Readiness of farmers’ institutions in facing environmental disruption: The case of participation of farmers as water users in maintaining trash-polluted irrigation in Indonesia

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Abstract. Farmers’ participation in maintenance irrigation system is very important to support irrigation sustainability. The key success of participation in irrigation management are the existence and activeness of farmer-led water-user associations through dynamic social-institutional interactions. The spread and accumulation of trash in irrigation, requires institutional readiness to carry out on improvement collective action. This study aimed to assess the farmers’ institutions readiness to their participation to cleaning the irrigation canals. The study was conducted in 19 Group Water User Associations (GWUA) at Bantul Regency Yogyakarta, Indonesia. Questionnaire and interview were used to collect the data, followed with descriptive statistics and exploratory analysis. The results showed that problem of trash in irrigation canals triggering GWUA’s activities in form of members’ meetings, tracing and inventorying irrigation issues, and irrigation maintenance. Communication among farmers in meetings and other activities pertaining a collective awareness to support other GWUA activities. The study also revealed that financial situation, members’ participation and equipment were the constrains in irrigation maintenance participation. A support from local government to farmer is expected, aiming to improve effectiveness and widening irrigation maintenance areas. Moreover, a community participation also needed to deal with trash spreading to prevent water pollution in irrigation system.

1. Introduction
The agriculture sustainability is a very complex issue, one of that is the irrigation system. According to the previous study its complexity was due to agriculture systems is multi dimension. Moreover, the sustainability issue is also broad in view with many parameters involved, having potential as conflict source between parties [1]. In an irrigation system, the sustainability challenges occur due to emergence and increase of environmental disruption in form of garbage which polluting the irrigation canals, lead to disrupt water drainage then affected to more working hours to the farmers [2, 3, 4], degrade the quality of water physically, chemically [5, 6], and bacteriologically [7].

In an irrigation system, its operation and maintenance (OM) activities have become a condition for its sustainability [8] because the activities able to maintain the condition and function of irrigation from any changes and disturbances. Both from inside and outside the system. Therefore, the efforts
from government and farmers’ institutions in carrying out the responsibilities of irrigation OM in each of their areas of authority constitute the central point of irrigation sustainability. In some aspects, the government has limitation due to financial affairs, organization and facility of management to reach out and implement OM in all irrigation areas [8, 9, 10]. Likewise, the GWUAs have limitation in terms of finance, collective action, member organization, and its members’ support for running OM at the tertiary level [11, 12].

The existence of environmental disruption in irrigation system in Bantul Regency in the form of trash pollution, technically requires a serious OM effort than that in normal. However, not all farmers’ institutions are able to develop action collective when irrigation problems occur. Therefore, there are two challenges in overcoming the trash pollution in the irrigation system namely farmers readiness to carry out collective action and improvement of operation and maintenance of irrigation. According to that fact, this study was aimed to assess the farmer institutional readiness in responding to changes and disruption caused by pollution in their irrigation system. Therefore, the irrigation system in Bantul Regency can be evaluated in is sustainability whether achieved or not.

2. Methodology
This research was conducted in 19 GWUAs at Bantul Regency in province of Yogyakarta Special Region, Indonesia. Data were collected using questionnaires and interviews with heads of GWUAs. This research was conducted from July 2014 to January 2016. Questionnaires in this research was Likert Scale of 4 to collect information in the form of group meetings, the basis of pollution claims, efforts to legitimate claims, process of implementing actions, and institutional support for the implementation of actions. Interviews with a number of heads of GWUAs were intended to obtain a complete picture of farmers institution condition, knowledge management, and the dynamic of the process within institutions. Descriptive statistics and exploratory factors analysis were applied to analyse the data using SPSS version 14.

The assessment of farmers’ readiness employed a valuation model used in Aydin and Tasci’s study [13], which was modified from scale 5 to scale 4 according to the contents of questionnaires using Likert Scale of 4. The four preparedness groups were, adjusted equally on a scale of 4 with an average mean score of 2.72 as the value of the expected level of readiness (Figure 1). The assessment of the stages which the farmers’ institutions took to solve the problems of trash pollution in irrigation employed the constructing environmental problem approach created by Hannigan (2006), which consists of three stages, namely assembling, presenting, and contesting.

3. Result and analysis

3.1. General profile of the study location
The working area of GWUAs was a hydrological irrigation area. Accordingly, irrigation networks could pass through several villages in one, and even several, districts. Location and environmental conditions of irrigated areas in the working area of GWUAs were mostly close to the settlements and
highways, but there were also some which developed in dense settlement, commercial areas, markets and education institutions (Table 1). The source of irrigation water, commonly came from rivers that mostly carry waste which could enter the irrigation canals. In areas where settlements had developed, their existence was getting closer to irrigation canals.

### Table 1. Location and environmental condition in the working area of GWUAs

| Name of GWUA     | Village   | District | Locations Around the Irrigation |
|------------------|-----------|----------|---------------------------------|
| Merdiko Kiri     | Timbulharjo | Sewon    | Market, road, settlement, sub-urban area, food stall |
| Merdiko Kanan    | Pendowoharjo | Sewon    | Market, road, settlement, sub-urban area, food stall |
| Tengah           | Bangunjiwo | Kasihan  | Bordering with the city of Yogyakarta, road, settlement |
| Kenalan          | Ngentuk    | Kasihan  | Mostly farming land, settlement, road, store, sub-urban area |
| Kemiri           | Sabdodadi  | Bantul   | Settlement, road, office, store, school, market |
| Timbulsari       | Timbulharjo | Sewon    | Settlement, road, school, market, office, store, |
| Tanjung          | Tirtominolo | Kasihan  | Settlement, highway, office, market, school, food stall |
| Gamping          | Tamantirot | Kasihan  | Dense settlement, restaurant, highway, university, school |
| Mejing           | Sidomulyo  | Bambanglipuro | Dense settlement, road, school, mostly farming land |
| Pijenan Kanan    | Poncosari  | Srandakan | Mostly farming land, settlement, road, market, school |
| Tegal Kanan      | Srihardono | Pundong  | Settlement, road, market, school, commercial area |
| Tegal Kiri       | Sriharjo   | Imogiri  | Less dense settlement, tourist object, highway, home, industry, office |
| Sindet           | Wukirsari  | Imogiri  | Sparse settlement, road, mostly farming lands |
| Canden Kanan     | Srihardono | Pundong  | Sparse settlement, road, mostly farming land |
| Klegen           | Panjangejo | Pundong  | Mostly farming land, sparse settlement, road |
| Terong           | Terong     | Dlingo   | Mostly farming land, sparse settlement, road |
| Dokaran          | Timbulharjo | Sewon    | Settlement with moderate density, market, road, restaurant, commercial area, school, office |
| Karangploso Kanan| Putren     | Pleret   | Settlement with moderate to high density, market, industry, restaurant, commercial area, school, office |
| Nglaren          | Potorono   | Banguntapan | Settlement with moderate density, sub-urban area, highway, school, restaurant, office |

Source: primary data

### 3.2. Institutional profile of farmer water user

GWUAs as the subject of the research were all in active condition, had legal entities, administration board, members, and carried out the basic functions of the organisation. The secretarial location was in the house of the head of the GWUAs. A simple organisational structure was made, consisting of the head, secretary, treasury, OM, business sector, public relation, and supervisor board. The head and administration board members were all male, aged between 45 and 72 years old, and had been working as administrators for quite a long time. The regeneration process did not work because there were no farmers who want become the administrators of the organisation.

In general, the GWUAs have no proper data of their members. Their membership was voluntary, did not use any registration numbers and free of membership fees. They designed activities in short terms, monthly or bimonthly, through board meetings. The documentation system was simple and tended to be poorly organised, and the organisation's financial records were contained in a simple cash book.

### 3.3. Readiness and participation constraints

The readiness of GWUAs’ participation in irrigation maintenance consisted of several aspects, which included meetings with their members, carrying out data collection on irrigation conditions, building relation with relevant institutions, contributing to irrigation cleaning activities and irrigation cleaning. The score of readiness was a combination of these five aspects. Based on the analysis, there were 8 institutions that fell into the category of "ready but needs a few improvement" and 11 institutions that fell into the category of "not ready, needs some work" (Table 2).
Table 2. The score of GWUAs for maintaining trash polluted irrigation

| Description                              | Name GWUAs |
|------------------------------------------|------------|
|                                          | A  B  C  D  E  F  G  H  I  J  |
| GWUAs meeting                           | 2.67 3.50 2.67 3.00 2.67 2.83 2.67 3.17 2.83 2.67 |
| Data collecting on irrigation           | 2.75 2.50 2.50 3.00 2.25 3.00 2.25 2.75 2.00 2.00 |
| Institutional relation                  | 3.00 3.00 3.00 3.00 2.67 3.00 2.67 2.33 2.67 2.67 |
| Contribution of activities              | 3.00 3.50 1.75 2.75 2.25 3.00 2.25 2.25 2.00 1.75 |
| Irrigation cleaning                     | 3.00 3.00 3.00 3.00 2.00 3.00 3.00 3.00 2.50 2.00 |
| Mean                                    | 2.88 3.10 2.58 2.95 2.37 2.97 2.57 2.70 2.40 2.22 |
| Farmer readiness                        | R1  R1  NR2  R1  NR2  R1  NR2  NR2  NR2  NR2  |

(continue)

| Description                              | Name GWUAs |
|------------------------------------------|------------|
|                                          | K  L  M  N  O  P  Q  R  S  |
| GWUAs meeting                           | 3.00 3.50 2.00 2.83 2.33 3.00 3.50 2.83 3.50 |
| Data collecting on irrigation           | 3.00 4.00 3.00 2.50 2.50 2.25 2.75 3.00 2.50 |
| Institutional relation                  | 3.00 2.67 2.33 3.00 2.33 2.67 2.33 2.67 2.67 |
| Contribution                            | 1.00 2.75 2.25 2.00 2.50 2.25 3.00 2.75 2.50 |
| Irrigation cleaning                     | 2.50 3.00 2.50 2.50 3.00 3.00 3.00 3.00 3.00 |
| Mean                                    | 2.50 3.18 2.42 2.57 2.53 2.63 2.92 2.92 2.85 2.83 |
| Farmers’ readiness                      | NR2  R1  NR2  NR2  NR2  NR2  NR2  R1  R1  R1  |

Description:
Name GWUAs:
A: Merdiko Kiri; B: Merdiko Kanan; C: Tengah; D: Kenalan; E: Kemiri; F: Timbulsur; G: Tanjung; H: Gamping; I: Mejing; J: Pijenan Kanan; K: Tegal Kanan; L: Tegal Kiri; M: Sindet; N: Canden Kanan; O: Klegen; P: Terong; Q: Dokaran; R: Karangploso Kanan; S: Nglaren
Farmers’ readiness:
NR1: not ready and needs a lot of work; NR2: not ready, needs some work; R1: ready but needs a few improvements; R2: ready, go ahead

Groups’ meetings had become a formal way of communication between administrators and members as well as among the groups’ members. The meetings were effective because there was a direct response from the participants to the issues that were discussed and had a purpose to share information and knowledge. Data collection on irrigation through the activity of tracing irrigation networks and recording the condition and function of the irrigation was carried out periodically, at least once a year. Data on irrigation was the basis of the GWUAs for arranging activity plan of irrigation maintenance and determining implementation priorities in accordance with their organisational capabilities. Data collection on irrigation carried out in conjunction with governmental agencies aimed to share data and request support for the implementation of the activities. Good relation established by the GWUAs with the local government was able to improve the implementation of activities financed by the local government.

The contribution of the GWUAs to irrigation cleaning activities was still facing constraints due to limited financial capacity of the groups, members’ participation, and equipment in irrigation maintenance. This is understandable due to they did not have any mechanism of collecting mandatory dues from their members to finance their activities, not all members were aware of the importance of collective action and there was limited equipment for cleaning irrigation canals at the primary and secondary levels as well as transporting trash to disposal sites.

3.4. Environmental claim and institutional action

Environmental problems which was occurred in irrigation system, were addressed by the GWUAs using two approaches, first making claims on environmental issues and secondly taking action as part of institutional responsibility in resolving irrigation and environmental cases. Environmental claims and actions followed the order stated in environmental problem construction of Hannigan’s model.
3.4.1. **Institution’s problem statement.** In the context of environmental disruption in the irrigation system, the GWUAs conducted an assembling process to formulate the issues of irrigation environment, confirm the causes of environmental impacts, and ensure data related to pollution in irrigation as described below:

A. **Issues of irrigation environment**

Issues of irrigation environment were discussed at almost every meeting and the discussion focused on the trash pollution in the irrigation canals. Trash was easily seen by farmers and had disrupted the water flow because it was trapped at the irrigation doors and the bottom of irrigation canals. The farmers claimed that the government had to take irrigation cleaning measures.

B. **Sources of impacts**

The farmers suspected that the trash came from the community around the irrigation canals and people who pass by then disposed their trash in the irrigation canals. Non-farmer community members were suspected to be the trash dumpers. As for passers-by, the farmers described that there were two kinds of plastic bag they carried, one of them contain trash.

C. **Data on trash pollution in irrigation canals**

In a simple way, the farmers identified trash in the irrigation canals as domestic waste, plastic waste and swaddling. The details of the trash were not the concern of the farmers. However, the farmer stated that several types of waste indicated that the trash left an impression or deep memories in their mind pertaining to its impacts on the irrigation and their life as farmers.

3.4.2. **Demonstrating concern and validity of environmental issues.** In order that the problem of trash pollution in irrigation remained a priority to be resolved, the GWUAs continued to emphasise efforts to find out the effects of trash, which in turn were justified as an environmental claim to the stakeholders. This stage was the effort of the farmers to present environmental problems, which are described below:

A. **Form of concern and internal relation**

The GWUAs traced irrigation networks together with its members to confirm that there was trash pollution, how much pollution had occurred, how often it occurred, locations that had been polluted, what kind of disruption it had caused, and summarised the expectation of the farmers. They also collected evidence from other areas to strengthen the evidence that the problem which had occurred was not a small and trivial one because it involved the connection between the upstream and downstream and people’s behaviour, that was predicted to take a long and systemic solution.

B. **Legitimating the claim**

After having enough data about the condition of trash pollution in irrigation, the GWUAs legitimised the claim through three strategies. Firstly, conducting irrigation tracking with agricultural field advisors, irrigation officers, village and district officials, and community leaders; secondly, cleaning the irrigation canals to show their members and the public that it was real trash that had settled, accumulated, and blocked the irrigation canals; and thirdly, bringing and disseminating this claim to a broader level through meetings attended by the GWUAs at the village level up to the provincial level.

3.4.3. **Creating clean irrigation.** The effort in the third stage was contesting. It was how the farmers’ institutions could carry out roles to get support from various parties, mobilise the existing support, and fight for the interests of their members to get a better irrigation environment as explained below:

A. **Shifting from the external to internal support**

In the beginning, the GWUAs proposed irrigation cleaning activities to the Ministry of Agriculture because the Agricultural Agency was deemed not to have made any response. It turned out that the Ministry of Agriculture also did not take action expected by the farmers. Based on this condition, the GWUAs changed their strategy by activating the internal participation of their members, which had previously been minimal, through the preparation of irrigation cleaning schedules and asking the members to participate in these activities.
B. The strength of internal movement of the organisations
The choice to independently handle irrigation cleaning would require a large contribution from the members. Encouraging the presence of member farmers, raising funding, providing food and drinks, and preparing equipment would be the task of the organisations so that the activities could run. In its implementation, the presence of the farmers was still low, funding came from the members and assistance from universities, food and beverages were presented in a simple manner, and the tools used for community service were the farming tools they had.

C. Fighting for clean irrigation
The GWUAs fought for the creation of clean irrigation by conducting irrigation cleaning independently to show the seriousness and strength of the farmers. In addition, it is necessary to carry out further advocacy through official and scientific forums to encourage the attention of regional authorities which handled agricultural and irrigation issues to support the activities of the farmers and take responsibility for the conditions that occur.

4. Discussion
The trash problem in the irrigation canals became a trigger of the increasing activities of the GWUAs in the form of members’ meetings, tracing and listing irrigation issues, and irrigation maintenance. Communication among the farmers in their meetings and activities pertaining to irrigation maintenance had raised collective awareness to support other GWUAs’ activities.

Irrigation canals that were cleaned included primary, secondary and tertiary ones. This indicate the understanding of the farmers about irrigation as an integrated upstream-downstream system, but also their concern about the extent of trash pollution in irrigation. In a situation in which the farmers had developed awareness and readiness to participate, the government would need to take quick and appropriate actions in form of support needed, which covered strengthening the institutionalisation of the farmers, providing equipment or tools, improving cleaning of primary and secondary canals, which were the government’s work areas, and collaborating with the farmers and community.

Support from the local government was expected to improve the effectiveness and outreach of the maintenance of irrigation areas that could not be fully reached by the farmers. Community participation was also needed to deal with trash in a friendly way.

5. Conclusion
Factors that underlining the readiness of water users’ institutions in irrigation maintenance was formal communication in the form of meetings with their members, data collection on the conditions of trash pollution in irrigation canals, cooperation with other parties, ability to carry out irrigation cleaning, and contribution to the implementation of irrigation cleaning activities.

According to the study, in total of 8 institutions were ready, scoring between 2.72 and 3.36, which means that the GWUAs were ready to participate but would need improvement in some aspects, that still showed low scores. A total of 11 institutions had readiness score between 2.08 and 2.72, which means that those GWUAs were not ready and that improvements would still be needed in regard to independence and activities undertaken. In a sequential order, the highest constraints of readiness included contribution and the implementation of cleaning activities, such as financing the activities and members' participation and equipment or tools in participatory irrigation maintenance.

The readiness and participation of the GWUAs will need to be improved through mentoring and technical assistance by the government. They must also be ready to change and become a learning institution so that they will become independent and have a positive response as well as build their capacity in condition where local and global environmental dynamics take place.

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