

Protection Strategies on Irrigated Farm Using Analytic Hierarchy Process

Novi Pramana¹⁾, Suci hatiningsih Dian Wisika Prajanti²⁾,

^{1,2} Economics Faculty, Semarang State University

Corresponding Author: dianwisika@yahoo.com

Received: April 2018 | Revised: September 2018 | Accepted: November 2018

Abstract

This study aims to determine the strategy in the protection of irrigated rice fields in Semarang regency. This study uses a method of Analysis Hierarchy Process (AHP) with a purposive sampling technique to collect 10 respondents. A protection strategy on irrigated farm lands in Semarang Regency consists of several criteria with a prioritized program criterion of sustainable land and water utilization (0.322). The following criteria are optimization of irrigation network performance (0.241), law (0.186), economy (0.160), and social (0.091). There are some suggestions after conducting this study, such as providing education and socialization of legislations of law on farm land protection especially the irrigated ones, construction of reservoirs and dams, utilization of organic materials on farm lands management, irrigation network rehabilitation, strengthening legislations on protection of farm lands, authorities' closer controls and supervisions, facilitation in obtaining agricultural inputs to improve welfare by empowering families, owners, and managers of those irrigated farm lands, as well as escorting policies on layout and regional plans to maintain the wide agricultural areas of irrigated farm lands.

Keywords: Protection Strategy, Irrigated farm lands, Analysis Hierarchy Process (AHP)

JEL Classification: O13, Q12, Q13

How to Cite: Pramana, N., & Prajanti, S. (2018). Protection Strategies On Irrigated Farm Lands In Semarang District Using Analysis Hierarchy Process. *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi dan Pembangunan*, 19(2). doi:<https://doi.org/10.23917/jep.v19i2.5998>

DOI: <https://doi.org/10.23917/jep.v19i2.5998>

1. Introduction

Economic development is an effort to improve people's lives. To improve living standards, each individual should perform production activities. Indonesia, as a developing country, still depends on agricultural products that the major production activities come from agricultural sectors. Agricultural sector is one driving force sector in regional economic development. The development of agricultural sector as a primary food sector in Indonesia is greatly important for

the development of Indonesia (Jumna, 2015). Agricultural sector has an important role not only in fulfilling the needs on food, but also in providing employment for many people to generate income. In addition, agricultural sector also provides contribution in GDP formation in Indonesia (BPS Indonesia, 2015).

Semarang Regency is an area which one of its focuses on improving regional economy mainly based on agricultural sector. However, population increase results in the

increase of needsonfood, economic activities, and demands for buildings to support the economic conditions that competitions on land utilization are taking place. Thus, the availability of lands for agriculture activities, including farm lands, is reducing as the impacts of competitions in land utilization. Economic development in Semarang Regency through agricultural activities as well as at national level influenceson the fulfillment of needs on food, people who generate income from agricultural sector, its contributions to GDP, and the most important thing is that agricultural sector is a sector producing commodities which are then used as raw and additional materials innon-agricultural sectors.

The existence of land as a place for implementation of development is greatlynecessary. Land utilizationis not separated from its inside part,calledsoil. Soil in agricultural development in Indonesia has a very important role. Soil as a production factor in agriculture also plays an important role in producing agricultural commodities, such as rice. Soil which contains chemical elements are parts of land utilized as a place forthe growth of agricultural crops, including all environmental conditions which consist of climate, water resources, topography, and natural vegetation conditions, which all potentially may influence the land utilization (Rai & Adnyana, 2011)

The agricultural sector's influences result in the efforts to protect agricultural lands, especially the irrigated farm lands in Semarang Regency. Sincefarm lands in Semarang Regencyare dominated by the irrigated ones, their reduction is greater than that of non-irrigated farm lands. According to Adimihardja (2006), one factor accelerating the conversion process of irrigated agricultural lands is rapid development of non-agricultural sectorsin order to obtain those which are ready to use, especially from biophysical and accessibility point of views. The needs

may generally be fulfilled with the irrigated agricultural lands. Off those supporting areas in the surrounding of Semarang Regency, Semarang Regency is a region with the highest decrease of irrigated farm lands in a period 2010-2014 as shown in Table 1.

The wide of irrigated farmlands in Semarang Regencyare almost dominating all the existing farm lands. However, the wide of those irrigated farm lands in Semarang Regency is annually decreasing during a period of 2010-2014 by 1,104.58 hectares, or 6.7% as shown in the following Table 2.

The decrease of those irrigated farm lands occurs annually. Stakeholders' awareness on the decreasing farm lands is greatly required. The conversion of irrigated farm landsmay cause long term permanent although the conversion may no longer exist (Irawan, 2005).Irrigation systems will be vital to help meet future food needs and reverse past environmental degradation, even given higher yields from rainfed agriculture (Mukherji & Facon, 2009). Irrigation networks are the investment forms due to the sustainable needs on food.According to Ilham, Syaikat, & Friyatno (2005), investment is defined as funds to createfarm lands and build dams and irrigation systems. The irrigated farm landsare relatively more productive, and are relatively costlywhen land reclamation is required for residential purposes.

Due to the importance of irrigated farm lands, the government is encouraged to issue a policy through Indonesian Law No. 41 Year 2009 on Protection of sustainable food agricultural land. In Law No. 41 of 2009 on Food Agricultural Lands stipulated as Sustainable Food Agricultural Land is, one of them,in the form of irrigated lands. Thus, the layout existence which supports sustainable food agricultural land protection in each region is greatly necessary.

Table 1. The Irrigated Farm Lands' Wide Areas Surrounding Semarang Regency

Area	2010	2014	Decrease(Ha)
Kendal	25,194.00	24,439.00	755
Demak	33,168.00	33,436.00	268
Semarang	17,706.70	16,602.12	1,105
Grobogan	30,662.04	29,881.00	781

Source: BPS Kendal, Demak, Semarang, Grobogan, 2015

Table 2. Wide of Farm Land Utilization based on Irrigation in Semarang Regency during a period of 2010-2014

Year	Farm Land Utilization					Total
	Irrigation	Non Irrigation			Others	
		Rainfed	Rising and Falling Tides	Valley		
2010	17,706.70	6,679.32	0	0	0	24,386.02
2011	16,646.94	7,336.16	0	0	0	23,988.83
2012	16,603.94	7,317.33	0	0	0	23,921.27
2013	16,602.72	7,316.79	0	0	0	23,919.51
2014	16,602.12	7,316.53	0	0	0	23,918.65

One of those areas trying to implement it is Semarang. By Regional Regulation No.6, 2011 on layout planning system of Semarang Regency in a period of 2011-2031, one of them, contains the prevention of agricultural wetland conversion, especially the irrigated farm lands into non-agricultural lands for cultivation. Based on background of the research problems described, analysis on protection efforts of the irrigated farm lands in Semarang Regency by setting the program criteria which are possible to perform and the prioritized strategies to protect those irrigated farm lands in Semarang Regency.

2. Research Methods

The samples of this study are 10 respondents, here in after referred as key persons collected with a purposive sampling technique. Those key persons' objective competence, knowledge, and

measure are considered and adjusted with this study, covering: Agricultural Office; Agrarian Office; Regional Planning Agency; Regional Secretariat of Legal Section Office; Agricultural Extension agency; Academicians; Chairman of Farmers Group 1; Chairman of Farmers Group 2; Irrigated Farm Land Owners 1; Irrigated Farm Land Owners 2

In order to determine types of programs necessary to be prioritized in the efforts to protect irrigated farm lands in Semarang Regency, AHP method is implemented. AHP is a method of comprehensive decision making by considering those qualitative and quantitative aspects (Suci hatiningsih, 2014). To determine priority elements in a decision matter is by making a pair-wise comparison, that is, each element is compared in pairs against the determined criteria. The pair-wise comparison is in the

forms of matrix. The completion of the pair-wise comparison matrix uses numbers describes the more relatively important elements than the others (Sucihatiningsih, 2014). AHP methodology allows us to determine which alternative is the most consistent with our criteria and the level of importance that we give them (Mu & Pereyra-Rojas, 2017)

3. Results and Discussions

Priority protection of irrigated farm lands is made by selecting the determined criteria, covering land and water sustainability, irrigation network performance optimization, economy, law, and

social. Those criteria are benchmarks to consider or determine anything related to alternative strategies. Of the alternative strategies available in each criterion, the followings are criteria and alternative strategies resulted from the efforts of irrigated farm land protection in Semarang Regency calculated using *expert choice* software.

This suggests that arrangements in good land and water use are a top priority in the strategy of irrigated farmland protection. Without appropriate management, irrigated agriculture can be detrimental to the environment and endanger sustainability (Howell, 2001).

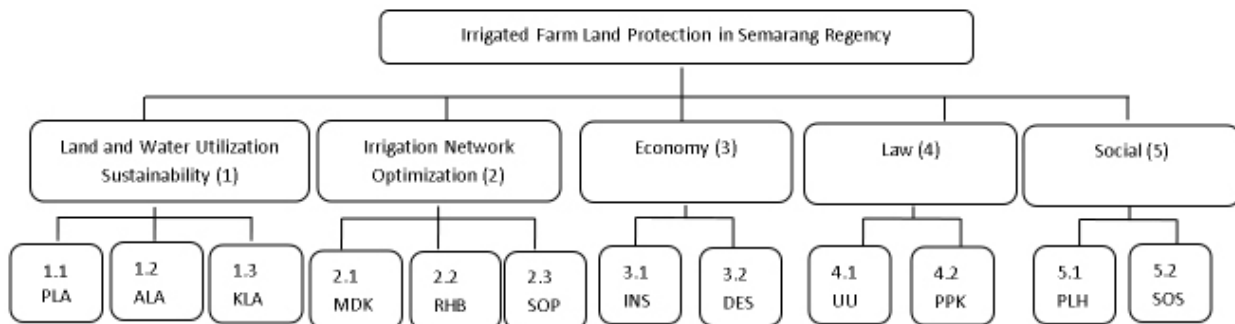


Figure 1. AHP Framework

Criteria group for sustainable programs of land and water utilization

PLA : land and water utilizationsin accordance with the supporting potentials and capacities

ALA : land and water allocation for the appropriate utilization

KLA : land and water conservation leading to the sustainability resources

Criteria group for irrigation network performance optimization

MDK : design modification (improvement) for irrigation networks

RHB : irrigation network rehabilitations

SOP : Repairs of irrigation system operation and maintenance (OP)

Criteria group of economic programs

INS : Incentives

DES : non-incentive applicability

Criteria group for legal programs

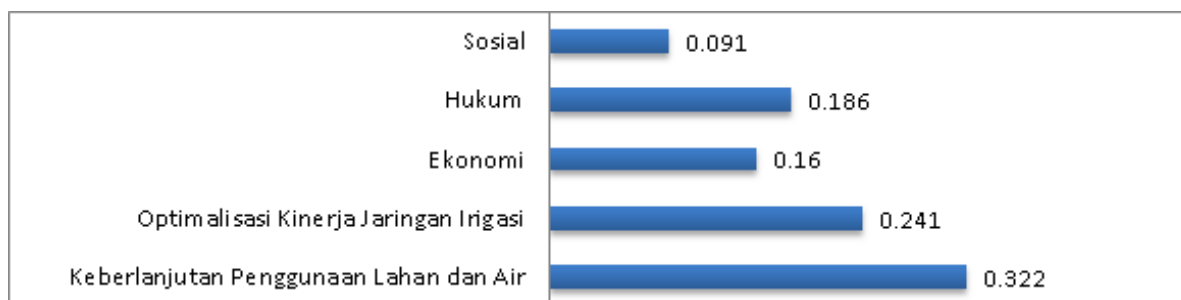
UU : Strengthening legislation of laws

PPK : closer control and supervision

Criteria Group for social programs

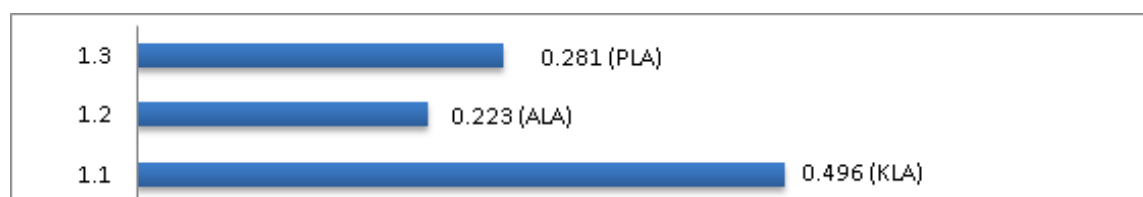
PLH : Extension activities

SOS : Socialization



Sources: Processed Primary data, 2017

Figure 2. Criteria of Irrigated farm land Protection



Sources: Processed Primary data, 2017

Description:

1.1 PLA: Land and Water Utilization in accordance with the supporting potentials and capacities

1.2 ALA: Land and Water Allocation for appropriate utilization

1.3 KLA: Land and Water Conservation leading to the sustainability resources

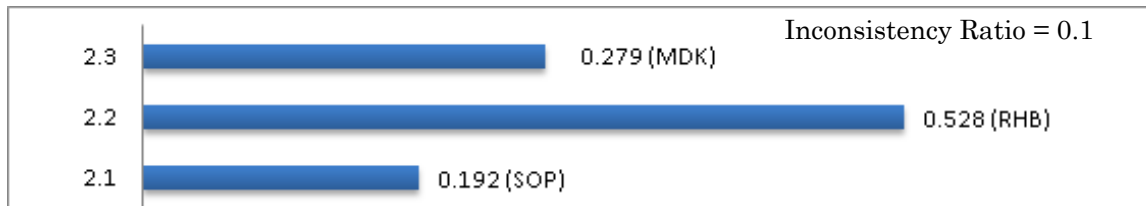
Figure 3. Alternative Criteria for Land and Water Utilization Sustainability

Land and water sustainable utilization is the most important prioritized criterion in the protection of irrigated farm lands in Semarang Regency with a priority percentage of 32.2%. Due to figure 3, it shows that land and water utilization which is in accordance with the supporting potentials is one of the most prioritized alternative in the protection of irrigated farm lands from land and water sustainability utilization criterion with a priority percentage of 49.6%. Land and water utilization which is in accordance with the supporting potentials and resources is one land resource utilization without changing the utilization of potentials and capacities of the existing lands and that of water resources which may be utilized all the time based on land capacities to be irrigated.

Conditions related to the supporting potentials and capacities of the changed farm lands, land physical condition which should be able to produce is lost due to utilization changes of the irrigated lands. When dry season is coming, the water availability is reduced and eventually influences the production quality. The harvest

quality resulted in the dry season may be better as long as the reservoirs to collect the water is well provided. Thus, the collected and stored water in the reservoirs may be utilized to see the production quality in the dry season.

According to Sumaryanto (2006) irrigation water is a strategic agricultural resource, unlike the other inputs, such as fertilizer and pesticide which role dimension is relatively selected, limited by the selected production process. The role of irrigation water has a broader dimension which does not only influence productivity. Accordingly, the second priority to protect the irrigated farm lands from agricultural sustainability utilization criterion is agricultural land and water conservation leading to resource sustainability with a priority percentage of 28.1%. The land reduction related to the existing farm lands is due to the processing performed by humans themselves (agricultural small holders) with poor agricultural sciences and exploited land management due to the increase of needs, reduced farm lands and/or excessive overuses of chemical fertilizers as well as those of chemical pesticides.



Sources: Processed Primary Data, 2017

Description:

MDK: design modification (improvement) of irrigation network

RHB: Irrigation Network Rehabilitation

SOP: Irrigation operation system repair and maintenance

Figure 4. Irrigation Network Performance Optimization Alternative Criteria

The availability of water is sometimes insufficient, especially in dry season. In addition, the existing water sources have also been reduced. The water used for farm land irrigations is also polluted with a lot of garbage. Land and water conditions require repairs that land and water conservation may lead to the resource sustainability, aiming to preserve land and water resources both in quality and quantity by wisely utilizing the existing resources that those may last longer.

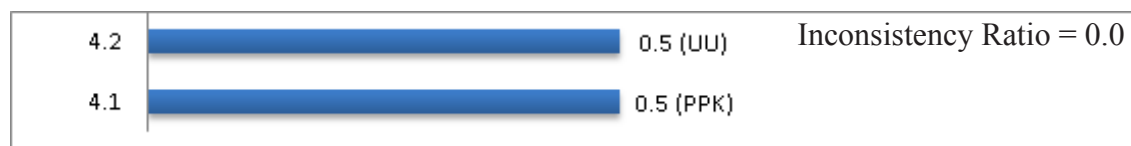
The last priority is allocation of land and water utilization based on a priority percentage of 22.3%. Allocation may be defined as a consideration and determination on numerous resource areas of lands and water which may be utilized. The numerous areas considered as lands are those which can be utilized while numerous areas for water are the amount of water which can be utilized for each determined sector. Competitions on land and water utilization may not be avoided, yet may be organized through the determined allocations by the government as regulation to utilize resources.

Irrigation network performance optimization criterion is the second highest prioritized criterion for protection strategies on the irrigated farm lands in Semarang Regency with a priority percentage of 24.1%.

Based on Figure 4, it shows that irrigation network rehabilitation is the most important

priority of irrigation network performance optimization criterion with a percentage of 52.8%. Irrigation network rehabilitation is intended to improve water gates which are covered with sediment, leaking, and garbage along the irrigation network by restoring irrigation functions and services. According to Sumaryanto (2006), the poor performance is caused by the degradation of infrastructure functions on irrigation system as well as management of irrigation operation and maintenance. Degradation of infrastructure functions, one of them, is caused by infrastructure damages, sedimentation on irrigation system, weed spread in both distribution and drainage channels.

The second priority is improving irrigation operation system and maintenance with a percentage of 27.9%. The inadequate water supply is caused by the poor awareness on water distribution schedules made that sometimes conflicts arise as the result of water obtaining competitions. It is necessary to improve the roles of farming communities in developing collective actions in maintaining irrigation networks. Collective action development is required to improve farmers' attention upon the roles of irrigation, mainly due to the schedule consequences made that each farmer group may not feel worried upon the water distribution schedules agreed before.



Sources: Processed Primary Data, 2017

Description:

UU: Strengthening legislation of laws

PPK: Closer Control and Supervision

Figure 5. Alternative Law Strategy

The last priority is irrigation network design modification with a priority percentage of 19.2%. The modification is in the forms of irrigation network design improvements that water may smoothly come into the rough areas and in fact, it is found that there are still many irrigation network constructions which are susceptible to damage as they are constructed based on tender system. Irrigation network design modifications are highly required that irrigation networks may not be easily damaged.

The next priority criterion in protection of irrigated farm lands in Semarang Regency is law with a priority percentage of 18.6%. Based on figure 5, it shows that two alternative strategies in protection of irrigated farm lands due to the law criterion have the same priority percentage of 50% for strengthening legislation of laws and of 50% for closer control and supervision.

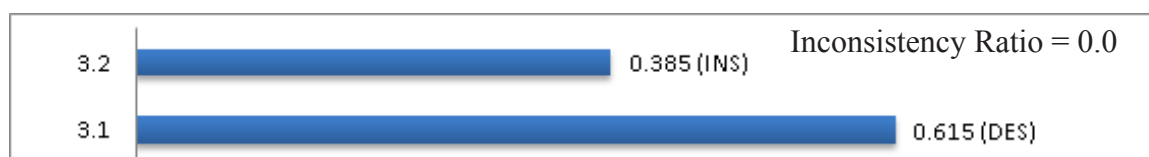
Government through a number of legislation of laws has issued policies to protect the irrigated farm lands, one of them is law. No. 41 of 2009 on protection of sustainable food agricultural lands which is actively implemented through regional layout planning, one of those, is Regional Regulation No. 6 of 2011 on layout planning of Semarang Regency as a reference to protect the irrigated farm lands. Regional regulations are applied within RTRW which organize the irrigation are as elsewhere even those with no-irrigation but provide good crop production, may be preserved. However, those regulations are still less optimal.

Although land utilization changes have already qualified the administrative set, the

presence of non-farm buildings is unavoidable due to the increasing population. In addition, due to the data released by Central Statistics Bureau, the utilization of irrigated farm lands in Semarang Regency is reducing. Thus, regulation emphasizing on maintenance of the irrigated farm lands is greatly required.

According to Sumaryanto (2006) the implementation has not been optimally realized due to the lack of supporting data and inadequate proactive attitudes on controls over farm land utilization changes. Thus, it is necessary to strengthen the legislation of laws to protect the irrigated farm lands in Semarang Regency by providing incentives and non-incentives which specifically have not been formally set, yet generally has already been implemented. The regional regulation on LP2B is included into one of those on-process legal products.

Priority is required to be made in balance by strengthening legislation of laws, called closer control and supervision. Supervision and control over the status of lands with utilization changes preventively made by the Agricultural Office and repressively by civil service police unit (*Satpol PP*). There are also outside land controls called the administrative land controller who have the authority on land administration. According to Sumaryanto (2006), land conversion controls with banning regulations are less effective without the supports of closer supervision systems and the applicable law enforcement. It has become a public opinion that law enforcement in Indonesia is extremely weak due to various factors.



Sources: Processed Primary data, 2017

Description:

3.1 INS : Incentivesgiving

3.2 DES : Non-incentives Implementation

Figure 6. Alternative Economic Criteria

The fourth priority criterion in protection strategies of the irrigated farm lands in Semarang Regency is the economy with a priority percentage of 16%. Those conditions are associated with economic facilitations in management of those irrigated lands in Semarang Regency, including rules on incentives (stimulating facilitation) and non-incentives which have not been formalized in a regulation in Semarang Regency, yet implemented in the forms of programs which support the agricultural activities. Incentives are the greatest priority for the irrigated farm land managers and owners in Semarang Regency and provide assistance in protecting the irrigated farm lands, including by increasing grains' Selling Cost Price, fertilizer subsidies, seed price subsidies, farm road rehabilitations, and availability of mechanical equipment for land management and irrigation pumps.

Incentive top priority for the irrigated farm land owners includes improvement of grain price, fertilizer subsidies, seed price subsidies, farm road rehabilitations and mechanical equipment for land management and irrigation pumps. Grains' Selling Cost Price improvement is highly required by the irrigated farm land owners and managers as they found problems of as price instability. When coming to harvest seasons, the Selling Cost Price drops. Grains' Selling Cost Price is increasing, yet insufficient for farmers' daily needs.

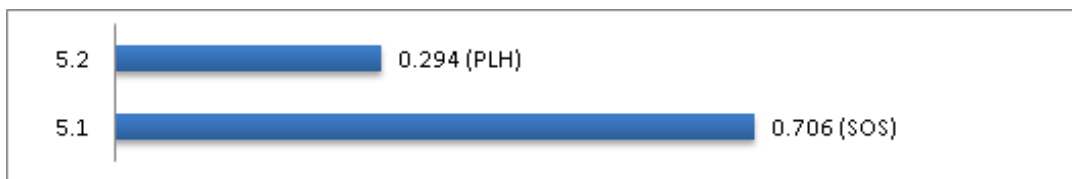
Subsidized fertilizer, beside as farm lands' stimulus, is also one important component in management of farm land to reduce expenses in food production. However, various problems are found. The encountering difficulties lie on

systems. Government has made numerous efforts that all farm land managers are expected to easily obtain the subsidized fertilizers. However, many irrigated land managers find it difficult to obtain subsidized fertilizers. Subsidized seeds are not annually provided. The availability of subsidized seeds may help facilitate farm land managers' burdens to buy superior seeds at affordable prices which enable them to improve productivity and quality of food production.

Most farm roads are still in the forms of land that all farm lands are not reachable. Thus, irrigation networks are not well improved. The needed materials are hard to reach the location that costs for irrigation networks are increasing twice bigger. Empirically, the farm roads' poor quality is resulted from the rehabilitation low priority. Repairs on farm roads are highly necessary that vehicles may pass through the farm roads to easily transport the harvests.

Irrigation pumps are provided to guarantee the availability of water for each farmers group. However, the available irrigation pumps may not be utilized as the amount of water is inadequately available. Thus, technological touch and activities are greatly necessary to restore the availability of water supply that can be utilized any time.

Mechanical equipment availability to maximize land processing is highly required by each farmers group, yet the agricultural equipment is less compatible with the irrigated farm land physical conditions as well as that with the natural conditions that the utilization may not be maximally performed.



Sources: Primary data is processed, 2017

Description:

PLH: Extension Activities

SOS: Socialization

Figure 7. Alternative Social Criteria

The last prioritized criterion of protection strategies for the irrigated farm lands is social with a priority percentage of 9.1% of all specified criteria. Based on figure 7, it shows that alternative strategies on social criterion include extension activities as the priority of social criterion in protecting the irrigated farm lands with a priority percentage of 70.6%, while the second one is socialization by 29.4%.

Agricultural extensions due to the irrigated farm lands and land conversion impacts may be necessarily performed by the government's agricultural extension officers to all managers of the irrigated lands. Extension activity is defined as an effort made to improve people's knowledge on irrigated farm land multi-functions and further impacts of agricultural land conversion to maintain the agricultural land preservation.

Government actively provides agricultural extensions and socializes regulations of law on protection of the irrigated farm lands. The second priority after the extension activities is socialization which is defined as introduction regulations of law made by the government and are applied to farmers to provide information in preserving those farm lands for sustainable food, especially the irrigated ones as well as to provide steps or strategies to make in achieving the programs.

4. Conclusion

Regarding to the protection strategies on the irrigated farm lands in Semarang Regency, there are several priority criteria to make, including land and water sustainable utilization

which has a priority percentage of 32.2% over the whole criteria. Education is required by the irrigated farm land owners and managers upon the benefits of the irrigated farm lands through extension activities and socialization of laws that the irrigated farm land utilization is in accordance with the supporting potentials, capacities, and more importantly, escorting policies on protection of the agricultural lands for sustainable food by maintaining the width of the land areas stipulated in RTRW regulations in Semarang Regency even if there are utilization changes of irrigated farm lands for public interests which are considered more important, urgent, and sustainable for the National development. Government has made some plans dealing with the availability of water supply required by the irrigated farm lands by constructing reservoirs and dams as well as improving the irrigated farm land physical conditions by utilizing organic materials both fertilizers and supporting pharmaceutical products in organizing the irrigated farm lands and also improving the irrigation network water quality.

In order to restore the irrigation functions and services, rehabilitation of irrigation network is greatly required. The irrigation network rehabilitation is made by optimizing the irrigation network performance. In addition to both aspects above, the other one made to protect the irrigated farm lands is through legal aspects by strengthening the legislation of laws in order to optimize the protection of the farm lands, especially irrigated ones. To complete the existing regulations, the new ones should be made as

well as having closer control and supervision by the authorities to perform both preventive and repressive actions.

The last one is incentives which facilitate farm land owners and managers in obtaining agricultural inputs and supports. The other incentives are made to improve the welfare through family empowerment of the irrigated farm land owners and managers which are adjusted with the owned motivation and skills. It is greatly necessary as income generated from the irrigated farm land is unable to meet farmers' daily needs.

5. Acknowledgement

I would like to express my deepest gratitude upon the assistance provided by Semarang State University, Faculty of Economics, and Department of Economic Development.

6. References

- Adimihardja, A. (2006). Strategi Mempertahankan Multifungsi Pertanian Indonesia. *Jurnal Litbang Pertanian*, 25(3), 99–105.
- BPS Demak. (2015). *Demak Regency in Figures 2015*. Demak, Indonesia: Central Bureau of Statistics of Demak Regency.
- BPS Grobogan. (2015). *Grobogan Regency in Figures 2015*. Grobogan Regency, Indonesia: Central Bureau of Statistics of Grobogan Regency.
- BPS Indonesia. (2015). *Indonesia in Figures 2015*. Jakarta: Central Bureau of Statistics of Indonesia.
- BPS Kendal. (2015). *Kendal Regency In Figures 2015*. Kendal, Indonesia: Central Bureau of Statistics of Kendal Regency.
- BPS Semarang. (2015). *Semarang Regency in Figures 2015*. Semarang, Indonesia: Central Bureau of Statistics of Semarang Regency.
- Howell, T. A. (2001). Enhancing Water Use Efficiency in Irrigated Agriculture. *Agronomy Journal*, 93(2), 281–289. <https://doi.org/doi:10.2134/agronj2001.932281x>
- Ilham, N., Syaikat, Y., & Friyatno, S. (2005). Perkembangan Dan Faktor-Faktor Yang Mempengaruhi Konversi Lahan Sawah Serta Dampak Ekonominya. *Socio-Economic Of Agriculture And Agribusiness*, 5(2), 1–25. Retrieved from <https://ojs.unud.ac.id/index.php/soca/article/view/4081/3070>
- Irawan, B. (2005). Konversi Lahan Sawah : Potensi Dampak, Pola Pemanfaatannya, dan Faktor Determinan. *Dalam Forum Penelitian Agro Ekonomi*, 23(1), 1–18.
- Jumna, B. K. (2015). Strategi Pengembangan Usahatani dalam Upaya Peningkatan Produksi Padi Organik. *Economics Development Analysis Journal*, 4(3), 233–241. <https://doi.org/https://doi.org/10.15294/edaj.v4i3.14830>
- Mu, E., & Pereyra-Rojas, M. (2017). Practical Decision Making. An Introduction to the Analytic Hierarchy Process (AHP) Using Super Decision V2. In *Springer Briefs in Operations Research* (pp. 7–22). https://doi.org/10.1007/978-3-319-33861-3_2
- Mukherji, A., & Facon, T. (2009). *Revitalizing Asia's Irrigation: To sustainably meet tomorrow's food needs*. Asian Development Bank. Retrieved from <http://hdl.handle.net/11540/2391>
- Perda. (2011). *Peraturan Daerah No. 6 Tentang Rencana Tata Ruang dan Wilayah Kabupaten Semarang Periode 2011-2031*. Semarang: Badan Perencanaan, Penelitian dan Pengembangan Daerah.
- Rai, I. N., & Adnyana, I. G. M. (2011). *Persaingan Pemanfaatan Lahan dan Air*. Denpasar, Bali: Udayana University Press.
- Sucihatningsih, D. W. P. (2014). Strategy for Controlling Agricultural Land Conversion of Paddy by Using Analytical Hierarchy Process in Central Java. *Management of Environmental Quality: An International*

Journal, 25(5), 631–647. <https://doi.org/https://doi.org/10.1108/MEQ-07-2013-0080>

Ekonomi Air Irigasi. *Forum Penelitian Agro Ekonomi.*, 24(2), 77–91.

Sumaryanto. (2006). Peningkatan Efisiensi Penggunaan Air Irigasi Melalui Penerapan Irigasi Berbasis Nilai

Undang-undang Republik Indonesia No.41 Tahun 2009 Tentang Perlindungan Lahan Pertanian Pangan Berkelanjutan (*Indonesian Law no 41 Year 2009 on Protection of Sustainable Food Agricultural Land*). Jakarta: Republik Indonesia.