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## PARTICIPATIVE APPROACHES TO ENHANCE ADOPTION OF FASCIOLOSIS CONTROL STRATEGIES IN CATTLE, IN YOGYAKARTA PROVINCE, INDONESIA

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### ABSTRACT

Fasciolosis is a widespread, significant, endemic problem in cattle in rice-growing areas of Indonesia. Its effects are usually sub-clinical so it remains largely unrecognised by farmers and extensionists. Indonesian and Australian parasitologists have developed a suite of control strategies. Initial attempts to promote these strategies through Transfer of Technology (TOT) approaches achieved increased awareness, but little lasting change in farmer practices was evident 4 years later. This paper reports on the process, and early promising results from, an initiative to trial a Participatory Action Research (PAR) methodology to stimulate an extension process whose outcome is effective, sustainable fasciolosis control in Yogyakarta Province, Indonesia. In PAR, groups of farmers, extension agents and scientists work closely in a cooperative and flexible process, to resolve commonly identified problematic issues. The emphasis is on working with rather than for people through an interactive process to enhance opportunities for learning by doing. The process involved working through a four-step process to gain credible access to four farmer groups in three villages identified as having a fasciolosis problem. This was followed by a 9-month long series of activities, coordinated through farmer group meetings, which included (1) creating awareness through developing a media package, and then maintaining farmer involvement through (2) design and execution of field trials, (3) monitoring results, and (4) presentation and discussion of results with farmers. Group meetings were an important part of the information exchange process, and the use of learning aid tools was regarded as complementary for interpersonal communication.

Of the four recommended control strategies, two were already practised for reasons other than fasciolosis control, one was acceptable but had prohibitive cost, and the fourth was unattractive because it was technically difficult to implement. A significant development was a new strategy generated within a farmer group that was adopted readily by other groups. We conclude that adoption of technical innovations by farmers depends largely on two issues: (i) the nature of the associated farming systems, and (ii) the way in which the innovation is presented through extension agency activity. A participative approach appears to have considerable potential for stimulating significant practice change, particularly if it incorporates farmer involvement in generation and dissemination of locally relevant knowledge and recommendations. PAR fosters such a reflexive approach.

**Key words:** Fasciolosis control, participatory action research, adoption process

### INTRODUCTION

Fasciolosis is a common disease in cattle and other ruminants caused by parasite *Fasciola*

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*F. gigantica* known as liver fluke. The disease is widespread in South East Asia and many other humid tropical regions. Roberts and Suhardono (1996) identified the highest prevalence of fasciolosis in cattle and buffaloes in Indonesia associated with production of irrigated rice. It reduces draft, production and reproductive efficiency of cattle and buffalo due to poor feed conversion, and has a debilitating effect on animals. It also contributes to liver condemnation. The distribution of *F. gigantica* depends on the presence of an intermediate host, *Lymnaea rubiginosa* in irrigated rice fields (Suhardono et. al., 1988; Estuningsih and Copeman, 1996; Widjajanti, 1998)

Fasciolosis is mostly chronic and subclinical, so production losses are hard to observe. Consequently, little control is practised because the lower level of weight gain, reproductive rate and draught output is largely unrecognized by farmers.

A set of strategies for fasciolosis control in cattle and buffaloes, in areas where irrigated rice is grown extensively, was developed in West Java by a team comprised of parasitologists from the Research Institute for Veterinary Science (Balitvet) in Java, and James Cook University in Australia, supported by ACIAR Project 9123. These strategies were reported by Suhardono et al. (1998):

- **Strategy 1:** Grazing control. Prevent animals grazing in the rice field adjacent to a village or cattle pen for up to a month after harvest, to reduce their risk of ingesting metacercariae.

- **Strategy 2:** Feeding control. Feed only the top two-thirds of freshly cut rice stalks, cut 20-30 cm above water level, to avoid feeding metacercariae, and dry the lower third of the straw in sunlight for 3 days before feeding.

- **Strategy 3:** Biological control. Before using cattle dung as fertiliser in the rice fields, mix it with duck or chicken manure naturally infected with *Echinostoma revolutum*, or build the duck/ chicken pen side by side with the cattle pen.

- **Strategy 4:** Chemical control. A single anthelmintic treatment with Triclabendazole given one month after the end of the last regional harvest in the dry season.

A pilot extension program to introduce fasciolosis control strategies to farmers was first conducted in Surade, West Java in 1996 (Martindah, et. al., 1998). It also provided a test of suitable extension methodology. The pilot showed that the Transfer of Technology (TOT) technique created awareness among respondents. The villagers then conducted intuitive cost-benefit analysis and agreed to adopt 2 of the 4 strategies. However, an evaluation four years later of longer-term benefits in terms of both sustained reduction in the level of infection and retention of knowledge on control, found there was little adoption evident (Martindah, et. al., 2000). This is consistent with Blacket (1996), who said that the TOT model can create awareness of an issue, but this awareness does not easily translate into understanding or change. Frank (1995) notes that farmers will listen politely to the advice of visiting agents and disregard it, because the costs they perceive will exceed perceived benefits.

From the previous experience, and with extension input from University of Queensland, we learned that effective extension is not about transfer of technologies, it is about developing human and social capital (knowledge, understanding, motivation, skill, attitudes, behaviour) for individual and community to implement and maintain activities (Uphoff, 1999). To promote sustainability of fasciolosis control strategies, we stepped away from the traditional linear concept of technology transfer. In its place we developed a participatory approach, in which farmers could learn to identify problems that limit their productivity in close collaboration with field extension workers and research scientists.

Participatory Action Research (PAR) combines research to understand the problem situation with action to improve it using a cyclic process which alternates between action and critical reflection (Dick, 1999). PAR involves farmers in the research process, the aim is to foster a collaborative research process (Cornwall and Jewkes, 1995). It means that farmers become directly involved in research that is appropriate to their needs. Group meetings are an important part of the information exchange process. Emphasis of the participatory approach is on working with people rather than working for people. Extension is most effective when it is participative through an interactive process, if potential user (farmers) and extension agent are able to interact with researchers to enhance opportunities for learning by doing (Knowles, 1990). The Participative Action Model (PAM) (Chamala, 1995), for example, describes criteria for effective partnership between people at different hierarchical levels in cooperating organisations, in order to negotiate desirable change.

## **PROJECT OBJECTIVES**

In this situation, extension agents had a difficult task creating an awareness of fasciolosis in the target group, as the problem and its consequences are not clearly visible. In light of the ineffectiveness of TOT in stimulating long-term change in understanding and behaviour, a revision was required. Consequently, two objectives were formulated:

1. To revise the fasciolosis extension program used in Surade, for conduct in Yogyakarta province using a participatory approach, to give farmers and other stakeholders a greater sense of involvement.

This was to be achieved through encouraging and enabling key stakeholders to work together in a cooperative and flexible social process to facilitate awareness, consideration and implementation of the four fasciolosis control strategies.

2. To use this situation to develop and test a suitable extension approach for introducing fasciolosis control strategies that are consistent with established farming systems in other parts of Indonesia.

## **METHODOLOGY**

Participative Action Research uses qualitative techniques that emphasise the search for meaning in context rather than numerically measured data (Anderson & Poole, 1994). The qualitative data in this study is derived from joint use of a semi-structured questionnaires and interviews, field observations and field notes. The steps taken in the PAR process were as follows:

1. Development of a promotional package
2. Gaining provincial and district endorsement
3. Conducting a collaborative workshop and co-ordination meeting
4. Purposive selection of village field sites
5. Conducting a series of farmer meetings over an extended period (9 months)

These steps are elaborated below.

### **1. Development of a promotional package**

In order to illustrate the symptoms and effects of fasciolosis, a media package was developed prior to early meetings, including:

- (a) A set of photos for display at each meeting, and for extension staff; showing damaged vs. normal livers, host snails, flukes and metacercaria.



(b) An audio cassette in a local language describing the life cycle of the fluke and the strategies to control it.

(c) Brochures and leaflets to create awareness and basic understanding of fasciolosis, for wide distribution to other farmer groups, the University library, and other institutions within Yogyakarta Province.

(d) A booklet (Balitvet version) instead of a wall display to describe the epidemiology of fasciolosis in greater detail than the leaflets.

## **2. Gaining provincial and district endorsement**

An official visit was made to the Provincial and District Livestock Offices in Yogyakarta Province to get endorsement to survey and identify locations where fasciolosis is endemic.

## **3. Workshop and Coordination meeting**

In order for the fasciolosis control program to be sustained in the selected areas, the four strategies were introduced to a one-day workshop, where issues that might limit their implementation were negotiated and discussed. The workshop was divided into two sections:

- A workshop on control of *Fasciola gigantica* informed and introduced four fasciolosis strategies that were closely associated with the rice farming system in Yogyakarta Province. Sixty participants attended this workshop including government officials from province to district level, extension workers, and farmer group leaders.

- Coordination meeting: The 25 participants who attended the coordination meeting were all stakeholders who were expected to be involved directly or indirectly in the activities. The coordination meeting discussed the method of extending fasciolosis control by PAR and also negotiated a visit with each selected livestock village for conducting a benchmark study.

## **4. Purposive selection of village field sites**

Three districts (Sleman, Bantul and Kulon Progo/Wates) were recommended which met the following criteria:

- Rice growing area
- High population of cattle
- High prevalence of fasciolosis in cattle

Within these districts twelve 'livestock villages' were surveyed, showing that the prevalence of fasciolosis varied between 16% and 76%.

The selection process was 'purposive' in that it was primarily determined by the above criteria. Livestock villages were selected on the bases of a prevalence of fasciolosis exceeding 40%, and the extent to which farmers agreed to co-operate in the study. Four 'livestock villages' (groups) were selected for on-going extension activities (Table 1). This process of selection was also discussed with officers at Provincial and District Livestock Office levels, as well as with extension agents and representatives of the farmers from the survey areas. The intent of being 'purposive' was to focus extension program efforts on areas of greatest need, and to involve the farmers, thereby encouraging their commitment, support, and participation in planned activities.

Since fasciolosis is not clearly visible, most participants wanted a field extension aid (brochure, leaflet), or a demonstration so they could learn about fasciolosis and its control strategies. This was a good start as part of a participatory process for sharing ideas amongst the participants. Information was gathered from direct observation combined with a benchmark

Table 1. Farmer groups involved in control of fasciolosis, in Yogyakarta Province

District	Sub district (village)	Farmer group	No. of farmers	No. of cattle	Prevalence of fasciolosis
Sleman	Mlati (Cebongan-Tlogoadi) Tempel (Tambak rejo)	G1: "Margo Bhakti"	18	34	47%
		G2: "Sidodadi & Lestari"	48	80	40%
Bantul	Bambanglipuro (Bondalem)	G3: "Manunggal Lestari"	24	40	72%
	Bambanglipuro (Tangkilan)	G4: "Andini Rejo"	33	80	52%

study. The benchmark study used a semi-structured questionnaire to interview the farmers. The questions addressed the farmers’ personal background and their knowledge about causes, symptoms, treatment of infection and feeding management.

5. Conducting a series of farmer meetings over an extended period (9 months)

(a) Awareness. A series of meeting were planned in each cooperating village over 9 months after the second harvest period. The first important stage of the village extension activities aimed to create an awareness of the problem. At the farmers meeting in each group, we distributed leaflets and demonstrated the cercariae and eggs of *F.gigantica* under a binocular microscope, as well as dried fluke and the host snail. It gave farmers and extension agents an opportunity to learn.

(b) Drugs trials. These were carried out in each livestock village, organised by District Livestock Officers together with extension agents and active participation of the farmer group members. Through these, extension agents and farmers in each group could learn to identify the problem through observation.

(c) Faecal sampling. Faecal samples were taken from 4 groups and examined for evidence of parasite infestation in the Laboratory of District Livestock Services.

(d) Presentation of results and discussion. The results were presented to each group at the farmers’ meetings. Farmers then discussed the results and agreed to split the cattle that were positive for fasciola into two groups: control and treated. The farmers decided to observe those two groups for 1 month. Two people in each group were chosen as recorders, and 2 notebooks and pens were given to them to record their observation of control and treated groups.

RESULTS

Rice-livestock Farming System

The benchmark study showed that farmer members of the 4 groups worked primarily in rice fields, whether on their own land or on others’ as labourers; about 15% of them worked outside farming in varied occupations including school teachers, government officers, traders, and drivers. Keeping livestock (cattle) was not their main livelihood. The purpose of keeping cattle is as a form of saving, and animals are sold when farmers need cash. They keep only 1 or 2 cattle per household. About 40% of the farmers had more than 10 years experience in keeping cattle.

Results of the benchmark study indicated that farmers did not know about fasciolosis specifically; however, about 60% did know that cattle can be infected by worms, and that the





source of infection is either grass (44%) or cattle dung (14%). Most farmers believed that cattle infected by worms lose their appetite, and their coats lose their shine. Once such symptoms occur they would ask a veterinarian or paramedic to give anthelmintic treatment.

### **Farmers' observations after treatment**

In general, most farmers in the 4 groups realised that after one week of treatment, cattle in the treated groups were healthier than those in the control groups, in terms of increased feed consumption and better performance. They noted that 2 cattle in G1, and 3 cattle in G3 had diarrhoea on the 2nd day after treatment, but were recovering 3 days later.

Farmers in all 4 groups reported that they could not see the difference between untreated cattle, which tested positive to *Fasciola*, and cattle which tested negative. Consequently, farmers recording their observations of the untreated group said “no difference”, “they were like normal cattle”, or “as usual”. The farmers’ discussed their observations informally within each group and with others. Although the untreated cattle group seemed to look like normal cattle, the farmers had evidence of the better performance from the treated cattle. From this they concluded that when fasciolosis is present, ill thrift from the disease, although present, may not be clearly visible.

Consequently, most farmers, especially in G1, G2 and G3, requested anthelmintic (Triclabendazole) for the untreated cattle groups. One farmer (G2) with cattle in the untreated group asked veterinary services staff to treat his cattle soon after he realised that cattle in the treated group were getting better, rather than wait one month for the observation to finish. Owners of untreated cattle in G4 took 5 months to request such treatment, because they needed to discuss it amongst themselves, but rarely all attended the regular meetings together. Thus, the month-long group activities observing treated and untreated cattle stimulated most farmers to take action to resolve the problem.

## **IMPLEMENTATION OF THE CONTROL STRATEGIES**

### **Strategy 1: Grazing control.**

This strategy was not relevant in the 4 livestock villages (farmer groups) because cattle are already normally kept in pens at all times. Therefore, no change in current practice was required. Cattle are coincidentally prevented from grazing in freshly harvested rice fields.

### **Strategy 2: Feed control.**

The main feeding method for cattle is ‘cut and carry’ grass, with additional feed concentrates, provided to penned cattle. However, at harvest time most farmers also give the top part of fresh rice straw. Rice straw or other agricultural by-products are complementary to grass, which is grown along irrigation canals and along the dikes (pematang) between rice fields. Beside feeding grass and fresh straw, most farmers also stock dry rice straw. They dry the straw usually during the 2nd harvest time, in June/July, when there is enough sunshine, because the first harvest in March occurs in the rainy season. Farmers have developed the practice of using the top 2/3 of the straw for feeding, and removing the bottom part, because cattle do not like the bottom part and the farmers believe it is not nutritious. As with Strategy 1, current practice already complies with the recommendation. This means that two of the strategies to control fasciolosis were already, coincidentally, part of accepted management practice, for other reasons.

### **Strategy 3: Biological Control.**

This strategy was more difficult for most farmers in all groups to adopt. As a tradition, farm-

ers heap dung in the corner of or behind the cattle pens, for sale or use as fertiliser when it has dried. In the first planting season it is not used as fertiliser because it is hard work spreading the cattle dung onto irrigated rice fields when the land is wet and muddy. However, dung is used as fertiliser on dry (non-irrigated) land for peanuts, corn, watermelons and vegetable crops. It is also spread on the rice fields in October/November when preparing the land for rice. The practices of the rice-livestock farming system are shown in Figure 1.

Two farmers in G3 implemented the biological control strategy, then after 2 months another four farmers in this group followed them, keeping their ducks close to the cattle pens. The faeces of both species were mixed when the farmers swept the pen floors. This practice continued only for 4 months, however, because most of the ducks died after scavenging in a stream nearby, due to a poison ('potas') that is used to catch fish. They gave up keeping ducks, and did not want to substitute with chickens, because chickens around the cattle pens disturb the cattle.

Some farmers in G1 and G4 were also willing to keep ducks, but prevented from doing so by other farmers because ducks are likely to destroy rice plants in the fields. In contrast, through discussion among group members, farmers in G2 were uninterested in implementing this strategy because of the extra cost of building the pens, and buying the ducks or chickens. However, one G2 member was prepared to implement the strategy if he received some subsidy incentive to build the pen and stock it with ducks or chickens. The next G2 farmer meeting discussed this issue and it was agreed that incentives for this strategy could create jealousy amongst others. It was further agreed to refuse to allow ducks to scavenge in the rice fields unless they were herded, which effectively precluded this activity through lack of time. Farmers were sceptical as to whether it was worth investing their time and energy to implement this strategy, particularly if it offered little financial benefit or if there are considerable technical difficulties associated with its implementation.

However, the farmers themselves developed a modified biological control strategy that was more acceptable because of several advantages.

### **Strategy 3 (a) (Farmers' adaptation of strategy 3): Composting the cattle dung.**

After the biological control strategy with ducks failed, the group leader and 2 members of G3 decided to make compost from the cattle dung. Their purpose was to cut the life cycle of *F.gigantica* as well as to make a better quality fertiliser. The idea was based on their knowledge that the fluke eggs hatch in 9-12 days, and that the process of composting takes 3 weeks and generates high temperatures. They concluded that high temperatures would kill any hatching larvae well before the compost was applied to rice fields.

This idea was discussed at several meetings of G3 because of the farmers' differing perceptions of advantages and disadvantages. Some argued that the sale of cattle dung was already profitable for them without composting. Then the G3 leader asked the extension agent to explain how to make compost and what material is needed.

Together, group members calculated a simple cost-benefit analysis. Without composting, the value of 400-kg cattle dung was estimated at Rp. 20,000. The cost to make 400-kg of composted dung was much higher, at Rp. 44,200, but it also should be valued much higher, at about Rp. 100, 000. Even though the farmers did not include the value of their labour and time spent in their calculation, they were all enthusiastic, as it appeared to be profitable.

Finally, the farmer group G3 agreed to make compost collectively as a demonstration, and negotiated how much dung was to be collected and returned as compost to the owner. When the compost was ready, the farmer leader conducted his own trial to compare compost and chemical fertiliser for growing corn. He observed that corn with compost was growing better than





corn with chemical fertiliser and he showed his trial to the group members. Consequently, the group members were making compost for use on their own land.

Since the farmer group G3 succeeded, through an interactive process, to make compost, we negotiated with the farmers and extension agents to share their knowledge with the other groups, especially G1 and G4. Interested farmers from G1 and G4 as well as the extension agents and veterinary services responsible to those groups were invited to attend a farmer meeting in G3. They had a warm informal discussion, exchanged experiences and shared knowledge about what they could and could not do to control fasciolosis.

#### **Strategy 4: Chemical control.**

Most farmers in all four livestock villages accepted this strategy. Farmers decided to adopt drenching with Triclabendazole one month after the 2nd harvest period. However, prohibitive cost made this option unlikely to be adopted unless the cost was subsidised in some way.

#### **Finalisation of fieldwork (first cycle)**

To mark the end of this cycle of fieldwork, the progress of the fasciolosis control strategies was discussed at a special farmer meeting called to promote active reflection on the activities and their outcomes. A major output was a calendar of practice to guide implementation of the strategies as an action plan, made according to their own timelines, the local weather patterns, and rice-livestock farming activities.

### **DISCUSSION AND CONCLUSION**

The extension process began with acceptance of a problem by researchers, who recognised that they needed assistance in extension in order to achieve adoption of the strategies they had developed, since a TOT approach had been found to be unsuitable in the Surade work. Consequently, a participatory approach was adopted. In this approach, groups of farmers, extension agents and researchers worked closely to create and share information to reach a common and better understanding of the problem (Guerin and Guerin, 1994). The participative approach focused on collaboration with all relevant stakeholders. Participants were actively involved in a learning-by-doing exercise, which generated intrinsic motivation among all stakeholders: extension agents, researchers, veterinary services and farmers.

Hawkins et al. (1982) suggest that to work successfully with farmers, extension agents must respect farmers' skill and knowledge, and adjust to the farmers' situation. The relevance of the process to the local farming system was illustrated by the way farmers adapted strategies, for example composting and feeding upper stems for nutritional advantages. Such activities provide a learning situation through interactive process to allow and encourage every one in the group to participate. As the Transfer of Technology model had proved to be an inappropriate concept for fasciolosis control in this situation, the PAR (participatory action research) approach was chosen to improve participation of the farmers through active involvement in planning and implementation. The length of the decision process to implement fasciolosis control strategies varied between groups. Depending on the individuals' initial awareness, the decision to adopt could be immediate or take several months.

We concluded that farmers learn most and best from their experience, through an interactive learning process to help people understand their problem situation. Group meetings enable an interactive method of learning, and the use of learning aids helps interpersonal communication. However, the process that leads to a decision to implement fasciolosis control strategies depends on individual awareness and need. This need varied between and within groups.

With respect to the two research project objectives, we concluded that (1) the successful revision of the original extension approach had been largely achieved, and (2) there was considerable potential for this more participatory approach to be applied, with locally relevant modifications, in other situations.

The longer-term outcomes of this project continue under review in subsequent PAR cycles.

## REFERENCES.

- Aderson, J. & Poole, M.1994, Thesis and assignment Writing, 2nd .Ed, John Wiley and Sons, Brisbane.
- Blacket, D.S.1996, From Teaching to Learning: Social Systems Research into Mixed Farming, Department of Primary Industries, Brisbane.
- Chamala, S.1995, 'Overview of participative action approaches in Australian land and water management' in Participative Approaches for Landndcare: Perspectives, Policies, Programs, eds. S. Chamala & K. Keith, Australia Academic Press, Brisbane.
- Cornwall, A. & Jewkes, R. 1995, 'What is participatory research?' Soc.Sci.Med, vol. 41, no.12, pp.1667-1676.
- Dick, B.1999, 'What is action research?' Available on line at <http://www.scu.edu.au/schools/gcm/ar/whatisar.html>
- Estuningsih, S.E. & Copeman, D.B.1996, 'Trematode larvae in Lymnaea rubiginosa and their definitive hostin irrigated rice fields in West Java', J. Ilmu Ternak dan Veteriner, vol. 1, no. 3, pp. 200-205.
- Frank, B.1995. 'Constraints limiting innovation adoption in the North Queensland beef industry. I: A socio-economic means of maintaining a balanced lifestyle', Agricultural Systems vol. 47, pp. 291-321.
- Guerin, L.J.& Guerin, T.F.1994, 'Constraints to the adoption of innovations in agricultural research and environmental management: A review'. Australian Journal of Experimental Agriculture, vol.34, no.4, pp. 549-571.
- Hawkins, H.S., Dunn, A.M. & Cary, J.W. 1982, A Course Manual in Agricultural and Live-stock Extension. The Extension Process. Vol. 3. Australian Universities International Development Program, Canberra.
- Knowles, M.1990, The Adult Learner: A Neglected Species, 4th ed, Gulf, Houston,Tex.



Martindah, E., Kusumaningsih, A., Widjajanti, S., Partoutomo, S., Frank, B. & Suhardono 1998, 'Extension program on the control of bovine fasciolosis in West Java, Indonesia', J. Ilmu Ternak dan Veteriner, vol.3, no. 3, pp. 206-213.

Martindah, E., Cameron, D. & Frank, B. 2000, 'From top-down instruction to participative learning – new approach for extension in Indonesia', Paper presented in The third Annual Meeting of ACIAR Project ASI/96/160, 28-30 November 2000, Cambodia.

Roberts, J.A. & Suhardono 1996, 'Approaches to the control of Fasciolosis in ruminants', International Journal for Parasitology vol. 26, pp. 971-981.

Suhardono, Widjajanti, S. & Partoutomo, S. 1988, 'Freshwater snail of medical and veterinary importance in Indonesia', Proceedings of the Asian-Plant Technical Meeting on snail and slugs of Economic Importance, 22-24 June 1988, Bangkok.

Suhardono, Widjajanti, S. & Partoutomo, S. 1998, 'Strategi penanggulangan fasciolosis oleh *F.gigantica* secara terpadu pada ternak yang dipelihara di lahan pertanian dengan sistim irigasi intensif', Prosiding Seminar Nasional Peternakan dan Veteriner, Jilid I, 18-19 Nopember 1997, Bogor.

Uphoff, N. 1999, 'Understanding social capital: Learning from the analysis and experience of participation' in Social Capital: A Multifaceted Perspective, eds. P. Dasgupta & I. Serageldin, World Bank, Washington DC.

Widjajanti, S. 1998, 'Estimasi populasi siput *Lymnaea rubiginosa* dan siput air tawar lainnya di sawah dan kolam di Bogor, Jawa Barat', J. Ilmu Ternak dan veteriner, vol. 3, no.2, pp. 124-128.