REFEREED ARTICLE

DOI: 10.5836/ijam/2014-03-05

Structuring the problematic situation of smallholder beef farming in Central Java, Indonesia: using systems thinking as an entry point to taming complexity

N.A. SETIANTO[1,2], D.C. CAMERON[3] and J.B. GAUGHAN[3]

ABSTRACT

Improving smallholders' performance remains a seemingly intractable central issue for beef farming development in Indonesia. Studying a complex system such as beef farming requires a systemic approach. This paper reports on the combined use of three complementary systems approaches to structure and subsequently model the problem situation as the first research step towards seeking effective solutions. System Dynamics (SD) is considered to be a powerful methodology for taming the complexity of a system. However its problem identification stage has been criticized as being insensitive to the multiple interests and power structures likely to occur in a smallholder system. This study aimed to explore the possibility of combining Soft System Methodology (SSM) and Critical System Heuristics (CSH) to overcome that limitation and accommodate multiple perspectives including smallholder views on system improvements. A series of interviews and workshops involving 2 farmer groups was undertaken in Central Java, Indonesia. The benefits of inclusion of CSH in the research protocol included its ability to embrace the opinions of the less-powerful stakeholders - the farmers. Thus, for the stakeholders, it provides a better understanding of the system than provided by a combination of SD and SSM, and thereby the potential for facilitating development of more effective interventions.

KEYWORDS: Multi methodologies; System Thinking; Soft System Methodology; CATWOE analysis; Critical System Heuristics

1.Introduction

Beef Farming in Indonesia

The imbalance of beef supply and demand is a crucial issue for agricultural development in Indonesia. In the decade to 2012 the cattle population increased from 11.1 to 14.8 million animals (DGLVS, 2012). However, beef demand was also increasing due to a combination of population growth of 1.49% per annum (Rahayu, 2011), and increasing per capita consumption of animal-protein sourced products, including beef (Darajati, 2009; Fabiosa, 2005; Pingali, 2007). Although many government programs have been introduced to boost the Indonesian cattle population, in 2012 Indonesia still imported 283,000 of live cattle, equal to 51,000 tons of carcass, and 34,000 tons of frozen beef. In total, this comprised 17.5% of the national consumption (Director General for Livestock and Veterinary Services, 2012).

Smallholder beef farming

Improving smallholder performance is the key to developing Indonesia's beef industry (Hadi *et al.*, 2002). With a typical farm size of 1–4 cattle/farmer, there are more than 4 million beef-farming households in Indonesia (Boediyana, 2007). Zero-grazing is the common feeding strategy. Cattle are kept in sheds and farmers cut grass from forests, fallows, rangelands, roadsides, wastelands, and post-harvest cultivated areas (Devendra and Sevilla, 2002). For smallholders, cattle are not merely a source of income, but are also a valuable asset (Patrick *et al.*, 2010), a wealth status indicator, and an economic buffer for the household (Huyen *et al.*, 2010; Stroebel *et al.*, 2008; Dovie *et al.*, 2006; Siegmund-Schultze *et al.*, 2007).

As part of an agricultural system, smallholders have intense interconnectedness both within their own households and to the wider community (MacLeod *et al.*, 2011). Smallholder farming involves not just biophysical,

Original submitted December 2013; revision received March 2014; accepted March 2014.

[1] Faculty of Animal Science, the University of Jenderal Soedirman, Indonesia.

[2] Corresponding author: Room 228 Building 8117A. School of Agriculture and Food Sciences. Faculty of Science. The University of Queensland. Gatton Campus, Queensland, Australia. novie.setianto@uqconnect.edu.au Phone: +61-478045646

[3] School of Agriculture and Food Science, the University of Queensland, Australia.

but also social, ecological, political and economic elements (Snapp and Pound, 2008; Tavella *et al.*, 2012). In addition, as demonstrated by Hounkonou *et al.*, (2012), smallholders engage with a wide variety of actors whose interests are varied. Acknowledging these varied interests is an important aspect of a successful development strategy (Binam *et al.*, 2011; Drafor, 2011; Kaufmann, 2007).

In the developing world, smallholder groups are typically characterized by the occurrence of power asymmetry, a condition where some people or groups of people are more favored and have dominance over others who are marginalized (Ayittey, 2006; Hounkonnou *et al.*, 2012). In cultural terms, a common aspect of Indonesian society is the existence of a social hierarchy in which asymmetrical power relations are common, leadership styles are mostly top-down, and communication is indirect, averting direct negative feedback (Hofstede, 2001). Thus, dealing with smallholders requires an approach which is sensitive to this power inequality.

This paper reports on part of a research program focused on developing strategies to improve smallholder beef farming in Central Java, Indonesia. The target population is the farmer groups which received aid through the *Graduates Support Farmers Program* - one of the major programs specifically designed to promote cattle breeding to support national beef self-sufficiency. Each group is assisted by a university graduate in animal or veterinary science.

Systems thinking methodology

Systems thinking emerged for dealing with complex problems (Maani and Maharaj, 2004; Kapsali, 2011) which provides a framework for seeing dynamic interrelationships and patterns of change as *a whole* (Senge, 1992). Senge uses a simple metaphor to explain the importance of seeing things as a whole: ''Dividing an elephant in half does not produce two small elephants'' (Senge, 1992). A system is more than the simple sum of its parts and dividing them will often result in incomplete and irrelevant outputs.

System Dynamics (SD) is considered to be an important methodology in systems thinking because it has the power to build a rigorous model which represents the dynamics of the real situation (Jackson, 2002; Rabbinge *et al.*, 1994; Rodriguez-Ulloa and Paucar-Caceres, 2005).

The entry point of SD is problem identification, known as ''*problem structuring*'' (Maani and Cavana, 2007; Maani and Cavana, 2002; Sterman, 2000). This is an important step to justify and clarify the purpose of the whole SD process. However, at this stage of SD it is considered to have limitations because it tends to neglect the stakeholders' interests, which are likely to be varied (Rodríguez-Ulloa *et al.*, 2011; Lane and Oliva, 1998), as well as being insensitive to power structure issues (Jackson, 2002). These limitations will be exacerbated when dealing with smallholder farming which typically exhibits both issues.

Soft System Dynamics Methodology (SSDM) which combines SD with Soft System Methodology (SSM) is one of the approaches that has emerged to overcome these limitations of SD (Rodriguez-Ulloa and Paucar-Caceres, 2005). SSM is regarded as being sensitive to multiple stakeholders' interests (Hardman and Paucar-Caceres, 2011) although it has been criticized for lacking sensitivity to power structures (Mingers, 2000; Flood, 2000). SSDM employs two main features of SSM; *the rich picture* and *the CATWOE analysis*.

Typically, a rich picture is a cartoon-like summary of the system which describes diagrammatically the main variables and issues involved in the system. The CATWOE (Customers, Actors, Transformation, Worldview, Owner, and Environment) analysis helps to define how human activity contributes to the problematic system, and subsequently develop a *root definition of the system* (Checkland and Poulter, 2006; Maani and Cavana, 2007; Wilson, 2001), ''a concise, tightly constructed description of a human activity system which states what the system is'' (Checkland, 1999). Both tools are intended to make it easier for all stakeholders to 'see' the problem and therefore encourage them to be more 'involved' in the process of structuring the problem (Checkland and Poulter, 2006). This is where SSM is considered to be sensitive to multiple stakeholder perspectives (Jackson, 2002).

As mentioned above, despite this advantage, SSM has also been criticized for being insensitive to power structures (Mingers, 2000; Flood, 2000). In order to deal with the distortions introduced by power asymmetries in the target groups, this study complemented SSDM by incorporating aspects of Ulrich's Critical System Heuristics (CSH) (Ulrich and Reynolds, 2010; Ulrich, 1983). CSH is considered to provide enhanced sensitivity to the societal power issue, even in certain coercive situations (Flood and Jackson, 1991; Reynolds, 2007; Jackson, 2003) through its use of 12 boundary critique questions, each asked, in *is* and *ought* mode. System stakeholders are asked to respond to these questions, usually in separate iterations of interviews or focus groups, to contrast what the system currently *is* with what it *ought to be* (Flood and Jackson, 1991; Midgley, 2000), as presented in Table 1. Such a process enables system designs or proposed designs to be carefully interrogated as to their partiality and also provides criteria for debate between stakeholders, including not only those involved in systems design but also those affected by the designs but not involved (Jackson, 1991).

This paper proposes an approach to enhancing the problem structuring stage of the SD approach, as a way to ensure development of better outcomes. It employs a combination of both SSM and CSH frameworks in an effort to provide methodology which is able to produce a rigorous model that not only acknowledges the multiple perspectives of different stakeholders but is also sensitive to social power structures. Such methodology is required to study the problematic situations of the smallholder as the initial step in developing appropriate interventions.

2. Methodology

The study took place within 2 purposively-selected farmer groups in Central Java, a major beef producing province in Indonesia. Both groups had been participating in the *Graduates Support Farmers Program*, but with disappointing results. Despite the program focus on

Table 1: CATWOE questions of SSM

No	Element	Question
1	Customers	Who are the system beneficiaries?
2	Actors	Who transforms inputs to outputs?
3	Transformation	What transformations exist?
4	Worldview	What is the reason for this transformation?
5	Owners	Who can stop or change this transformation?
6	Environment	What constraints are there in the immediate surroundings of this transformation?

Source: (Checkland, 1999; Checkland and Poulter, 2006).

improved breeding performance, results to date included a long calving interval (>500 days) with a very low (3%) rate of second calving (Yuwono and Sodiq, 2010). Consequently, farmers had suffered losses rather than improved productivity and financial outcomes (Sodiq, 2011).

Clearly, there were problems involved. However, it is not easy to define *the problem* without oversimplifying the situation, as farmers thought that they were conducting their farming routines as usual. Therefore, instead of defining the problem, this study tried to explore *the problematic situation*, defined as an uncomfortable situation which provokes people to think that something needs to be improved (Checkland and Poulter, 2006). The problematic situation was then structured as an input to determine proper intervention strategies.

Four stages of field study were undertaken to explore and structure the problematic farming situation. This was commenced by conducting interviews with all actors involved, followed by a workshop to confirm the findings. Then a further set of interviews was undertaken to map the problematic situation. Finally, another workshop was performed to finalize the results. The methodological steps of the research are presented in Figure 1.

Expressing the flux of everyday farming

This stage was aimed to capture the current farming situation. It commenced by conducting a meeting with the farmer groups' representatives to gain mutual understanding among researcher and participants with regard to the objectives and the approaches of the study. Canvassing farmers' perspectives from an early stage was aimed at building farmers' sense of being acknowledged; this was expected to endorse future cooperation. Additionally, elaborating perspectives of farmers and other identified actors was expected to create a situational understanding that the problem was as identified by stakeholders, not researchers, and the action objective selected was defined and desired by them, thereby encouraging participation (Checkland and Poulter, 2006).

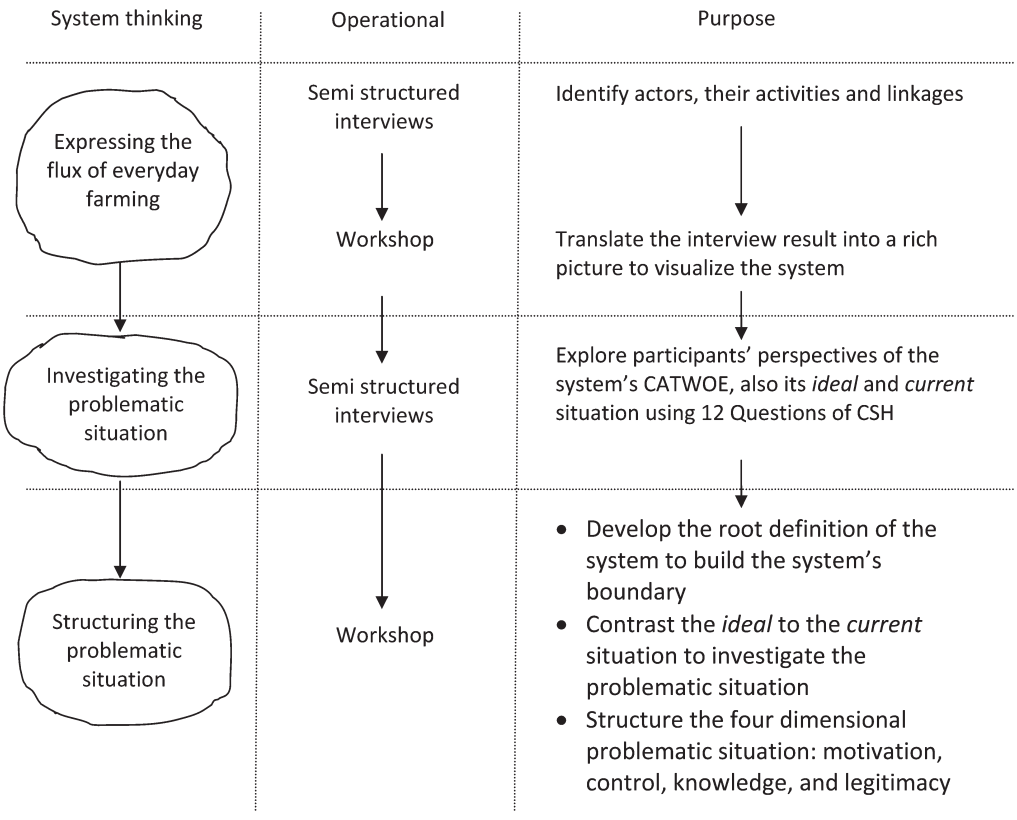

Figure 1: Methodological steps

The next activity was a series of semi-structured interviews undertaken with all farmers in the two selected groups. The open nature of semi-structured interviews ensured the participants were free to express their opinions without any structural interference from the researcher (Checkland, 1999). However, as points of reference for interviewees the researcher set three elements to be identified: *the actors*, *the activities* and their *linkages* in the system. As a result, in addition to farmers and their households, 4 other actor groups were identified: university researchers; livestock service officers; cattle traders; and the program coordinator. These identified actors were then interviewed to enrich the perspectives.

Following the interview series, a workshop involving farmers, graduates, extension agents, cattle traders, and the program coordinator was conducted for each group to develop the rich picture. The workshop took place in the residence of one of the farmers, so that participants would feel at ease in familiar surroundings.

The list of actors obtained from the interviews was presented on a poster-sized paper for discussion by the participants. Afterwards, based on findings from the interviews, a diagram of the linkages among actors and their activities was drawn by the researcher as a draft of the rich picture. This draft was then critiqued by all participants to ensure that it best-represented the real world situation.

Investigating the problematic situations

Another series of semi-structured interviews of the same participants was then conducted to explore participants' perspectives on the situation considered as problematic. At this stage, SSDM used the CATWOE questions of SSM to harness the problematic situation of the system (Rodríguez-Ulloa *et al.*, 2011). However, this study complemented the CATWOE questions with the 12 boundary critique questions of CSH to investigate whether CSH was able to enhance the CATWOE analysis and how its sensitivity to power asymmetry was able to assist participants to identify problematic situations.

The interviews started with the CATWOE questions of SSM (Checkland, 1999; Checkland and Poulter, 2006) (Table 1).

This was followed by the 12 boundary critique questions of CSH (Ulrich, 1983) (Table 2). To make it easier for the participants, the 12 questions were first posed in the "ought to be" mode (Ulrich and Reynolds, 2010), following the recommended question sequence by Reynolds (2007). During interviews, the rich picture was displayed for reference.

Structuring the problematic situations

The results of the interviews were then collated and listed by the researcher for discussion at the second workshop to structure problematic situations. There were three phases. In the first, the discussion was focused on CATWOE analysis to help develop the root definition of the system. The next phase consisted of discussion of the *is* and the *ought to be* modes of the CSH. Finally, the participants were asked to critique the gap between the actual and the ideal situation. During the discussion, the rich picture was also displayed for reference.

The gap critiques were then compiled by the researcher to build the structured problematic situation of beef farming in four dimensions: motivation; power control; knowledge; and legitimacy (Ulrich and Reynolds, 2010). Finally, in consultation with key informants, variables which seem to drive the problematic situations were investigated.

3. Results

Current farming activities

Figure 2 presents the translated version of the original rich picture developed in the workshop. Diagrammatic visualization is important, because it can portray simply but effectively how the system works (Salles and Bredeweg, 2006; Salles *et al.*, 2006). Furthermore, visualization encourages learning more so than equations or numbers (Mayer *et al.*, 1996; Moreno *et al.*, 2011).

The rich picture developed depicts the system at farm-household and community level (McConnell and Dillon, 1997). A total of 5 actors were identified to have a relationship with the group's farming activity: university; government; peer-farmers; cattle traders; and farmer households. The role of each actor is presented in Table 3.

At the household level, all farmers in both groups had rice plantations; these ranged in area from 1,250–12,500 m^2, with a mean of 2,830 m^2. Almost 75% of them had a farmed fish pond (average size 288 m^2); and 32% of them had a fish pond and a rice plantation. All these activities were conducted by the household head, because fewer than 25% of farmers in each group made use of family labor. However, they could employ casual workers whenever needed, usually during planting, weeding, and harvesting.

At the broader level of community system, these farm households were connected into a broader group activity of beef farming. As a system, beef farming in both groups was linked to farm-households for supplying labor and rice straw. In return, beef farming supplied households with cash and manure, either for fish ponds or for cropping. River banks and forest margins were the two main locations where farmers could collect forage for their cattle.

Problematic situation

The second interview series provided inputs for the workshop session designed to identify and structure the problematic beef farming situation. Results of the CATWOE analysis from the workshop are presented in columns 1 and 2 in Table 4. Following Checkland's SSM (Checkland, 1999), the root definition of the system was formulated as follows:

> *"A farmers' group-owned system which, under the constraints of feed availability, price uncertainty, lack of access to markets, and unfavorable pricing policy, receives government grant assistance and transforms cattle into cash through raising cattle, mostly by fattening. The transformation is carried out by farmers, and directly affected by cattle traders, farmers' household members, and the government. The worldview behind this transformation is to generate additional revenue to the farmers' household"*

Table 2: The 12 boundary critique questions of CSH

No	Element	Question (*is* and *ought* mode)
1	Beneficiaries	Who *are/ought to be* the actual beneficiaries of the system, i.e. belong to the group of those whose interest and values are served?
2	Purposes	What *is/ought to be* the actual purpose of the system?
3	Measure of success	What *are/ought to be* the system's measures of success?
4	Decision maker	Who *is/ought to be* the decision maker, i.e. in control of the conditions of success of the system?
5	Resources	What resources *are/ought to be* under the control of the system?
6	Decision environment	What conditions of success *are/ought to be* outside the control of the system decision maker?
7	Expert	Who *are/ought to be experts* i.e. who provides relevant knowledge and skills for the system?
8	Expertise	What *is/ought to be* relevant knowledge and skills that should flow into the design of the system?
9	Guarantor	What or who *is/ought to be* the regarded as guarantor, providing assurance of successful implementation?
10	Witness	Who *are/ought to be* the witnesses, representing the interest of those negatively affected but not involved with the system?
11	Emancipation	What *are/ought to be* the opportunities for the interests of those negatively affected to have expression and freedom from the worldview of the system?
12	Worldview	What space *is/ought to be* available for reconciling differing underlying worldviews about design of the system among those involved and affected?

(Ulrich and Reynolds, 2010; Georgiou, 2012).

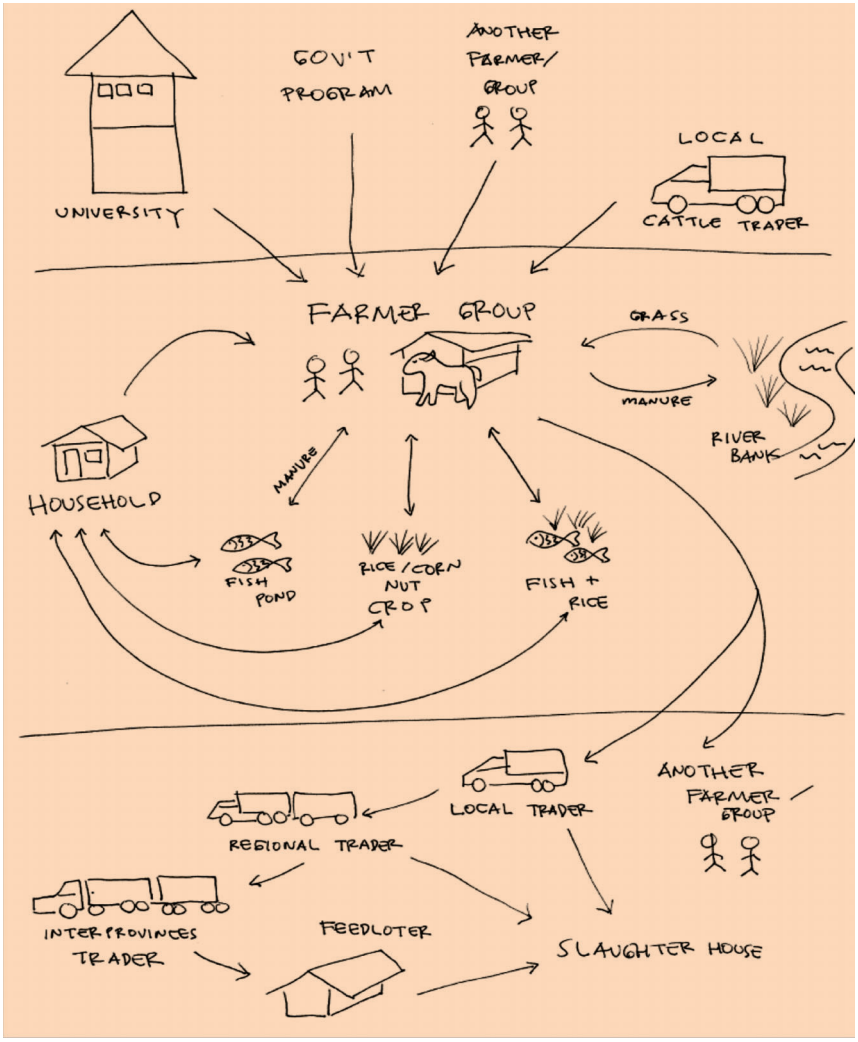

Figure 2: Rich picture of smallholder beef farming

Table 3: Actors of the beef farming system

No	Actor	Role
1	University (Faculty of Animal Science)	Provide expertise to improve farmer's knowledge and skills particularly on veterinary and feeding technology Give recommendations to farmer groups when applying for government program aid Manage the program implementation at the local level
2	Government	Extension services and artificial insemination
3	Peer-farmers	Including group leaders, are sources of information, knowledge and skills Buy or sell cattle from and to other peer farmers
4	Cattle traders	Provide stock whenever farmers need to buy cattle Buy and sell cattle
5	Farmers' household	Provide labor when required to help the household head to manage their resources

Transformation (T) is the core of the root definition encapsulating the concepts of the system. This transformation expresses any purposeful activities which "*change or transform some input into some output*" (Hardman and Paucar-Caceres, 2011). In this context, participants suggest that the transformation existing in their beef farming is "*raising cattle to generate cash*". The CATWOE analysis also identifies some problematic situations: feed availability, price uncertainty, lack of access to market, and unfavorable pricing, all of which potentially obstruct the transformation process.

The next step in the process, to deal with the situation where asymmetric power is likely to exist, as in the case of smallholder farmers, was to direct the workshop discussion into addressing the 12 questions of CSH (12Q CSH), in *ought* (ideal situation) and *is* (current situation) modes. When mapping the ideal conditions, participants were able to reach agreement without lengthy debate. It took longer to debate the real *is* conditions, because of the quite different perspectives held by different participants. The argument divided participants into 3 groups: Group 1 (comprising farmers, graduates, group leaders, and traders); Group 2 (the government representatives); and Group 3 (the *graduates support farmer* program coordinator).

The results of the CSH explorations are shown in Table 4, columns 3–6. To help in structuring the problematic situations, these elements of CSH were categorized into the 4 dimensions of motivation, knowledge, power structure, and legitimacy (Ulrich and Reynolds, 2010). As shown in Table 4, the 12Q CSH were able to expand the *actors* of CATWOE into three elements (*expert, expertise* and *guarantor*) and *transformation* into two elements (*purpose* and *measure of improvement*), thereby providing a richer description of the system. Moreover it also provided a basis to encourage discussion among participants, because it allows critiquing of the actual compared to the ideal situation. Disparity of responses on the *purposes*, the *measure of improvement*, and the *worldview* in the actual condition reflect that CSH was able to elicit farmers' views which differed from those of the government and the university.

Further, each of the dimensions was explored to find out what were the reasons behind these gaps between actual and ideal conditions (Figure 2). These sets of reasons allow the researcher to generate conceptual models as an input to develop the appropriate intervention model. Compared to SSM, the 12 boundary critique questions of CSH clearly provide a richer description of the problematic situation of smallholder beef farming (Figure 3) which is an entry point to taming its complexity.

4. Discussion

This research showed that simple tools including development of the 'rich picture' and CATWOE analysis of SSM were useful in elucidating the real situation of the smallholder beef farming system. The hand-drawn rich picture encouraged farmers to comment and contribute to the discussion. Displaying the rich picture side by side with the table of the CATWOE analysis helped the participants to define their beef farming system as reflected in the root definition. To become operational, conceptual models which describe a set of logically-linked human activities required to improve the situation, should be developed based on the root definition (Checkland, 1999). However, in an asymmetric power situation, as in the case of smallholder farmers, it can be difficult to explore their opinions because of their low positional power (Hofstede, 2001); failure to recognize and accommodate this deficiency in research design thus might result in a less-than-comprehensive definition.

This is where 12Q CSH complements the CATWOE analysis of SSM. CSH enhances CATWOE in two aspects. Firstly, CSH enriches the criteria specified in the CATWOE. Six elements in the CATWOE were expanded into 12 elements in CSH as presented in Table 4. Secondly, CSH's ability to distinguish between *the actual is* and *the ideal ought to be* modes provides a construct for participants to make a comparison.

The *ought to be* mode of the 12Q CSH encouraged participants, including farmers, to speak and to give opinions about the ideal conditions for farming. Eliciting inputs about the ideal condition was easier because farmers considered it to be *risk-free*. It was more challenging interrogating the actual versus the ideal situation. The list of responses obtained from the previous farmers' interviews proved to be useful in initiating the debate. Using this list, even though comments were provided anonymously, made farmers aware that their opinions were also taken into consideration in the workshop.

Any gap between the real and the ideal situation indicates a potential problem which can be explored further. For the researcher, this was a practical tool, providing a reference point in interviews and a focus to encourage discussion. Without this tool, it would be difficult to define a problem because farmers commonly

Table 4: Stakeholder-generated CATWOE Analysis and responses to the 12 Questions of CSH

CATWOE(SSM)		12Q (CSH)			
Element	**Current situation**	**Element**	**Dimension**	**Ideal Condition**	**Actual Condition**
Customers	Farmers' household, cattle traders, government	Beneficiaries	Motivation	Beef farmers	Beef farmers (group member), cattle traders
Actors	Farmers	Expert	Knowledge	Farmers together with scientists, the local livestock service office and financial institutions	Group leader, peer farmers. (University and livestock office are always welcome to visit farmers, but farmers are mostly reluctant to come to their offices.)
		Expertise	Knowledge	Farming skills, marketing, network building	Feed preservation
		Guarantor	Knowledge	Knowledge and skills, objective, and politically impartial	Trust and social position
Transformation	Raise cattle to generate cash	Purpose	Motivation	To breed and raise cattle	Government: to increase beef population Farmers: to gain income
		Measure of Improvement	Motivation	Three indicators of improvement: number of cattle, income generated, group assets	Each pursued different improvement indicator; Government: cattle population; Farmers: sales revenue; Program coordinator: group assets
Worldview	To gain revenue for the household	Worldview	Legitimacy	To increase both cattle population and farmers' welfare	Farmers' worldview differed from those of government and program coordinator. Farmers view was improving their welfare; whereas Government and Program coordinator views were that the cattle population should be increased first, and then it would generate more income and improve farmer welfare.
Owners	Head of the group, farmers	Decision Makers	Control	Farmers	Group leader and program coordinator
Environment	Feed availability, price uncertainty, access to market, pricing policy	Resources	Control	Financial, high quality cows, feed, market access	Cattle bought mainly from grant, farmers provide feed, man power, and housing
		Decision Environments	Control	Fair pricing, fair market	Feed price volatility, dependency to local trader, imported live cattle, discouraging practice from politically-affiliated farmer group
		Witness	Legitimacy	Representative of the affected	Surrounding farmer, some group member feel as the affected of the program
		Emancipation	Legitimacy	Farmer groups offer a forum or media to discuss the affected perspectives	Routine monthly meeting, but mainly for members only

ISSN 2047-3710
170 International Journal of Agricultural Management, Volume 3 Issue 3

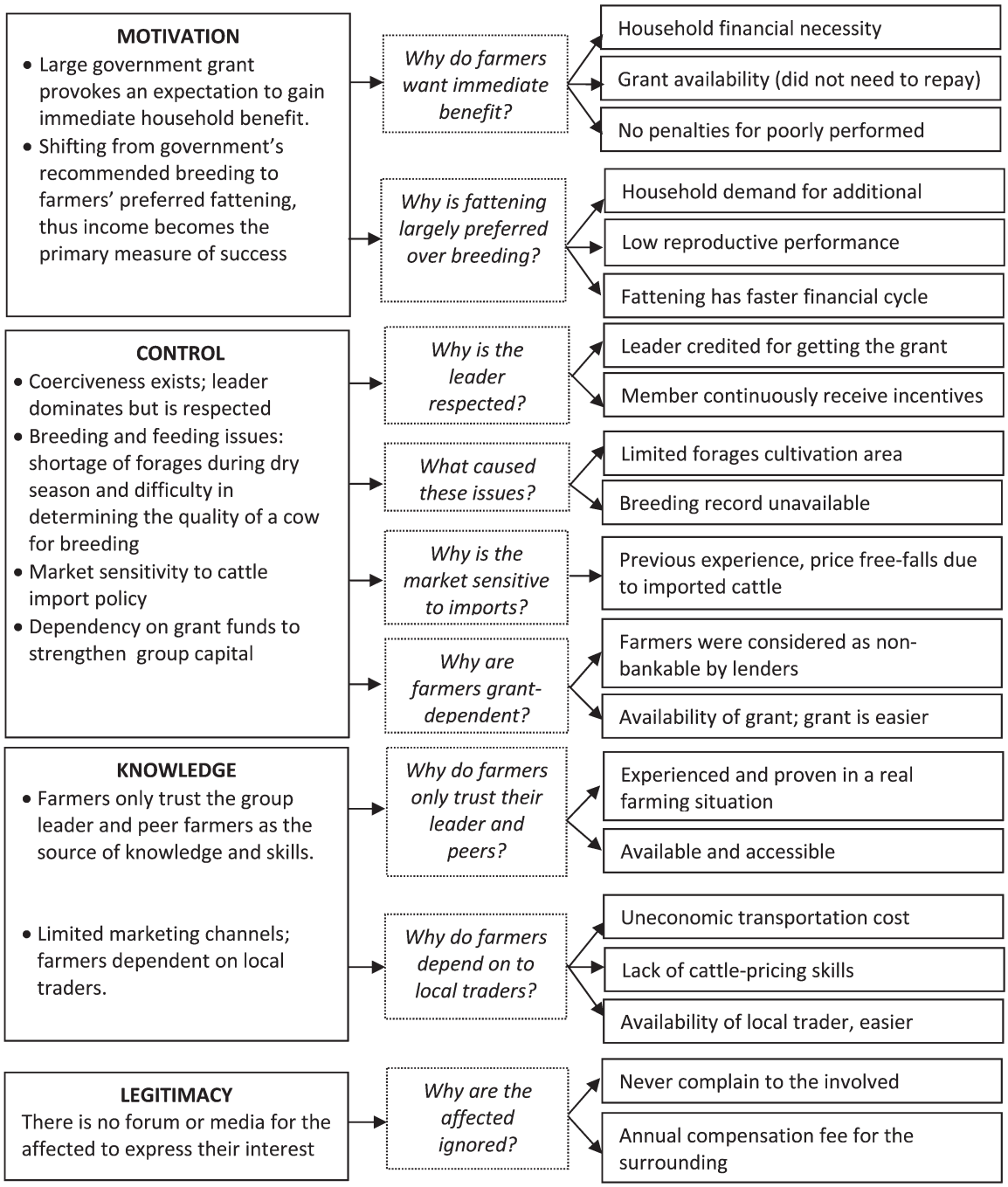

Figure 3: The problematic situation of smallholder beef farming in Central Java, developed from CATWOE analysis and the 12 questions of CSH

feel that the existing uncomfortable situation is "*normal*". This tendency is even more likely in a culture which has high power inequality as in Indonesia (Hofstede, 2001).

The fact that farmers and the government have different *purposes* and different *measures of improvement* indicates that with the 12Q CSH, farmers, although lacking positional power, were able to express their opinions. Purposes are closely related to motivations which will influence the level of engagement of the participants with the program (McAllister, 1999) whereas measure of improvement reflects *how participant measure the outcomes of the program*. Therefore a proper problem structuring method should elaborate purposes and outcomes in its framework (Midgley *et al.*, 2013)

Moreover, the four dimensions of the critiques (Figure 2) enabled the further exploration of the possible reasons behind the existing problematic situations. These reasons can be used as an input to design any possible and feasible intervention.

The combination of SSM and CSH facilitated the structuring of the problematic situations of the current smallholder beef farming system in a more sophisticated and holistic way than was provided by SSM alone. The combination of the methodologies was useful to identify and to structure the problematic situation of a system

which has multiple stakeholders and positional power asymmetry issues in particular. Once the problems were properly identified and structured, they could be used as the basis to develop further intervention strategies.

However, the combination had consequences in that it increased the complexity of the methodology. Participants should be exposed into two sets of interviews and workshops. At some level, this might create an ethical issue of excessive calls on farmers' time. Thus, in this study the workshops schedule were adjusted with the regular farmers' meeting so that farmers did not have to allocate extra time specifically for workshops. Another possible problem that emerged was that some elements of the CATWOE and the actual *is* mode of the 12 questions of CSH were similar. Exposing participants to similar questions repeatedly might also bring ethical consequences. Participants might feel bored at the repetition, or that they had been initially ignored, on being asked the same questions repeatedly. Nevertheless, experience from the study showed that this is worth to risk, provided participants understood the need for the lines of questioning and were actively engaged in answering them.

During the CATWOE analysis, all participants agreed with the result of the analysis but when they were exposed to the 12Q of CSH and asked to critique the differences between the ideal *ought to be* and the actual *is* situations, some disagreements occurred. The disparity between the farming objectives of different participants revealed in this study indicates that the methodology was able to embrace the opinions of the less-powerful stakeholders - the farmers. The availability of the contrasting constructs of the *ideal* and *actual* conditions clearly provides a reference point for participants to explore and debate their opinions.

5. Conclusion

Our results show that in comparison to using SSM alone, the combination of SSM and CSH enabled better structuring of the problematic situation of a complex system which had multiple stakeholders and probable positional power asymmetry issues as in the case of smallholder beef farming. The collaboratively developed rich picture was able to assist both the participants and the researcher to express opinions and also learn more about the current farming situation. Further, the CATWOE analysis of SSM and the 12Q of CSH were useful aiding thorough investigation and better structuring of the problematic situations.

However, despite the advantages of enabling the structuring of the problematic situation in a four dimensional diagram, the combination of methodologies has the disadvantage of increasing the complexity of the investigation. It also has limitation in describing the causal relationship between the actors, the activity, and the problematic situation. Nonetheless, it provides an entry point for taming the complexity of the smallholder beef farming system in Central Java.

About the authors

N.A. Setianto is a Lecturer at the Faculty of Animal Science, University of Jenderal Soedirman, Indonesia. Currently a PhD candidate at the School of Agriculture and Food Sciences, the University of Queensland, Australia.

D.C. Cameron and **J.B. Gaughan** are Senior Lecturers at the School of Agriculture and Food Sciences, the University of Queensland, Australia.

Acknowledgments

Directorate General for Higher Education (DIKTI) of the Ministry of Education and Culture of the Republic of Indonesia for the supporting funding for this research.

Anonymous reviewers whose constructive comments helped refine this paper to its final form.

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