QUANTITATIVE EVALUATION MODEL OF IRRIGATION PERFORMANCE
Case study at Sempor and Wadaslintang Irrigation System [1]

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A B S T R A C T

A quantitative model of irrigation performance was created in order to evaluate irrigation system. The model contains three element indicators: (i) basic performance indicator as the output reflecting irrigation performance and productivity; (ii) proxy indicator as the input reflecting condition of irrigation infrastructure and irrigation management; and (iii) impact indicator reflecting the social and environment effect; and sustainability. All indicators are performed by scoring and weighting factors. Range of the total score of ech component system is 1-4. The model was applied in the Sempor and Wadaslintang dam irrigation system located at Central Java, covers 6.478 ha and 31.082 ha, respectively. The irrigation system is a complex system. Three irrigation service areas were used as samples describing three level condition of irrigation infrastructure and irrigation management: good, average and poor. The result shows that generally the model is sensitive enough for describing the actual condition of irrigation performance. The score performance of each element was calculated with applying weighting factor to find total score, then the total score value of each irrigation area was plotted in quadrant system. This system describes the correlation between irrigation infrastructure and irrigation management. Position of each irrigation area plotted in the quadrant is reflecting its irrigation performance.

Key words: assessment model, system approach, performance of irrigation system

I. INTRODUCTION

Irrigation system in Indonesia has highly significant in contributing rice production. However, in the recent years the performance of the irrigation system is decreasing due to both water resource availability and also change in social, economical and cultural orientation of irrigated land society (Susanto, S., ed., 1999). The government of Indonesia, through directorate general of water resources of has implement many innovation of irrigation management programs, such as rehabilitation of irrigation infrastructures, famer empowerment for

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contributing operation and maintenance irrigation system in tertiary level, introducing a rice cultivation method with efficient irrigation, namely the System of Rice Intensification (SRI), etc. but decreasing performance of irrigation system seems still exceed that of the programs. An innovation assessment model for evaluating irrigation management performance is still needed to ameliorate the situation. A quantitative assessment model for evaluating performance irrigation management was created using system approach is proposed.

The aim of the study is focused to evaluate an irrigation management performance using quantitative assessment model.

II. THE ASSESSMENT MODEL

2.1. The concept of the model

Many analysis of irrigation performance has been discussed in the recent years (M. Yercan, et al, 2003). However, a simple analysis that can be applied in unique irrigation system in Indonesia is still limited. The basic principle of system was applied to the irrigation management in the assessment model. Those are input, process, output and impact **(Fig.1)**. The model contains three element indicators: (i) basic performance indicator as the output reflecting irrigation performance and productivity; (ii) proxy indicator as the input reflecting condition of irrigation infrastructure and irrigation management; and (iii) impact indicator reflecting the social and environment effect; and sustainability (**Table 1**).

Tabel 1. Irrigation performance indicator

No	Indicator	objective
1	Basic indikator: • Supplying irrigation performance • Productivity	Giving information of output system regarding level of performance and productivity of irrigation system
2	Proxy indicator: • Input: condition of irrigation infrastruktur and its function • Proses: performance of irrigation system manajemen	Giving information regarding operation as and maintenance of irrigtaion infrastucture as an input system; and irrigation system manajemen performance as a process system
3	Impact environment indikator: • change of shallow ground water level	Giving information regarding positif impact of irrigation system on environment as an impact system
4	Sustainability indik ator keberlanjutan: • internal presure factor • external pressure factor	Giving information regarding internal and external factor to the irrigation system as sustainability of system

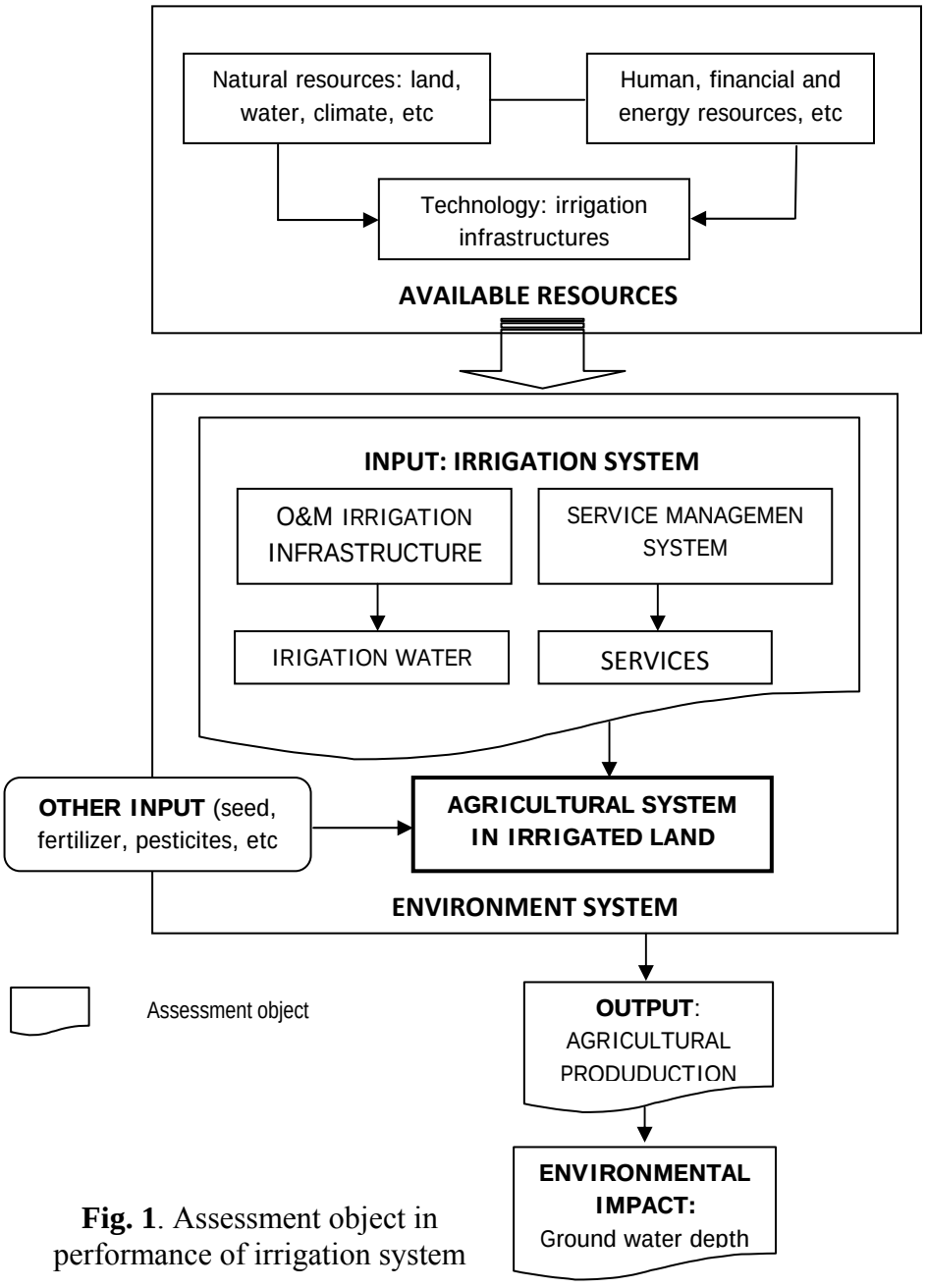

Fig. 1. Assessment object in performance of irrigation system

2.2. Scoring system

All indicators are performed by scoring and weighting factors, as presented in **Table 2**. From the calculation result in scoring basis then they transfer to quadrant system, which show

the relationship between performance of irrigation management and prerequisite for good irrigation management in quadrant system (**Fig.2** and **Table 3**). With this system, it also can be made relationship between component system (input, process, output, outcomes and impact) and each indicator of irrigation performance.

Tabel 2. Scoring of irrigation performance

Indicator	Parameter	Weigting factor	score			
			1	2	3	4
Input	irrigation infrastruc-ture and its function	4	Very bad	poor	average	good
	Water resource availability	3	poor	Average	good	
	Human resource availability	3	Not enough	enough	More than enough	
	Financial availability	2	Not available	Available but not enough	Available and enough	
	Institutional asset	1	Not available	Available but not enough	available and enough	
Proses	Irrigation operasion	3	poor	Average	good	
	Irrigation maintenance	2	poor	Average	good	
	Institutional condition	1	Non active	Not so active	Active	
Output	Water irrigation services	3	poor	average	good	
	Time of service	2	poor	average	good	
	Drainase system condition	1	poor	average	good	
Outcome	Production	2	< 90% average regional production	90 – 100% average regional production	> average regional production	
	Planting area	1	< 90% of planting plan	90% - 99% of planting plan	100% or more than planting plan	
Environmenta l impact	Depth of shallow ground water	1	poor	average	good	
Sustainability	Internal factor	2	poor	average	good	
	Exsternal factor	1	poor	average	good	

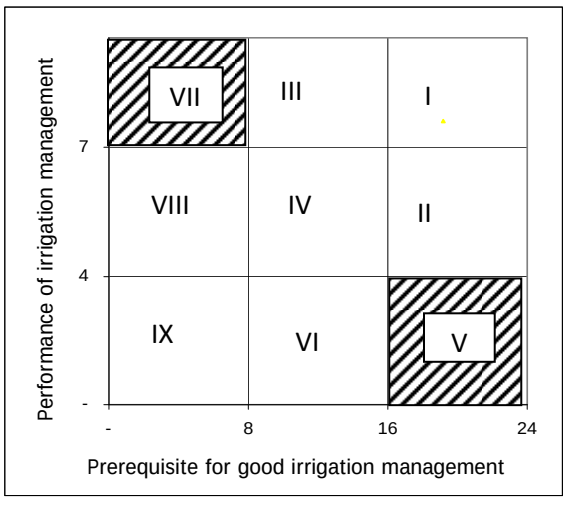

Fig. 2. Relationship between performance of irrigation management and prerequisite for good irrigation management

Table 3. Criteria of irrigation system performance

No.	Quadrant position	Condition of irrigation system performance
1	**I**	Condition of irrigation system performance is good or in optimal position
2	II	Condition of irrigation system performance is nearly in optimal position
3	III	Condition of irrigation system performance is still going to be in optimal position.
4	IV	Condition of irrigation system performance is not in optimal position but it has potential to be moved in optimal condition with small improvement
5	V	Not happen in the reality
6	VI	Condition of irrigation system performance is not in optimal position but it has potential to be moved in optimal condition with medium improvement
7	VII	Not happen in the reality
8	VIII	Condition of irrigation system performance is not in optimal position but it has potential to be moved in optimal condition with large improvement
9	IX	Condition of irrigation system performance is not in optimal position but it does not has potential to be moved in optimal condition. All element of prerequisite of irrigation management does not meet the demand

III. RESULT AND DISCUSSION

3.1. Location of the study

The assessment model was applied in Sempor and Wadaslintang dam irrigated area located in the Serayu-Bogowonto river basin system, Central Java (**Fig. 3**).

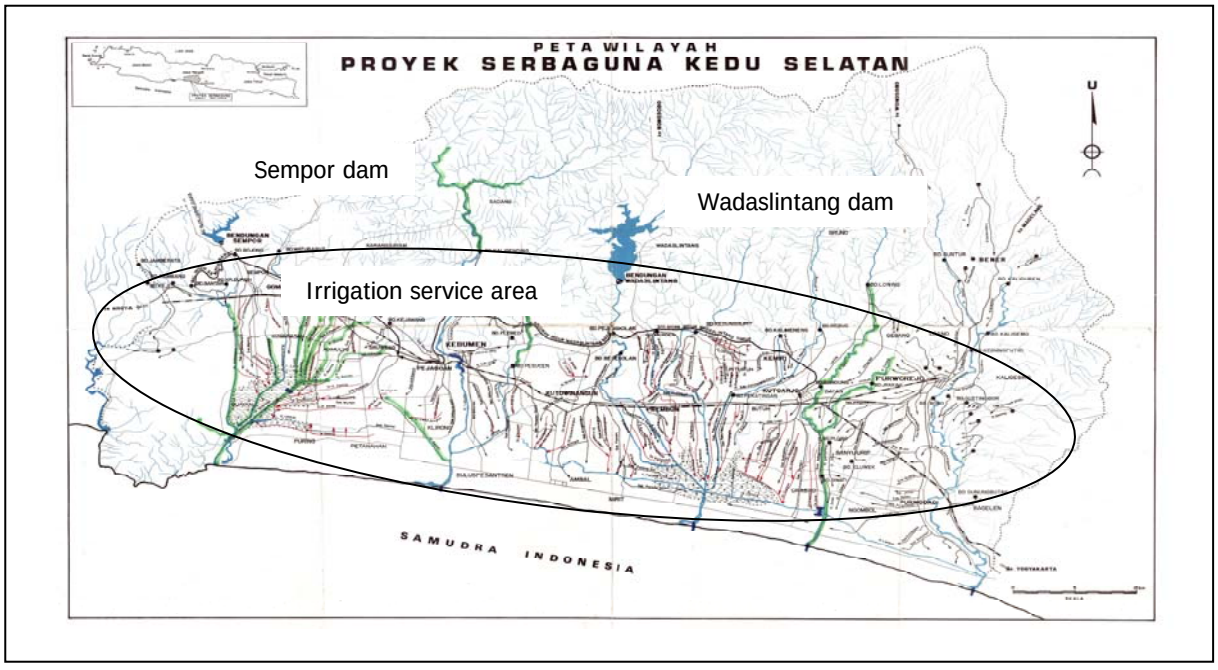

Fig.3. Area of irrigation system supllied by Sempor and Wadaslintang dam

Irrigated area of Sempor dam covers 6.478 ha or 18,32% of the total irrigated area (35.3590 ha) administratively located in Kebumen district. Meanwhile, irrigated area of Wadaslintang dam is 21.402 ha located in two districts, Kebumen and Purworejo. This system is a complex system and it is part of a strategic asset in food production, mainly rice.

Irrigated common area representing upper, middle and lower of Sempor and Wadaslintang dam system was chosen as a sample in collecting data (**Fig.4**; **Fig.5**; **Table 3**).

Table 3. Sample irrigated common area

No	Irrigated area	Sample irrigated area		
		upper	middle	lower
1	Sempor system	Bojong	Sindut	Kejawang
2	Wadaslintang system	Kedunggupit Kulon	Rebug	Bedegolan

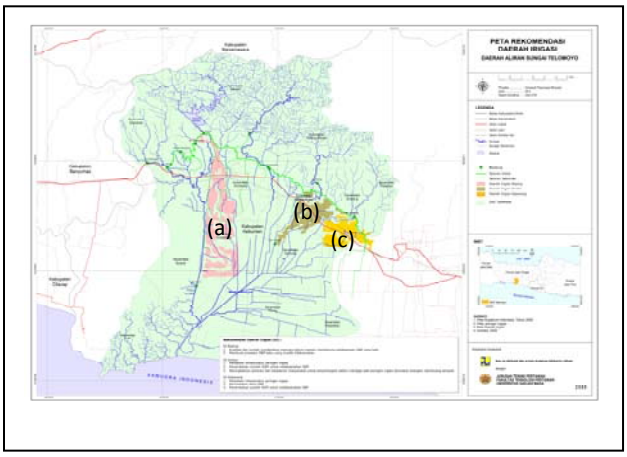

Fig. 4. Sample irrigated common area of Sempor dam system
(a) Bojong; (b) Sindut; (c) Kejawang

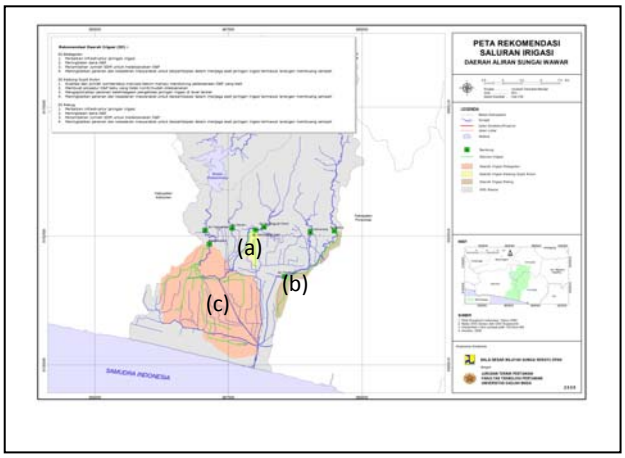

Fig. 5. Sample irrigated common area of Wadaslintang dam system
(a) Kedunggupit Kulon; (b) Rebug; (c) Bedegolan;

3.2. Performance of irrigation common area

Fig 4 and **Fig. 5** shows the position three samples of irrigation service area of Wadaslintang and Sempor system at the quadrant, respectively. From the sample shows that irrigation common area of Wadaslintang system of Gedunggupit Kulon is in quadrant I,

meanwhile Rebug and Bedegolan falls into quadrant IV. For irrigation common area of Sempor system all three samples are in quadrant IV. Condition of irrigation performance of the quadrant is presented in **Table 4.**

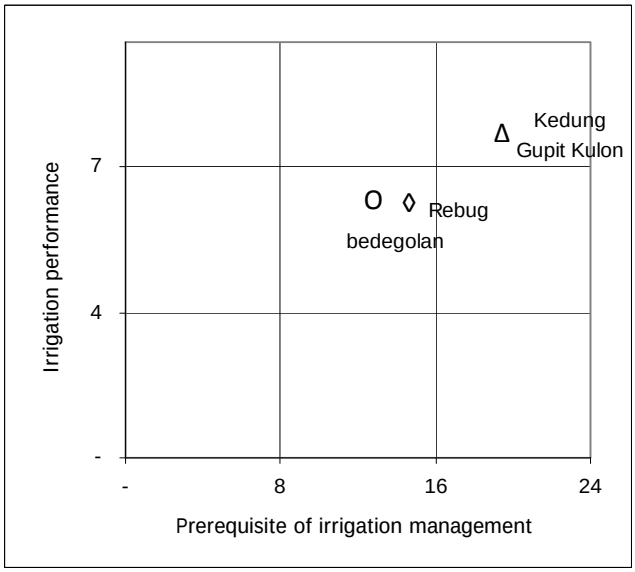

Fig 4. Position of irrigation performance of three sampels of Wadaslintang Sistem

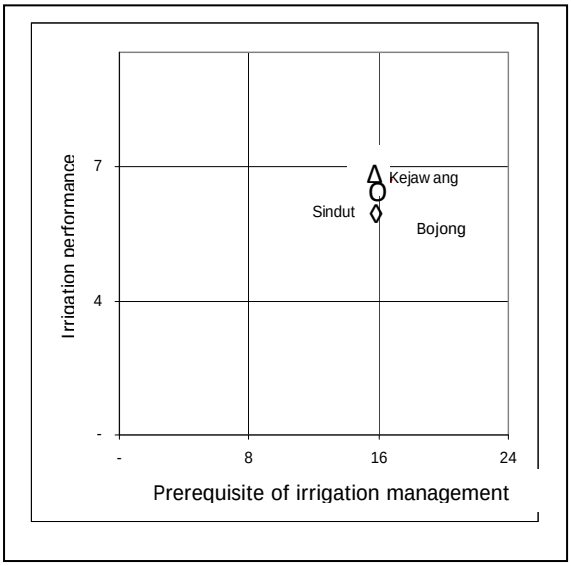

Fig 5. Position of irrigation performance of three sampels of Sempor Sistem

Table 4. **Condition of irrigation system performance of**

No	Irrigation service area	Quadrant position	Condition of irrigation system performance
1	**Wadaslintang system:** Kedunggupit Kulon	**I**	Condition of irrigation system performance is good or in optimal position. It is indicated by: • enough water availability for irrigating in three planting season (PS-1, PS-2, and PS-3) with good operation and maintenance • good condition of irrigation infrastructures • available and enough financial for operation and maintenance of irrigation infrastructures • enough human resource availability for conducting operation and maintenance of irrigation infrastructures • O&M is in a good operation • no pressure from external factor, mainly pressure for changing of irrigated land to other function
2	**Wadaslintang system:** Rebug dan Bedegolan **Sempor system:** Sindut, Kejawang dan Bojong	IV	Condition of irrigation system performance is not in optimal position but it has potential to be moved in optimal condition with small improvement. It is indicated by: ▪ Water availability is enough only for PS-1, but not for PS-3 ▪ Condition of irrigation infrastructures is not good, half of infrastructures are not functional ▪ financial availability is not enough for conducting operation and maintenance of irrigation infrastructures • O&M is not in a good operation due to limited human resources availability • There is pressure from external factor, mainly pressure for changing of irrigated land to other function

It is clear from the table that location of irrigation common area has significantly effects to the value of irrigation performance. If location is closer to the source of water, the value of irrigation performance will get higher.

3.2. Discussion

Based on the result of assessment of irrigation performance as mentioned above, the following discussion is focused on the element of the system: input, process, output, outcome impact and sustainability.

3.2.1. Input

Important element of the input system is condition of network irrigation infrastructures. It is clear from the quadrant position of the irrigation performance of Sempor and Wadaslintang system that the infrastructures have not served optimally for all irrigation common area. Good infrastructures tend to give supplying water better than poor infrastructures. Position of irrigation common area from the dam also tends to give different services. Upper position of irrigation common area has better supplying water that the middle; and the middle position are better than the lower position.

In tertiary level, operation and maintenance of irrigation infrastructures (O&P) is managed together by government and Water User Association (WUA). However, financial contribution from WUA is very limited. Therefore financial subsidy from the government for this purpose is very significant. Financial support from the government is still not enough to cover financial need for O&M to give optimal services.

3.2.2. Proses

From the point of view of the process system, the quadrant position of the irrigation performance as mentioned above indicates that internal management is still weak. Survey conducted to the local irrigation office of the sample of irrigation common area prove the indication, such as: available data to fulfill the need of optimal irrigation performance is not enough, limited available data does not managed through dBase system, continuous and

systematic internal monitoring and evaluation system has not developed yet, capacity of human resources to operate good internal management, both at the local irrigation office and WUA needs to be improved and limited financial support, both from the government and WUA for operating internal management.

3.2.3. Ouput

The results of irrigation performance of the samples also indicate that the output system of irrigation performance of Wadaslintang and Sempor system show that as a function of volume and time, supplying irrigation for paddy field has not optimal for the whole irrigation common area of Sempor and Wadaslintang system, especially in planting season II and III. Small dams build in the rivers in the lower part of Sempor and Wadaslintang dam give significant contribution in supplying irrigation in planting season II and III.

3.2.4. Outcome

Supplying water of Sempor and Wadaslintang system to irrigated land proved that the productivity of irrigated land has been improved. Average irrigated land production for paddy is about 5-7 ton per ha (harvested paddy) with Crop Intensity is 1.8. Position of irrigation common area and tertiary block determine the paddy production and productivity. Upper position tends to give higher paddy production and productivity than the lower.

3.2.5. Impact

Flowing water from Sempor and Wadaslintang dam to irrigate land has significantly positive impact on environmental hydrologic condition around the irrigation common area. Direct impact can be found from better stability of groundwater level and growing vegetative land cover. In non direct impact, agricultural production of irrigated land under gives contribution to the people social-economic development.

3.2.6. Sustainability

Sustainability of irrigation system is affected by external and internal pressure. In Sempor and Wadaslintang system, the external pressures come from: decreasing of water resources availability, change of paddy land to non agricultural purposes, and conservation measures in the

recharge area is not optimal. Meanwhile, the internal pressures are limited financial support and weak internal management to operate O&M of irrigation structures.

IV. SUMMARY AND CONCLUSION

4.1. Summary

1. Quantitative assessment model of irrigation performance was conducted to this system in order to understand the position of irrigation management performance. The assessment instrument contains three element indicators: (i) basic performance indicator as the output reflecting irrigation performance and productivity; (ii) proxy indicator as the input reflecting condition of irrigation infrastructure and irrigation management; and (iii) impact indicator reflecting the social and environment effect; and sustainability. All indicators are performed by scoring and weighting factors. Range of the total score of ech component system is 1-4.

2. The assessment model was applied in the Sempor and Wadaslintang dam irrigation system located at Central Java, covers 6.478 ha and 31.082 ha, respectively. It is part of network irrigation system of Serayu-Bogowonto system and it is one of strategic asset in food production, mainly rice. The system is a complex system. Three irrigation service areas were used as samples describing three level condition of irrigation infrastructure and irrigation management: good, average and poor.

3. The total score value of each irrigation area was plotted in quadrant system. Five of six samples located at Rebug dan Bedegolan irrigation common area of Wadaslintang system and Sindut, Kejawang dan Bojong of Sempor system falls in quadrant IV. Meanwhile, only one sample located Gedunggupit Kulon of Wadaslintang system is in quadrant I. The results show that as a whole condition of irrigation performance in this area mostly is not in optimal condition but it has potential to be moved in optimal condition with small improvement.

4.2. Conclusion

1. Application of the quantitative assessment model of irrigation performance at the Sempor and Wadaslintang dam irrigation system proved that the model was sensitive enough for describing the actual condition of irrigation performance.
2. The score performance of each element was calculated with applying weighting factor to find total score, then the total score value of each irrigation area was plotted in quadrant system. This system describes the correlation between irrigation infrastructure and irrigation management. Position of each irrigation area plotted in the quadrant is reflecting its irrigation performance. The score show that as a whole condition of irrigation performance in this area mostly is not in optimal condition.
3. Based on the result of the assessment, each element of the system: input, process, output, outcome impact and sustainability were discussed.

4.3. Recommendation

In order to improve the irrigation performance at Sempor and Wadaslintang system, various programs of irrigation infrastructure and internal management should be conducted. In the same time, to make better water availability, various programs of conservation measures at the upper watershed of Sempor and Wadaslintang system should be made, both applying civil and biological approach.

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