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Support System for Irrigation Development in SRI (The System of Rice Intensification)

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ABSTRACT— ***The development of paddy seen on more paddy production through conducting methodic SRI has increased and gotten to economize irrigation. To word technology a new one therefore needful technological system sighting already been looked on well-established and adjusted by mean's concept a new one. In this case how SRI'S farming system that constitutes resource's technology system water at transforms into irrigation system already by society all this time.***

Keywords— SRI, irrigation, water balance

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1. INTRODUCTION

Water resources are part of the natural resources that are needed for life, both human and other living things. Recently, there is an increase in demand for water resources. Competition in the utilization of water resources is always increasing along with population growth, physical changes, and social and economic consequences that occur as the national development. In the spatial area of the river, the increase of competition is visible, such as for irrigated agriculture and other non-agricultural purposes such as industry, tourism, and including the needs of everyday household.

The shift of global climate and changing in the demands of water resources utilization and the environmental damage of river bank area, has contributed to a change in the behavior of water resources such as drought and floods. To address changes in developing sustainable water resources should be held with the approximation of anticipation of the possibility that will occur from the changes. On the other hand one of the missions in the field of water resources development in support of food security is through improving the function of irrigation networks that have considerable potential in the national food supply and economic development of farming communities.

In line with the program, early in year 2000, it has been developed agricultural system of SRI (System of Rice Intensification). It is a rice cultivation technique that can increase rice productivity by altering crop management, soil, water and nutrients. This method has been proven successful in increasing the productivity of rice by 50%, even in some places reaching more like the Sukamandi the 1999-2000 season with the 9.5 tons / ha, whereas in conventional rice farmers of around 5.9 to 6.9 tons / ha.

Provision of water in agricultural systems are not pooled SRI granted, but to wet condition until wetness condition (for the clay-textured soil) so that SRI farming systems require far less water than rice farming systems in the conventional fields. According to [2], conventional rice cultivation water needs (i) 150 mm for soil processing and (ii) 1000 mm for the plant. Therefore, the total demand is around 1150 mm (11,500 m 3 of water per hectare per season). While SRI farming system changes occur in the water needs for plant growth of about 600 mm, a total of about 750 mm (7500 m 3 of water per hectare per season). If it uses a water pump, price USD $ 1000 / m3, the value of irrigation water in conventional way is approximately USD 11.5 million and at SRI approximately USD 7.5 million /ha/season. Thus, by using the agricultural system of water-saving SRI results on saving 4000 m 3 of water per hectare or 34.7%.

The existence of water-saving opportunities through agricultural systems SRI, approximately 34.7%, [2] there will be a shift in the pattern of utilization of water resources for irrigated agriculture that is a water user in a very large proportion compared to the use of other sectors, becoming the pattern of irrigation water usage based on crop water requirements on time, number and space. To support this policy, it requires support in changing basic irrigation management, ranging from the technical aspects associated with the concept of equivalent technology, to the socio-cultural aspects related to the change in the related attitude of the actors (farmers).

2. IRRIGATION SYSTEM IN INDONESIA

As stated [7] that the conduct of the management of irrigation systems from the colonial era to the present almost no fundamental changes, such as in irrigation planning based on the book of KP-01 in 1966, which is calculated based on the service supply irrigation water from rivers and rainfall rain with a 80% chance of occurrence, using the 20- year series of data or more. Assumptions used in this system are that in a period of five years, there is a failure in one year, and thus this condition is considered as a natural occurrence. The problem that arises is when one fails, either the early years of the fifth year, the middle or end of or distributed throughout the year (this can not be ascertained).

As a result of such planning can not be used to assess the truth and fidelity performance of irrigation management, and even deviations occur frequently in irrigation management performance, especially in the provision and distribution. As an example in the event of droughts or floods, the management is only used as a justification to declare the cause of climate irregularities. So the main issue in the planning of irrigation is the result of the raw data errors are used to make assumptions, resulting in decreased water use rights guaranteed because of uncertainty re- occurrence patterns of water availability in the dam.

Problems in irrigation management system is now also evident in the provision of water resources data from the weather gauge, hidrometri that these tools have a lot of damage, never re ditera position or location of the hydraulic tool is not appropriate, nor sense of responsibility officer low so that the water resource data used irrigation management is very weak and does not describe the real situation. So that the irrigation management system like this will not guarantee water.

Further problems in irrigation management system is the gap between the technology used by the mastery of know-how or software is very low, as in the management of water supply and its distribution is very sophisticated in the world for size, while the ability to know how do not support, so what you want to achieve in the management irrigation will be far from his target.

Another problem, especially in irrigation management in water supply planning and the like which way its distribution does not directly involve farmers, farmers only to be told either individually or in groups were told only that the planting pattern to follow in the next planting schedule and rationed water debit.

From the above issue is quite clear that the concept of irrigation systems in Indonesia is not in harmony with the water scarcity situation and can not be relied upon to support the pattern of irrigated agriculture is dynamic, as in the development of SRI farming systems.

SRI farming systems require water from irrigated intermittently to meet the water needs so that they can; (i) create a good soil aeration, as a result that can prevent the formation of toxins, (ii) conserve water so that there are opportunities to expand irrigated acreage or utilized for the needs of non-agriculture, (iii) reduce the drainage problems, and (iv) to get water will be ensured both in the dry season, as long as water is available at the source.

As the positive impact of the SRI program, especially irrigation systems support the implementation of O and P in the development of irrigation farming system SRI system will differ from conventional farming. That requires the reliability of irrigation infrastructure are realized through increased activity, and management of irrigation networks to support the program SRI farming in irrigation management need improvement through (i) planning (Planning) (ii) design and construction (design) (iii) improvement of basic data (iv) completing or improving the calibration and contrition of measure means (v) increasing the sense of responsibility with respect to the officers irrigation in charge of measuring the flow and weather data collection (vi) operations, (vii) maintenance, (viii) rehabilitation of irrigation networks, and (ix) need to be changes in irrigation management institutions so that farmers have a range of decision-making, especially in water supply and distribution.

3. DEVELOPMENT OF THE FARM SYSTEM DEVELOPMENT IS BASED SRI WATER CONSERVATION

System of Rice Intensification (SRI) first developed by accident in Madagascar between the years 1983-1984 by the French Jesuit monk named FR. Henri de Laulani, SJ By, a discoverer, this methodology further in French called Le Syst me de Riziculture Intensive abbreviated RSI. In English, popularly known as System of Rice Intensification abbreviated SRI [8]. Before the year 1999 SRI only known and practiced only in Madagascar. Currently tested in nearly 30 countries with production SRI approximately 7 to 10 tons of dried grain harvest (GKP) / ha. SRI paddy cultivation method developed in the province of West Java since 1999. Until the year 2007 has been practiced by 5000 farmers in the area of 650 ha after as many as 125 armed training.

According to [10], the benefits of SRI activities in Indonesia in addition to covering a culture of water saving irrigation and rice production increased, also includes other benefits in the SRI method: 1). Saving seed 80%; 2). Saving 100% chemical; 3). better rice quality; 4). age shorter rice; 5). ecological better; 6). more harmonious social life (no conflict of water); 7). Making LMO (Local Micro-organisms) by farmers; 8). Organic fertilizer.

Furthermore the thinking of groups such as the Director of irrigation practitioners Director General of Irrigation Water Resources Department of Public Works M.Hasan (2007) which, compared to irrigation development requires funding for Rp20-30 million per hectare, increasing rice production through agricultural intensification SRI method is much cheaper, live how we change the behavior and culture of the farmers.

SRI farming system is quite unique, that can work on water-saving irrigation and also produces higher rice production to generate efficiency benefits of water (EMA) of about 200-300% of conventional rice. The water intermittently way on SRI farming system aims to create circulation in the area aerate roots, so that this condition will allow the root area of life increases the bacteria in this way will help to improve soil ecology. As a result the growth of shoots much more and resulted in increased number of panicles. However, SRI method does require more intensive efforts than conventional e. q the frequency and interval of irrigation water delivery, the frequency of weeding grass, organic fertilizer, creating a local micro organisms [10].

Besides the advantages of SRI methods as mentioned above, according to [10] SRI farming systems has minus value that is: requiring a lot of energy, causing a single plant vulnerable to pests, having difficulty in obtaining materials for the organic fertilizer, and the necessity of planting simultaneously in one block quarter.

Furthermore according to [5], the results of field research in Jembar Works Farmers Group I, the village Margahayu, MANONJAYA district, Tasikmalaya districts in the implementation of SRI in the irrigation area is cross-sectoral activities, integrated between: (a) the conservation of watersheds through GERHAN (Forestry offices) , (b) infrastructure, irrigation and drainage networks (PSDA offices and Agriculture), (c) the agricultural road network (PU office and Agriculture), (d) development of livestock (including worms) and areas of grass fodder crops (department of Animal Husbandry), (e) Bio-gas installation in the farm area (department of Animal Husbandry), (f) credit system software (services Cooperative), (g) the location of provider of market organic waste (Environment office), (h) count machine grass / hay (department of Agriculture), (i) mixing machines (department of Agriculture), (j) cultivator (department of Agriculture), (k) manure spreader machine (service Agriculture). This all is a challenge for expert irrigation, animal husbandry, agricultural engineering, forestry, fisheries within the umbrella of a regional development program.

From a few thoughts about the development of agribusiness in the field of SRI, which became the subject matter of the application of SRI methods in the field is required several ways or methods in order to adjust for income levels of farmers. Apart from some doubts about the success of SRI practitioners who can produce the production increase at the same time can save irrigation water. Some farmers also declined SRI method of paddy cultivation. Even the polemic that developed in the United States mention SRI methods is UFOs, unconfirmed Field Observation. This situation needs to be done in the laboratory and research field to search for a compromise solution that SRI methods can be standardized in Indonesia and accepted all the parties. This research is also intended to confirm the success of SRI that can be accepted internationally.

4. SUPPORT THE DEVELOPMENT OF IRRIGATION SYSTEM SRI

Some thoughts on the development of rice cultivation with SRI method of rice production increased and more water saving irrigation is logical and can be explained scientifically. But in the implementation of the study should be noted that the technological change can happen if the technology is interpreted differently by the meaning previously. That is, a technology accepted by the community for many years or were hereditary is a technology that is considered established and have no doubt for the users of these technologies. So to explain the new technology will require a review of technology systems that have been considered well-established and adjusted to the new concept of meaning. In this case how the farming system that SRI is a system of water resources utilization technology is transformed into the irrigation system has been understood by the public for so long.

According to the [9] irrigation system is defined as a set of physical elements of the social and used to obtain water from a natural source of concentrated, facilitating and controlling the movement of water from a source to the land or other land cultivated for agricultural production or other crops, and spread to the (zone) roots of irrigated land.

Meanwhile, according to [6], the irrigation system is a socio cultural system of society, which consists of several sub-system of sub-systems or cultural mindset, social and economic sub-systems; sub-systems artifacts (including technology) and sub-systems are not human. Meanwhile, SRI farming systems can be described as a system with a form of increased yield and water saving technology is a concept worth the SRI farming systems should refer to the constituent elements of such systems techno- ware, human-ware, organo-ware and info- ware. Therefore, it will be obtained SRI farming systems commensurate with the worth of irrigation systems as well. Technology means that all constituent elements corresponds to each other to operate in harmony with environmental constraints of each region biophysical and social environment that can support public welfare and sustainable. So SRI farming systems that will be transformed is the re lationship between the elements in the system that SRI is a technological system of water resource utilization is very complex. Some of them contain quantitative values, such as the elements of physical or material, and others contain qualitative values, for example, the elements which are the mindset of farmers and social behavior. To see the connection system that SRI system is a system of water resources utilization technologies and irrigation systems, as in Table 1.

Table 1: The relationship between the system that SRI is a technological system of water resources utilization and irrigation systems.

SRI system (system utility) Water Resources	**Technology System**				
	Tekno-ware		**Human-ware**	**Organo-ware**	**Info-ware**
	Software	Hardware			
1	2	3	4	5	6
Energy	- Head - Debit	Building energy breaker - Irrigation network - Building complementary - Agricultural land - Drainage	have an understanding and skills in managing the energy that can damage the irrigation bagunan that can be utilized.	Institutions or organizations that can and operate energy mengelolaa	Information relating to the energy that has the character damage can be managed s that it can be used, which is limited b the high places, topography forms
Period (material)	Quantity: flow patterns in accordance with the provision of water intermittently	- Agricultural Land - Building for the quarter is controlled according to requirement	Skills in organizing and agihan amount of water resources in accordance with the needs of	How can regulate the water there can be adequate yanag	Risk of uncertainty, because Indonesia has a tropical climate wet Moso
Time	- Magnitude - Frequency - Planting Pattern - JadwalTanam - Intensity of Cultivation	Building pengendal for irrigation and adapt to climate conditions	Skill in determining the water needs	Coordination between system	Efficiency and optimization
Room	Water gravity (surface soil) and below the ground surface and the suitability of land	Need a storage, as the anticipation of the dry season drought	Skill in making the existing water, to flow into agricultural land	How to provide water in accordance with the amount and the right time.	Ingenuous knowledge in an effort to bring water to agricultural land according to his needs
Diversity (Diversity)	- Security - Transfer - accountability to Water rights in the context of diversification	Pool mina paddy surjan	Skills and knowledge related to water rights	Regulate the utilization of water	Balance utilizatior
Economic Value	Suplus in productivity, efficient in the utilization of water resources	Simultaneous planting quarter level	Public understanding of SRI, which his welfare.	Accountability	Market Information

This research, produce and design the form of irrigation system management to support the agricultural system of SRI. Through specific methods that approach will wake up the performance of a new irrigation system, on the basis of crop water requirement and irrigation water use patterns on time, number and space. In the face of a fundamental change from the conventional irrigation system (pooled, and *continuous flow),* then irrigation is one of the main production facilities should be improved if supletion ability as effective rainfall can not meet crop water requirements for rice (technical terms of bethatan[1] at the time the rice was in need of water). To respond to these challenges the existing irrigation systems are currently not sensitive to lack or excess water, this condition is contrary to the requirements of SRI farming systems. In addition to the condition of irrigation design today also can not be supple *(flexible)* to various climate change.

These conditions has been demonstrated from the results of research conducted in Koto Tuo Irrigation in Padang city region, on the location of tertiary P3A Koto plot consisted of 6 Pulai farmer group, namely KMC, Mulia, Melati, Berkah, Basung Sepakat I, and Basung Sepakat II with a total area 192.5 ha. At this location began planting crops on 11 April and harvested on August 9. Crop water needs in the growing season I was in the amount of 4:43 mm / day (0.19 l / s / ha), effective rainfall 5:06 mm / day (0.27 l / dt / ha) during the planting season means the water needs for SRI farming systems have been met by effective rainfall, then why on this site is still in need of Irrigation. From the observations to meet water needs during the growing season months of April to August of irrigation water needed 23.28 mm / day (1.044 l / dt / ha), of the existing water balance appears that the amount of water needed is much greater than the water requirements of plants, it is quite clear that in this growing season rainfall distribution is uneven, there occurs so bethatan current is needed for irrigation water.

In addition to observing the balance of water and water potentials in Koto Tuo, this study also studied the performance of irrigation systems such as, (i) channel density between 6.79 to 7.46 m / ha long means that comparisons with the broad channel that flows through this, so water distribution does not go well, this proved water flow field in this region farmers fetch water from the tertiary channel and then flow through the inter row and another patch without channel, (ii) for building and building for the tapping of his condition "minor damage "This damage has not affected the activities of farmers. Damage occurs due to lack of maintenance is done such damage to buildings located on the door for treatment. Rusty door for some even is no longer functioning as BP.3. In addition, there are a lot of garbage on the building and building for the tap.

Various kinds of needs must be met by irrigation systems in order to increase productivity in the utilization of water resources to support SRI farming systems, which deal with the physical facilities that do not support because it is historically different from the function and purpose and under conditions that are different. This may happen because the physical facilities of existing irrigation systems are not sensitive to the scarcity of water, so to be operated to meet water needs in accordance with the rationing and planned of distribution is difficult to do.

From the preliminary investigation (Phase I) obtained a variety of technical problems in supporting irrigation farming systems of SRI at the tertiary network far more than the main net (primary and secondary), including the issue of support existing irrigation network in the tertiary patch does not match the standard value of the irrigation network performance stating physical fitness and ability to network operation and maintenance (O & P) irrigation. In addition to the technical problem of irrigation management systems, irrigation networks of physical weakness and low knowledge and inadequate skills to operate a network, it will lead to the ability to guarantee the certainty of water rights to the irregularities that occurred climate can not satisfy the farmers' SRI farming systems. So until the end of this study, farmers still doubt if the system is running if there is no water in the irrigation network there will be crop failures.

In addition to the above issues at the regional autonomy era, irrigation management institutions are not very conducive to achieving the realization of target operation and maintenance (O & P), it is proved that in 5-year period, there was no activity on O & P IN this so early in the irrigation dam of Koto Tuo collapse in 2009, and in mid-August the collapse of the dam has been repaired again due to collapse of a heavy flow of cold water stem.

Various problems of irrigation development in support of SRI farming systems discussed in this research and possible functions and purposes of completing irrigation systems perspective on time, number and space. Thus, in the first stage of this study can be summarized as follows;

1. In an effort to improve food security through SRI farming systems and conditions of the irrigation system design today is still oriented as water delivery and not sensitive to water scarcity or excess water, means that the irrigation system that is currently still on target to drain the water source and not flexible in the event of excess or shortage of water. This situation will become an obstacle to the development of SRI farming systems.
2. Design of the door that has not been intercepted tertiary able to be used as a divisor in measured water, this is one of the main causes of water use efficiency is low.
3. Although the design of irrigation networks have been directed to support food security through SRI farming, but the reliability and feasibility of networking services as a whole are not adequate to be used as a means for water providers SRI farming.
4. From the aspect of irrigation system management institutions have not been able to provide opportunities for P3A or GP3A for (a) determine the allocation and distribution of water, (b) determine the pattern and type of crop planting to be cultivated, (c) share the risk of loss or failure of farming because of the inability of water services and, (d) In the era of decentralization of irrigation O & P is not done properly, because most of the budget funds siphoned off by the salaries and election officials.

Changes in conventional farming systems to the SRI system, it needs the support of management changes in irrigation systems, ranging from technical field associated with equivalent technology needs, to social field related to cultural change in attitudes of the perpetrators. The above changes in terms of managing the irrigation system management in SRI farming systems can not be fulfilled without any training activities with the primary goal to change the attitude of a person (farmer) in implementing SRI farming to irrigation, and make the design of irrigation systems to support SRI farming systems with stakeholders to set the design form of irrigation systems as expected. Implementation of this will all be done in Phase II studies with the superficial, in the form of the proposed design and management of irrigation systems in accordance with SRI farming systems. At this stage will be reviewed and developed to be used as a guide in changing design and management of irrigation systems to support SRI farming systems with a wider scale.

[1] There is a certain period does not occur rain exceeded 15 days

Therefore, it bases on the matrix relationship between the system that SRI is a technological system of water resources utilization and irrigation technology systems based on **agro-system of socio-technical.** The shape changes of this transformation process can be used as a learning design in the adjustment of one element of the technical transformation and adjustment of irrigation management as a process of human, financial and information in support of community welfare and sustainable. For the existence of information about the transformation process and its impact on carrying capacity of irrigation systems, both externally and internally need to be further investigated.

From observation and performance characteristics of the irrigation network to support SRI farming systems refer to the elements making up such systems *techno-ware*, *human-ware*, *organo- ware* and *info-ware.* It needs the completion of irrigation infrastructure based on each aspect of technological systems;

1. Techno-ware **:** concerning the willingness of hardware ***(hardware)*** and software **(Softwere)** of the software aspect, the management of irrigation systems have been set by Government Regulation No. 20 of 2006 on Irrigation, and then a regional government regulation Irrigation, the local wisdom that accommodate need to be reviewed, especially in the following substances: (a) the right to use water that can be transferred from the main tap to building the individual level. (b) SRI farming uses less water, from farming systems that have grown conventionally in the culture of water saving irrigation, and (c) requires certainty to get water for farmers who have supported stronger regulation so that no one harmed.
Hardware aspects of the condition of the building and the irrigation network at the tertiary level plot to quarter, not yet able to be used as a divisor in measured water, is one of the main causes of water use efficiency is low mapped. This can be seen from the reliability and feasibility of networking services as a whole has not quite adequate in supporting SRI farming systems.

2. Human-ware ; concerning aspects of understanding, knowledge and skills of people involved in the utilization of irrigation water resources; it is seen in; (i) the tendency of farmers to store water in the mapped fields for the existing irrigation system does not guarantee certainty for water, (ii) no planting schedule that suits to the plan drawn up by the government with the conditions in the field because farmers use their own schedule in accordance with reality and the empirical experience of water sufficiency, (iii) construction and placement error measurement and low sense of duty officers so that the data flow meter provided does not describe the actual conditions and, (iv) operation and management of irrigation networks are inadequate.

3. Organoware, concerning the existence of organizations and institutions that is benefited by irrigation water resources, with a system which regulates relations between the parties involved. This means that existing institutions have not been able to provide an opportunity to P3A or GP3A for (a) determine the allocation and distribution of water, (b) determine the pattern and type of crop planting to be cultivated, (c) share the risk of loss or failure of farming because of the inability of service water and, (d) in the era of decentralization, irrigation O & P is not done properly, because most of the budget funds siphoned off by the salaries and election officials.

4. Infoware, regarding the availability of information systems and the fact that transparent, as realization attached to documents relevant to the operation and maintenance of irrigation networks. There are deficiencies or weaknesses that occur in this condition particularly in collecting hydrometric data that will be used in planning irrigation operations that will be used to manage water supply and distribution. Besides the support measure, hydrology measure tools that does not work properly anymore and also less support responsibility of staff gauge readers toward the data provided do not represent actual situation.

This paper has discussed the development of thinking and describing the support of the irrigation system in the development of SRI farming systems. From this description can be drawn in concrete, several related to the transformation of farming systems SRI into irrigation systems, among others;

1. Improvement of basic data for planning and design of irrigation systems.
2. There needs to be adjustments to the system design technology, water-efficient irrigation through rice cultivation with SRI method and harmonize with the cultivation of crops and horticulture.
3. There needs to be adjustments to the irrigation management system of farming program at SRI tertiary plot.

4. Legal support, legislation and policy on design and adjustment of irrigation management
5. Need to study the adoption of farming communities to adjust design a new irrigation system.
6. Change in the attitude of the executive management of irrigation in farming SRI will not possibly be fulfilled without an increase in the ability of the implementers *(capacity building)* through training activities.

With water-saving irrigation technologies through rice cultivation with SRI system, then the problem of irrigation as the largest water users is nearly 85% and efficiency only ranges between 40 and 60 percent can be overcome. Because of previous research using the SRI system of irrigation, water savings opportunity is about 34.7% (see, [2]). So, the problem of water scarcity will be overcome, if viewed in the context of the river along with some irrigation areas have water saving technology, the water that had been used excessively and used what, where and when?.

Based on the above matter to follow-up and to make the management of water resource, it uses within the river area in an efficient and sustainable. Accordingly, increasing the ability of communities *(stakeholders),* the management and utilization of water resources is a necessity for efficiency aspects and aspects of sustainability management and utilization of water resources can be guaranteed *(certain).* The question now is how to increase the ability or capacity *(capacity building)* human and institutional resources in the management of water resources in the river area in the implementation of Operation and Maintenance of Irrigation and River Region, in support of SRI. The implications for the implementation of SRI program in conjunction with the operation and maintenance of the river and the irrigation area and the optimization of water resource conservation.

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