), and Year boxes.

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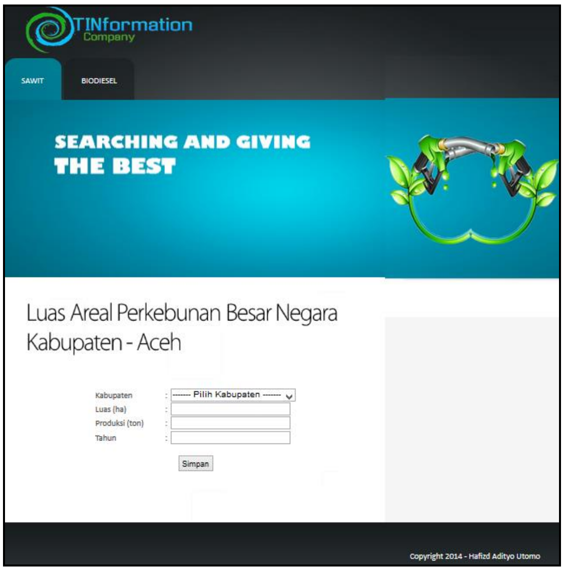

Fig. 11. Add Data form display

The Save button is used to store data that are already filled in to the Add Data form. Each table on the administrator page is connected directly to the database in the computer.

D. *System Implementation*

The implementation stage is a coding stage to materialize the existing design into an information system. The followings are done in this stage.

1. Software are procured to create a good web-based information system. The required software include Adobe Dreamweaver CS 6, Adobe Photoshop Portable, XAMPP 1.8.1, Microsoft Visio 2010, and Web Browser (Mozilla Firefox, Google Chrome, and Internet Explorer).

2. Coding is a programming activity to convert the whole design into a system device that fits users' need. All programming activities and database development are done on Windows 8 operating system. This web-based information system is developed by using Adobe Dreamweaver CS6 on a PHP programming basis.

3. After the coding activity is finished, the system is installed to the internet web so that the accessibility of the system can be tested. The system accessibility in Web Browser (Mozilla Firefox, Google Chrome, and Internet Explorer) is tested.

E. *System Maintenance*

This is the final stage in a system development system (SDLC) consisting of system monitoring, evaluation, and modification. System maintenance is done during and after the designing process.

The developed system is still in prototype form. Therefore, for system maintenance stage, only monitoring activity is done when performance test and evaluation are conducted. Modification is then done to make the developed system fits user criteria.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. *Conclusions*

This web-based information system is able to visualize tables and graphs that fit user need of an easy search for information on oil palm production, biodiesel production, and oil palm plantation area. The implementation of the analysis of greenhouse gases emission value with a land use change which has been previously integrated in the Microsoft Excel format by GEF is successfully done on a web basis.

B. *Recommendations*

Further studies on the development of an information system with different system approach, different information contents, and additional analysis modules of greenhouse gases emission calculation are recommended.

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