Weeds e-Catalog as a Tool for Identification of Weeds in Plantation

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Abstract. Weeds are one of the organisms that interfere with plant growth. Information about the identity of weeds becomes very important on plantations. Although weeds data digitization has been done a lot, currently there is still not much weeds data information system can be accessed online. Weeds management is often dealt with weeds herbarium or weeds photographs. In an effort to provide a good information system for farmers, this research aims to create a database of various types of weeds and an information system that can be accessed online. The methodology for developing a weed catalog information system uses the Software Development Life Cycle (SDLC). Weed samples in database were collected through systematic random sampling in the form of images and text. The result of this study is a Weeds Electronic Catalog or Weeds e-Catalog that can facilitate the information of weeds identity such as names, classifications, morphology, life cycles, and habitats of various types of weeds that grow on plantation land. Weeds e-Catalog can be used by plantation practitioners and farmers to make decisions in controlling weeds.

Keywords: Weeds, Identification, Weeds Management, System Information, Electronic Catalog

1. Introduction
Indonesia is a tropical country, this climatic condition supports the growth and production of several superior plantation commodities such as sugar cane, tea, tobacco, rubber, coffee, cocoa, oil palm. Management of plantation commodities must be in accordance with Good Agricultural Practices (GAP). One of the GAPs applied in plantation management is controlling plant-disturbing organisms such as pests, pathogens and weeds. Weeds is one of the disturbing plants which is a detrimental plant that grows around cultivated plants. In contrast to pests and plant pathogens, the effect caused by weeds is not seen directly and runs slowly, but accumulatively there are a lot of losses [1].
Losses incurred to crops can be directly or indirectly. The direct disadvantage is that weeds become plant competitors in utilizing nutrients and water. Competition occurs because weeds are able to adapt to a limited environment of water and nutrients. Weeds become easy to grow and breed. Indirect losses are weeds that disrupt the operations of the garden and host plant pests. The variety of weeds vegetation that grows has different characteristics, as well as different negative impacts. Different characters in each weeds vegetation require different control methods. Weeds vegetation analysis is needed to determine the various types of weeds that grow on a plantation. Vegetation analysis aims to see the absolute density, absolute frequency, and absolute dominance of weeds species, in order to obtain the value of Summed Dominance Ratio (SDR) of weeds that grow in a field. The SDR value is used as a basis for weeds control according to the dominant group. Weeds can be grouped according to morphology and life cycle. Weeds morphology consists of 3 types of weeds, namely grass, pitcher, and broad leaves. Weeds life cycle consists of 3 types of weeds, namely annuals, bi-seasons, and annual [2].

Weeds control aims to reduce the number of weeds that are harmful or detrimental to plants, as long as weeds have not been harmful and detrimental then the control time can be postponed. Weeds control in principle is an attempt to increase the competitiveness of plants and weaken the competitiveness of weeds. The superiority of plants must be increased in such a way that weeds are unable to develop their growth side by side or at the same time as cultivated plants [3]. Before carrying out weeds control activities, an analysis of diversity and dominance of weeds in a land needs to be done to obtain quantitative data that are used as a basis for effective and efficient weeds control policies [4]. Weeds identification according to morphology and life cycle is needed as initial information in carrying out weeds control activities on target, right dose, right way, right type and on time. There are several methods to reduce weeds populations including preventive control, mechanical control, control of technical culture, biological control and chemical control [5].

Technological progress is something that cannot be avoided in this life, because technological progress will go according to the progress of science. Every innovation is created to provide positive benefits for human life, one example is an evaluation and monitoring system to ensure effectiveness [6]. Technology also provides many conveniences, as well as a new way of doing human activities. Humans have also enjoyed the many benefits brought about by technological innovations that have been produced in the last decade [7]. Technological breakthroughs in the fields of microelectronics, biotechnology, telecommunications, computers, Internet, virtualization in cloud computing [8] and robotics have fundamentally changed the way we develop and transform technology into production sectors that produce goods and services with high technology [9]. In the agriculture or plantation sector, several studies have been carried out to apply the latest technology, such as fuzzy logic in coffee processing [10], high quality models help select optimal rice varieties for expected field conditions [11], the use of AI (Artificial Intelligence) for plant counting [12,13], fruit maturity classification [14], analysis of plant pattern [15], and genomics research [16]. Therefore, research in utilizing technology is needed to assist operational processes in handling plant pests, for example weeds data processing. The use of information technology in processing weeds data is expected to contribute significantly to farmers.

Information is one of the three basic resources besides material and energy potential. Agricultural Knowledge and Information System is a necessary instrument for increasing productivity of commodities [17]. The information revolution, usually understood as changes produced by information technology [18]. The diversity of weeds can be a good source of data for the development of weeds handling through technology assistance. Weeds identification or weeds data is currently summarized in a book. But to find a weeds specification in the book will be quite time consuming. Therefore, we need a system to get the information we need in ways and processes that are easy and efficient. By accessing data that has been recorded into the database, we can search for a type of weeds and handle it by only knowing certain characteristics of the weeds. In an effort to provide a good information system for farmers, this research aims to create an electronic database of various types of weeds and an information system that can be accessed online. The results of this study is a weeds Electronic Catalog or Weeds E-Catalog. By combining knowledge of weeds that can be summarized into an electronic catalog, it can help us in identifying a weeds by recording weeds data that are complete and manageable in a database.
2. Research Method

The aims to develop a Weeds E-Catalog. Weeds E-Catalog is an electronic database of various types of weeds and an information system that can be accessed online. The research method used in the study is the Software Development Life Cycle (SDLC) with the Waterfall model. Waterfall model was proposed by Winston W. Royce in 1970 to describe a possible software engineering practice [19]. In this model, the components in the software process are arranged as a linear sequence [20]. SDLC consists of 5 stages, namely (1) Requirements Definition, (2) System and software design, (3) Implementation, (4) Testing & Integration, and (5) Maintenance. Figure 1 shows the SDLC with the Waterfall model from Sommerville [21].

![Waterfall Model](image)

Figure 1 Waterfall Model [1]

This paper only presents the first 3 stages in SDLC, they are (1) Requirement Definition, (2) System and Software Design, and (3) Implementation. In the Requirement Definition stage, all requirements of the software products are gathered [22]. This paper reviews data related to weeds that often cause problems in a plantation. The results of this stage are in the form of a data dictionary related to weeds. The next stage is the stage of database design and application. The application consists of backend and frontend. In the next stage, the third stage is implementation. The database used is RDBMS. Front end is built using HTML, CSS and JavaScript, while back-end development uses PHP.

3. Result and Discussion

3.1. Requirements Definition

In creating a Weeds database, it is necessary to analyse the data related to Weeds. These data are organized into a data dictionary in the form of a structured table and makes it easy to do the search process. Table 1 shows the data dictionary related to weeds. This data dictionary consists of 3 fields, namely the main criteria, and 2 sub criteria. From the process of analysing data related to weeds, there are 13 main criteria. The main criteria include, namely: Weeds Names, Weeds Local Names, Family, Leaves, Stems, Roots, Flowers, Generative, Vegetative, Pictures, Life Cycle, and Morphology.

In accordance with the purpose of developing this e-Catalog, the e-Catalog application must be accessible online by the user. In this study, the use of web applications is the first choice. This choice is based on the consideration that the application can be accessed from all multi-platform tools with an
Internet browser. The use of a web-based application is expected to make it easier for farmers to access this e-Catalog application.

### Table 1. Weeds e-Catalog Data Dictionary

| Main                          | Sub Criteria                  | Sub Criteria                          |
|-------------------------------|-------------------------------|---------------------------------------|
| Name of weeds                 |                               |                                       |
| Local name of weeds           |                               |                                       |
| Families                      |                               |                                       |
| Species                       | Leaf Shapes                   | Linear; Palmately; Cordate; Ovate; Oblong Circular |
|                               | Leaf Margin                   | Entire; Crenate; Dentate Double dentate; Serrate Double serrate |
|                               | Leaf Vonation                 | Furcate; Palmate; Pinnate; Parallel   |
|                               | Leaf Surfaces                 | Smooth; Slick; Coarse; Scaly; Hairy   |
|                               | Arrangement on the stem       | Whorled; Alternate; Opposite          |
|                               | Stem Form                     | Round stem; Hollow stem; Solid stem; Flat; Angular |
|                               | Cambium                       | Cambium; None                        |
|                               | Branches                      | Branches; None                       |
|                               | Numbers                       | Multi flower; Uni flower              |
|                               | Position                      | Palt terminalis; Plant axilla         |
|                               | Color                         | Yellow; Orange; Red; Green; Blue; Violet; Pink; White; Others |
|                               | Roots                         | Type; Fibrous roots; Tap roots        |
|                               | Propagation organs            | Type; Sexual/generative; Asexual/vegetative; Both |
|                               | Vegetative organs             | Type; None; Rhizome; Tuber; Bulb; Corn; Stolon; Runner |
|                               | Life cycle                    | Type; Annual; Perennial; Not both     |
|                               | Morphology                    | Type; Grasses; Sedges; Not both       |
|                               | Habitat                       | Type; Dry; Wet; Aerial                |
|                               | Picture                       |                                       |

3.2. **System and Software Design**
The database on the Weeds e-Catalog is compiled using a relational database. The database design has been made based on the data dictionary at the requirements stage. Figure 2 shows the database design that has been developed.

Figure 2. Weeds e-Catalog Database Design

Figure 3 shows the design flow of the Weeds e-Catalog application developed. Overall, the Weeds e-Catalog application consists of 5 main features. The main features consist of (1) searching, (2) uploading, (3) home, (4) testimonials, and (5) about us. In the upload and testimonials feature, users need approval from the admin to do the next step.

Figure 3. Design flow of the Weeds e-Catalog

3.3. Implementation
The application consists of backend and frontend. In this stage, the database was created using MySQL. Frontend was built using HTML, CSS and JavaScript, while back-end development uses PHP. The result from this stage are showed in figure 4. Figure 4 showed weeds search engine user interface as the main feature of weeds e-catalog.

![Gulma Search Engine](image)

**Figure 4. Weeds e-Catalog Interface**

4. Conclusion
Weeds e-Catalog is one way to facilitate the information of weeds identity. Weeds e-Catalog is an online electronic information system that consists of a collection of names, classifications, morphology, life cycles, habitats of various types of weeds. The application can be used on various devices such as laptops, PCs or mobile because it is based on web applications and only requires a browser to access it. There are 2 (two) user choices, namely admin and visitor. Weeds e-Catalog web application is running well, from uploading data to weeds data searching. Existing data can still be developed and has the potential to become a complete database so that it can be used as a learning media or a complete weeds information system.
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