

The post-disaster transformation of interspecies dependencies: From talkative buffalo to desemiotized cows on the slope of Mt. Merapi

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Abstract. This paper suggests how natural disasters may serve as the final propulsion for changes already taking place within a society. While focusing on shifts in human–non-human animal relations, this text also discusses their embedding in broader transformations of human–environment relations and the underlying economic and cultural change. It carves out interspecific dependencies that constitute an agro-ecosystem and follows their demise as the agricultural species are switched to market economic production in a post-disaster context. It thereby suggests that the human-facilitated semiotic fitting of the agricultural species is replaced by human-imposed fitting in which the species composition is largely determined by the market prices. At the same time, the paper draws attention to the cessation and transformation of human–non-human communication as a marker, but also an experiential corollary, of modernization and market economy. As a case study, it focuses on the 2010 Mt. Merapi eruption in Indonesia and its aftermath in the villages on its slope. The study analyses how the shift from using plough buffalo to utilizing market economic cattle farming reflects not just an economic, but also an affective and semiotic change stemming from a shift in the intensity and kind of human–animal relations.

Keywords: human–non-human animal relations; post-disaster social change; modernization; political ecology; anthropological zoosemiotics; semiotic fitting

Introduction

A catastrophic event can have a significant impact not only on the lives and livelihood of human inhabitants of the affected area, but also on its non-human

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inhabitants. Factors such as the history, prospects, and ideals of a community, as well as its regional and international socioeconomic position, play a role in shaping post-disaster agricultural species composition, and interactions between humans and non-humans. This paper aims to investigate the ways in which these factors interact in the aftermath of a disaster and how they influence the multispecies complex. The paper also examines the changes in the modes of human and domestic-animal interactions and communication in the aftermath of a disaster and how these changes reflect or defy dominant social changes. Natural disasters are discussed as catalysts of modernization, and the entanglements of post-disaster conditions and modernization are examined further.

Existing research on animals and disasters has been conducted in different disciplines, with a variety of foci. There are a number of studies on the role of companion animals in disaster responses and in disaster risk reduction (for reviews, see Day 2017; Travers, Tegeling, Rock 2017), with companion animals receiving more attention than farm animals both in research as well as in post-disaster management (cf. Glassey 2020; Irvine 2009: 42). Secondly, whole regional and national research programmes have been devoted to animals as biosensors for monitoring and predicting natural disasters. For example, in the 1970s such programmes existed in the U.S. (Aronova 2018) as well as in China (Fan 2018). Research on the abilities of animals to predict and detect natural disasters continues also these days (e.g. Wikelski *et al.* 2000; Garstang, Kelley 2017; Wikramanayake, Prithiviraj, Leimgruber 2006). Thirdly, animals are also studied as a source of livelihood security, impacting decisions of relocation (Lavigne *et al.* 2008; Donovan 2010). A fourth set of studies focuses on post-disaster change, as differentiated from direct and indirect impacts of a disaster (see Birkmann *et al.* 2010), and the role of (farm) animals in post-disaster transitions and adaptations (e.g. Dove 2008; Laksono 1988).

In the past decades, disaster research has included animals in the discussions of vulnerability (Irvine 2009: 6), while also paying attention to the welfare of animals in disaster-prone areas during and in the aftermath of disasters (Glassey 2020; Sawyer, Huertas 2018). The welfare and vulnerability paradigms of animals in disasters have also opened up the vista to studying animals in their own terms in disaster contexts. This has been accompanying the developments in multiple fields of humanities (e.g. multispecies geography, ethnography, etc.) that are “marked by [...] attentiveness to nonhuman agency” (Ogden, Hall, Tanita 2013: 16). Although strongly supporting such an agenda, at the same time this study proceeds from the assumption that the agency of domestic animals, defined among other factors by the animal’s ability to establish and relate to semiotic relationships (cf. Tønnessen 2015), is not just a species property, as Jakob von Uexküll’s *umwelt* theory would

presume (see Uexküll 1992[1934]). Rather, it is to a significant extent also confined to and shaped by the present socioeconomic network and the agro-ecological complex that it creates. It is therefore worthwhile investigating the conditions that allow for animal agency to be prominent in human–non-human animal interactions, and the conditions that suppress it and lead to its instrumentalization. In addition, under market economic conditions the inclusion of different plant and animal species in an agricultural complex is dependent not only on their ecological relations and fitting of their *umwelten*, but also on the food chains that are established through global monetary flows. Such agricultural complexes cease to exist as ecosystems, as the interdependencies of different species are cut to such an extent that they do not form a linked system any more, but become individual units of production instead.

In biosemiotics, the history and development of interspecific relations has been explained via the compatibility of different *umwelten* and the correspondence of the meanings of different organisms. In the words of Morten Tønnessen, Jakob von Uexküll's concept of fitting or matching (*Einpassung*), conveys the idea of any *umwelt's* complementarity to certain other *umwelten* and “that *Umwelten* and organisms evolve in conjunction with each other in ever new variations of ecological complexes” (Tønnessen 2022: 452). Also Kalevi Kull emphasizes the perceptual and semiotic component in the formation of interspecific relations, employing the concept of ‘semiotic fitting’ as “the agent's capacity for making and preserving the local semiotic bonds, meaning the agent's functional or communicational match with its surrounding” (Kull 2020: 9). However, we propose that in the context of the modernization of the agricultural complex, the analysis of the mechanisms of establishing interspecific relations should be supplemented with an analysis of the socio-economic conditions that set limits, but also new possibilities for certain interspecific links.

Hence, this paper firstly holds a political ecological focus, analysing how disaster as a natural and social phenomenon can serve as a capacitor of otherwise diffuse social and ecological effects, inducing the community to address the salient pressures of modernization. It thereby aligns with studies on disasters that view them as amplifiers and accelerators of ongoing social change (e.g. Oliver-Smith 1996; Dove 2008), but goes further to observe more specifically how the collapse of certain agroecological dependencies is translated into the inevitability of change. At the same time, this paper integrates political ecological observations with zoosemiotic ones, by examining how first-hand experiences with domestic animals are embedded in the broader social and economic transformations of a community. This approach is consistent with the argument made by Alf Hornborg in his critical appraisal of Tim Ingold's anthropology: “[...] the distortions of

experience [...] tend to be produced by the social and ecological conditions of modern society” (Hornborg 2018: 253). In line with anthropological zoosemiotics (Martinelli 2010: 121; Maran, Martinelli, Turovski 2011: 8–9), the paper examines the modes of human and non-human interaction and their role as reflectors of social and ecological shifts. In accordance with human-animal studies, it highlights how the distortions of experience mentioned by Hornborg apply to both human and non-human animals.

However, it is important to note that the methods used in this study allow for a more thorough comprehension of how humans perceive changes in their communication with domestic species and how they mediate the perspectives of their domesticates. A different methodology, involving detailed observations of the animals’ behaviour, would be required to address the animals’ perspectives in their own terms in a better way. We share similar challenges with other fields of multispecies studies in humanities. While the focus has shifted to include the perspectives and experiences of non-human beings, the methods used in these studies often remain rooted in traditional disciplinary practices. For example, Eduardo Kohn (2005) examines the human–non-human relations, but relies mainly on human-mediated accounts of the contact. Similarly, Eduardo Viveiros de Castro’s perspectivism (Viveiros de Castro 1998) features an ontology of a specific group of people. Despite not identifying themselves as part of the multispecies studies field, these authors have become key references in this field (see e.g. Ogden, Hall, Tanita *et al.* 2013; Kirksey, Helmreich 2010).

As a case study, we will use the shift from buffalo ploughing to beef cattle raising in the aftermath of the 2010 volcanic eruption of Mt. Merapi in the two highest hamlets within the Srumbung District, Magelang Regency, Central Java, Indonesia: Jengglik Hamlet (Ngablak Village) and Ngepos Hamlet (Srumbung Village). As of November 2021, Jengglik Hamlet had a population of 549 people (163 families), while Ngepos has 306 people (97 families). Nowadays, most residents in these two hamlets, along with other hamlets within the Srumbung districts, cultivate a species of palm tree *salak pondoh* (*Salacca edulis* L.) as their major resource of subsistence. In addition, the locals also raise livestock, such as cows, chickens, ducks, and goats. The infrastructure in the area includes a wide asphalt road connecting Ngepos Hamlet, the home to one of the Mt. Merapi observation posts, to Magelang and Sleman city centres. Additionally, a narrow village road connects Jengglik Hamlet to neighbouring hamlets, including Ngepos Hamlet. In those two neighbouring hamlets, the post-disaster shift from buffalo to cattle breeding represents a broader transition to modernization, and it also illustrates how the disaster-aided shift in species composition impacts certain traditional modes of interacting with other species.

Materials and methods

The empirical part of the paper is based on fieldwork conducted by the first author in August 2021 in the two neighbouring hamlets mentioned above, Jengglik Hamlet (Ngablak Village) and Ngepos Hamlet (Srumbung Village). Since the 1930 eruption of Mt. Merapi – the most active volcano in Indonesia – the direction of the lava falls and hot clouds stemming from the eruptions has often been the western-southwestern side of the mountain (Thouret *et al.* 2000; for a history of the eruptions of Mt. Merapi see Voight *et al.* 2000). Therefore, these two hamlets, located on the southwestern side of Mt. Merapi, are among some of the most vulnerable ones, and the 2010 eruption impacted them severely, although fortunately there were no human casualties in those hamlets. The dynamic relations between the eruptions and complex socio-cultural changes, including the shifts in animal husbandry, were the main reasons for selecting these areas as research locations for the study.

Empirical data for the study were collected during fieldwork through participant observations, semi-structured and open-ended interviews, and informal talks. The observations were focused on the locals' daily practices of raising livestock and cultivating *salak* plants. The interview topics included the oral history of the hamlets, the history of eruptions that had directly affected the hamlets, modes of farming and livestock raising and their changes over time, as well as changes in interspecific interactions, and the development of *salak* farming. On some occasions after the fieldwork phase, interviews were conducted online to explore certain topics in more depth. Ten key informants were interviewed (some of them several times), including a former head of a hamlet, cow farmers, former buffalo farmers, *salak* farmers, and local youths. Interviews were recorded, and each interview was preceded with the informants' consent to record the discussion and interview. Consent was also asked for the use of their data for this study. The informants remain anonymous in this article.

In addition, the first author had previously conducted longitudinal qualitative research among other local communities on the slopes of Mt. Merapi on other topics, especially concerning cultural changes following the 2010 eruption (Nazaruddin 2013, 2022). He initiated first interactions with the local people during the emergency responses of the 2010 eruption. During this emergency crisis, he was active as a reporter and editor of a community-based online media site dedicated specifically to the issue of the Mt. Merapi eruption. In 2013 and 2019, he conducted ethnographic fieldwork in some hamlets on the upper slopes of Merapi, focusing on post-disaster social and cultural changes. These prolonged interactions have allowed us to contextualize and grasp the broader picture related to socio-cultural changes within the local communities on the slopes of Mt. Merapi.

We conducted the data analysis in three major steps. The first procedure was data reduction, in which we selected the relevant information connected with the issue of human–farm animal relations and the agroecological systems and their transformations. The second phase was data categorization, conducted inductively based on the empirical data. At this stage, we analysed the information under the two subtopics of this paper: the embedding of animal husbandry in the agroecological and socioeconomic complex of the area and the communication modes between humans and their farm animals. As a third step, we integrated the empirical findings with political ecological frameworks on natural disasters and human–non-human animal relations and anthropological zoosemiotics, which allowed us to make further generalizations on the basis of the findings.

The entanglements of disasters and modernization

These days, discussions on modernization and disasters reflect the ideologies of different paradigms of disaster studies. The traditional hazard paradigm believed that “the transfer of technology from the developed to the developing world, as part of an overall modernisation process” (Smith, Petley 2009: 5–6) would significantly reduce human losses and disadvantages caused by natural disasters. This perspective, which views modernization as a solution to natural hazards, still influences academic work that focuses on hazards as independent and external to social context (see Perry 2007; Scott 2020) and grounds the practices of disaster risk reduction in some countries. This is reflected in the use of structural mitigation measures, i.e. the development of physical mitigation infrastructure, such as lava dams, flood embankments, etc., the measuring, scientific monitoring and prediction of geophysical processes, and the use of military forces as well as their military-style command model in the emergency responses (Hewitt 1983).

The vulnerability paradigm, in contrast, views the consequences of extreme natural events as the result of deeper, structural problems such as underdevelopment, political dependency, and the marginalization of poor people (Smith, Petley 2009: 6). This perspective argues that modernization, which is often seen as a model for social transformation and development in developing countries (Gwynne 2009) is “too much a part of the root causes that underly societies’ vulnerability in the first place” (Bankoff 2018: 224). In line with this paradigm, some studies have shown that modernization may increase vulnerabilities and create new hazards. For example, it has been suggested that the modernization processes, including the development of new industries, residential areas, and plantation fields in Japan’s mountainous regions may generate new disaster risk factors (Li, Hasemi, Nozoe

2019: 13). Other scholars have criticized the modernization of disaster management and risk reduction through the application of specific scientific knowledge, which is contrasted with the traditional or indigenous models of preparedness. Some of these studies have reached a common recommendation that the modern approach should not marginalize traditional knowledge and it should be aligned with existing risk reduction methods in the local communities (see Kelman, Mercer, Gaillard 2012; Fresnoza 2021; Dekens 2007).

The connections between modernization and disasters vary among communities at Mt. Merapi. In some of the Mt. Merapi communities, the transition toward a modern society has been in progress since the 1980s. Modernization, in this paper, is seen as advancement towards a free market economy, resulting in the generation of wealth and enhancement of living standards under capitalism, predominantly influenced by Western societies (Miwa 2017: 1). This limited view of modernization, linking it to capitalism and free market economy, has been widely criticized (see for example Wood 1997), as some scholars have argued for the clear distinctness of modernization and free market economy, although these are often closely related to each other. However, on the slopes of Mt. Merapi some of the main features of modernization, especially the modernization of knowledge systems, particularly the shift towards modern scientific knowledge (see Schoorl 1981), have been accompanied by livelihood changes and the spread of capitalism. This has resulted in a transition from a subsistence agriculture system to a diverse range of market-driven economic activities such as cattle farming, vegetable farming, tourism and mining (see Nazaruddin 2022). We have to add that different villages have adopted these changes at different rates and the embracing of different elements of modernization has not been conducted simultaneously. For example, in the middle of the 1980s, some villages on the north-eastern slopes within Boyolali Regency already practised market-oriented vegetable farming. In contrast to their modern livelihood, until 2021 local people in the highest hamlet within this area were still performing an annual ritual based on a traditional perspective of their volcano: the locals believe that the volcano is the kingdom of spirits and that humans should live in harmony with them. The rituals are seen as a gift from humans to the spirits, as a symbol of human will to live in harmony with the spirits. Single communities have adopted the same elements of modernization at different paces. In the Jengglik and Ngepos hamlets, the research locations of this paper, some people had already begun cultivating *salak pondoh* (*Salacca edulis* L.) in the 1990s, while others had continued with traditional subsistence practices until the last big eruption in 2010. The disaster caused significant damage to the hamlets, but at the same time prompted the adoption of a subsistence system that aligns with modernization.

In the following, we will first introduce the history of the agricultural complex of the study region, while focusing on some of the key species. After that, we will examine how disasters accelerate modernization that also entails shifts in domestic species as well as shifts in human and domestic animal relations, including their communication.

History of agricultural interspecies dependencies at Mt. Merapi

Since the 1930s, farm animals have been an integral part of the communities' subsistence practices. Until the 1990s, the villagers raised swamp buffalo (*Bubalus bubalis carabanensis*) as part of their subsistence agricultural livelihood, using the animals specifically for ploughing fields at the beginning of the planting season. In addition, buffalo dung was collected, dried, and brought to the fields and used as a natural fertilizer. As a helper or companion, a buffalo was kept for years. A breeder explained his experience (interview, September 2021): "The female buffalo is kept to give birth eight to nine times, we keep it this long, the offspring are good, they're good when ploughing and make us happy." During the early periods of buffalo raising, the buffalo grazed freely. A former hamlet head explained (interview, January 2022): "In the 1930s, buffalo were left to look for their own grass. They grazed freely." However, since the 1990s, along with population growth and limited grazing land, and also in accordance with government regulations designating some forested former grazing land as national parks, the buffalo were more often fed in their sheds. These factors have created the necessity to collect grass for the local cattle.

During this buffalo-raising period in the 1930s–1990s, the locals planted rice and corn for daily consumption during the harvesting season. Having enough corn or rice for a particular planting season provided a sense of security and comfort. A ploughman recalled (interview, August 2021): "As villagers, having rice in one *grobog* (a traditional place for keeping the rice) makes us feel secure." If there was a surplus of rice and corn for their daily needs, they sold it at the nearest marketplace. Almost all families owned a buffalo, many had two to five, but some had even seven buffalo or more. Besides being an important part of subsistence livelihood, buffalo ownership was also a signifier of social status and wealth. In addition, since the late 1980s, some people began raising Javanese cow (*Bos javanicus domesticus*) to plough their fields. So, at that time, some residents kept buffalo, while others kept cows. A farmer who preferred to breed Javanese cows said (interview, January 2022): "When it comes to ploughing, a cow is stronger

than a buffalo. A cow can plough until noon, while buffalo can only do that until ten in the morning. Besides, cows do not need to be bathed.”

The local practices of raising buffalo created a kind of interspecific daily taskscape³ and routine, including feeding the buffalo in their stalls near the house, drying them around the shed, bathing them in the river, collecting grass for the animals, and ploughing the fields. According to a ploughman (interview, September 2021), during the ploughing season, early in the morning before going to work in the field, the buffalo had to have their breakfast. The ploughing itself usually lasted from six to around ten in the morning. After ploughing, the buffalo were taken to the river to be bathed. Then, after being cleaned and going back to the stalls in the afternoon, the buffalo received their dinner. However, outside the ploughing season, the daily taskscape was slightly different. As the same ploughman described (interview, September 2021): “At six o’clock the buffalo are removed from their cage and allowed to warm up, at ten o’clock they are put back in the cage and fed. At four in the afternoon, they are taken to the river, bathed, and returned to the cage and fed.” As the ploughman tended to his duties in the fields or the buffalo was sunbathing in the morning, other family members were looking for grass in areas near or within the forest. When grass dried out in the forest during the dry season, the residents would look for *damen* or the remnants of harvested rice stalks on the lower slopes. These activities were a kind of social mutualism, as people living upslope looking for *damen* thus helped rice field owners clean their fields after the harvest. These daily routines also encompassed a special set of skills: how to plough the fields, communicate with the buffalo, and plant rice.

Hence, one can observe a local alignment of activities and behaviours, affordances and needs that give ground to the community as “the local set of code related species” (Kull 2020: 10). Kalevi Kull also refers to such local code-based connections as habits. In a semi-natural agricultural community, the habits include also human skills as mediators between different species, shaped both by the species’ needs and behaviours as well as the cultural traditions of interspecific coexistence. These kinds of relationships can be described as ‘human-facilitated fitting’, as humans impose and induce the connections between different agricultural species, but also use agricultural skills and practices to promote the acceptance and recognition of different species. However, as Ingold (2000: 10) has noted, these skills can only develop through active engagement with the environment, shedding light on social relations as a “sub-set of ecological

³ Although Tim Ingold’s initial use of the term featured “an array of related activities” (Ingold 1993: 158), by talking about ‘interspecific taskscape’ we aim to highlight how the tasks can be shaped through human and non-human interactions.

relations”. In addition, the agricultural system described above demonstrates how neighbouring human communities get into mutualistic encounters through the need to care for non-human species.

Buffalo- and Javanese cow-keeping began to decline at Ngepos and Jengglik hamlets with the rise of *salak pondoh* farming in the 1990s. *Salak pondoh* (*Salacca edulis* L.), a type of snake fruit grown mainly for its fruit, is a popular agricultural commodity in the Magelang and Sleman Regencies. It was first cultivated on the southern and southwestern slopes of Mt. Merapi in the 1980s. Inspired by the economic success of *salak* farming in some neighbouring villages, some families in Srumbung village started planting *salak* at the end of 1980s and found the soil suitable for the growth of this plant. The economic success of the first generation of *salak* farmers led to more people adopting it as their livelihood in the 1990s. This shift involved learning new skills needed for the cultivation of the new species, like pollination with sickles, cutting fronds, harvesting *salak* fruit, etc.

Salak is an annual plant that does not require ploughing and, consequently, *salak* farmers do not need buffalo. Due to that, some people sold their buffalo and switched to raising cows for additional economic income. In this new practice, cows are kept for a few months, much more briefly than the buffalo that were usually cared for over a period of years, and once deemed fat enough, the cows are sold. However, a young cow owner said (interview, August 2021): “People here differ when raising cows, most people raise cows for several months and then sell them, but some keep them for up to two years before selling them.” Raising cows is considered to be much easier and less time-consuming than raising buffalo, as they are kept in a shed all day. The keeper only goes to the cows to feed them, and there is no need to clean them in a river. The only similarity between raising cattle and buffalo is using their manure as a natural fertilizer for the fields.

The main motivation for embracing *salak* farming was to boost economic income. An elderly farmer stated (interview, January 2022): “*Salak* can be harvested two to three times a month, while rice can only be harvested once every six months. *Salak* is planted once, and it can be up to 20 years before the plant needs to be changed.” A young farmer added (interview, January 2022): “*Salak* has high economic value and is easy to maintain. Calculated over six months, for example, *salak* yield can be several times higher than rice yield.” The shift from buffalo or Javanese cows to beef cattle was driven by similar economic motivations. As a local breeder explained (interview, January 2022): “Cows have more meat and gain weight faster, making it more profitable.”

During stable times, *salak* farming is the main source of income, while cattle is a secondary one, obtained periodically. The locals are convinced that *salak* agriculture can provide their daily livelihood, despite the price volatility. Currently,

the price of *salak* has dropped significantly, compared to its high point in the 1990s. As a *salak* farmer explained (interview, January 2022): “One kilo of *salak* used to equal five kilos of rice, now one kilo of rice is equal to four kilos of *salak*. But even if the price decreases, we still feel more secure and confident with *salak*.” However, during the eruption crisis, the positions of cattle and *salak* as sources of income reversed – cattle became the primary source of income, as the eruption damaged the *salak* fields. Later on, people can sell their livestock to fulfil their daily needs, purchase *salak* seeds, or support their temporary livelihood during crisis periods. While waiting for *salak* plants to recover, people rely on alternative sources of income, such as sand and stone mining or cultivating fast-growing vegetables (30 to 40 days). Hence, cattle serve as a vital economic backup: the locals do not sell cattle for daily consumption and cattle is typically sold for special reasons such as educating children, holding a feast, rejuvenating *salak* plantations, or addressing economic hardships post-eruption.

The expansion of *salak* farming has led to the decline of rice fields, both by replacing them and affecting the soil conditions of the remaining fields. The soil composition has changed due to *salak* farming, making it unsuitable for rice and corn. In addition, the decline of rice fields has concentrated the feeding of rice-eating birds to the few remaining rice fields, resulting in lower harvest. Also, rice fields surrounded by *salak* fields lack sunlight, hindering the growth of rice plants. A local farmer stated (interview, August 2021): “It took a long time to change from rice to *salak*. However, over time finally everyone, like it or not, adopted *salak*. It was impossible to plant rice now. The rice plants were overshadowed by *salak* plants, they did not get enough sunlight, and the *emprit* bird pest damaged the few remaining rice plants.”

The modern transition to *salak* cultivation and the shift from breeding buffalo to keeping cows highlights a major transformation and loss of interspecific ties as well as a switch to the linear transfer of organic products to the global market. People are no longer mediators in a network of interspecific relations, but instead act as intermediaries between the organic and the economic, while the composition and life history of the non-human species is determined by the latter. These changes in species composition and the contexts of their implantation serve as markers of modernization and “disembedding, decontextualizing forces that are inherent in modernity” (Hornborg 1999: 148).

Disaster as an accelerator of post-disaster species shifts

In the aftermath of the 2010 eruption, the last group of families in the study area who relied on traditional buffalo keeping practices were faced with drastic environmental change. The eruption had transformed rivers that had usually been used for bathing buffalo. Erupted materials, such as stones, gravel, and sand filled the rivers, and when the rainy season arrived, those materials were carried downstream by heavy rains, making the river deeper on the higher slopes. The eruption had also destroyed agricultural fields, including the fields that had been used for collecting grass, so no animal fodder was available. As a result, during the post-2010 eruption crisis, residents sold their livestock, including buffalo, at low prices. A local farmer explained (interview, September 2021): “After the eruption, I sold a large male buffalo. Before the eruption 12-million-high bids were made, after the eruption I only sold him for 8 million.”

In addition, the post-eruption emergency and recovery programmes focused solely on *salak* agriculture. In the emergency, a labour-intensive programme (*Program Padat Karya*) was implemented, where locals cleaned up their *salak* fields, cut the damaged bark off the *salak* trees, and earned daily wages from the government for such activities. In the recovery phases, post-disaster relief from the government and other donors, including international donors, was given to *salak* farmers to help them recover economically, through provision of *salak* seeds and fertilizers and expansion of *salak* farming (Anggraeni, Lestari, Widiyanto 2015). The head of a hamlet explained (interview, January 2022): “At that time, each household got 15 *salak* seeds from the government, also some fertilizers.” The amount of assistance, 15 seeds per family, was actually very little when compared to the number of *salak* plants that had been damaged and needed to be replaced. A farmer (interview, January 2022) said: “It was only to please us, 15 seeds only cover one row.” Despite the limited assistance, post-disaster aid for *salak* farming has significant implications for the local residents, reinforcing their belief that there is no other choice but to continue with *salak* agriculture as their main livelihood. In general, residents are very confident that within two to three years, the *salak* plants damaged by the eruption will recover. As a result, people stopped planting rice or corn and raising buffalo after the crisis. The loss of the river for washing the buffalo and the rice fields for ploughing also led to the buffalo losing the central social role as a helper in agricultural practices.

A disaster, which may bring along an abrupt break in the modes of fulfilling certain social functions, will inevitably enforce certain post-disaster social rearrangements or readjustments. Some anthropological studies have argued that disasters may speed up ongoing changes that are already taking place in the affected

societies (Oliver-Smith 1996; Henry 2011), while they may also open “windows of opportunity” for a simultaneous change across multiple interacting social and ecological domains (Birkmann *et al.* 2010). Also, the 2010 volcanic eruption in Mt. Merapi, which claimed 386 lives and destroyed hamlets, hastened the processes of modernization in local communities (Nazaruddin 2022). The eruption played a role in completing the ongoing transformation through an interplay of natural and social factors. The eruption caused radical changes to the natural elements essential for maintaining former agricultural practices, but the agenda of reconstruction, both by national and international agencies, did not aim to restore the previous conditions. Instead, it encouraged society to “go along with the flow”, i.e. to switch to the market economic trajectory, adopting new livelihood practices and species that would align with this path. The opportunity for a “policy window” that crises and catastrophes are believed to create to develop some alternative pathway for the resilience of the community (e.g. Rizzo *et al.* 2022), was missed, as the community was largely confined by pre-disaster policies and regional and international development agendas. The development agenda aimed at maximizing *salak* production to meet market demand, for example through expansion of *salak* plantations and innovation in *salak* plant maintenance.

The post-disaster changes of the Mt. Merapi 2010 eruption have involved a transition of knowledge systems just as much as economic and technological change. Moreover, as the results of our study demonstrate, such modernization may encompass the loosening of certain interspecific ties and modes of communication along with the transformation of the agroecological complex. Among the post-disaster changes involving other species, we observed an extension of the metabolic complex of the farm animals and plants through the use of animal fodder and plant fertilizers not stemming from the local agricultural complex. A shift to a de-localized agricultural system has led to a decline in local agricultural skills as components in the maintenance of the local interspecific ties (e.g. ploughing rice fields with buffalo, gathering animal fodder for the buffalo from the same rice fields). From the perspective of human life-worlds, the daily routines and rhythms of activity that were shaped by the tasks of tending to the animals and ploughing the fields with buffalo have been replaced with more linear production schedules focused on market-suitable assets, such as the cultivation of *salak* for its higher yearly yields than rice.

The cessation of one type of inter-specific dwelling does not rule out the possibility of new forms of human–non-human connections being formed along with socio-economic transitions. Dependence between species in subsistence agriculture made the system vulnerable – if one species was excluded from the system due to some external impact, others would follow (e.g. the cessation of rice

cultivation leading to the decline of buffalo breeding). At the same time, the self-sustaining agricultural complex along with its relative autonomy served as a buffer against economic fluctuations. At the same time, disconnecting local interspecific relations and the separation of different domains of the system (crop cultivation and animal husbandry as independent from one another) resulting from this exposed the communities to higher economic risks (e.g. in case of a sudden decline of prices). Some respondents were also aware of the new vulnerabilities and had experienced them, for example in the case of sharp decline in the market prices of *salak*.

Langushing of human and farm animal sign exchange

The buffalo used to be a companion and a helper for the farmer. The daily interactions between humans and buffalo were not only physical, but entailed communication through signs. People strongly believed that the buffalo could understand human messages, and could convey messages back. When ploughing the field, the ploughman communicated with the buffalo through particular sounds, some mimicking human speech, others meaningless in the local language. For example, a ploughman may cry “*gik, gik, gik*” or “*her, her, her*”, which does not carry any meaning in the local language, to straighten the buffalo’s path when ploughing. When bathing the buffalo, the farmer would utter “*njrum, njrum*” as a signal for the buffalo to dive into the river. The cue imitates the local word, ‘*njerum*’, which means entering the water. Likewise, the buffalo keeper would say, “*tas, tas*”, abbreviating the local word ‘*mentas*’, meaning that the buffalo should get out of the water. A ploughman said that before the first ploughing day, he used to whisper to his buffalo (interview, August 2021): “Tomorrow you will plough the fields, may God bless us, and it will be smooth and safe.”

Communication between humans and buffalo occurs through physical contact, gestures, facial expressions, and eye contact. A gentle tap on the buffalo’s skin with a whip signals the need to plough. However, if the sound is a bit louder or the whip is too rough, the buffalo will run erratically. A ploughman described (interview, August 2021): “When we want to plough, if the buffalo looks calm and the face is bright, then it is usually enjoyable [both for the ploughman and the buffalo, M. N., R. M.]. If the buffalo is not calm, leave the animal, replace him with another buffalo. If we keep using this uncalm buffalo to plough the fields, it will get even more difficult.” He explained that if the buffalo seems lethargic, instead of moving straight when ploughing, the animal will walk back and forth, provoking the emotions of the ploughman. In this case, the ploughman should understand:

“Oh, this animal is restless, just take it home and feed it” (interview, August 2021). Such daily communication requires specific skills, and not everyone is skilled at ploughing. The same ploughman mentioned that only he had the right skills in his family, despite everyone owning buffalo (interview, August 2021).

The son of a ploughman, who used to lead the buffalo to the river, added that the buffalo loved being washed. They would become calm when rubbed with grass or sacks (interview, August 2021). At the same time, bathing the buffalo was also fun for children or teenagers who were usually asked by their father to bring the buffalo to the river. Moreover, all daily tasks with the buffalo brought joy to the locals, including ploughing the fields with the buffalo: “If the buffalo is good, obedient, the face is pleasant, and the animal is strong in ploughing, its path is straight, then we will not sell it” (interview, August 2021).

Such human–farm animal communication has sharply decreased with the rise of cow rearing practices. This decrease is grounded in a fundamental difference between the buffalo as a companion and the cow as an economic asset. Human interactions with the cow are limited to feeding and stall cleaning. These interactions are primarily based on the economic value of the animal’s body, as the farmer aims to fatten the cows so that they could be sold at high prices. Such a market-oriented value has also changed the type of animal fodder. Previously, farmers fed their buffalo with local grasses, or with plants specifically planted as animal fodder. However, nowadays, they mostly combine grass with certain concentrates that they buy at the market, in order to fatten their cows quickly. The locals call such practice *‘kombor’*, which literally means mixing dry and wet food. Locals in the area also mix cow dung with chemical fertilizers for their *salak* plants. Thus, the change towards market economy has further pushed the adoption of modern technological methods into the livestock raising practices. To give yet another example, to breed cows, the local breeders are currently accustomed to asking veterinarians to utilize artificial insemination.

However, despite cows being viewed primarily as economic assets by local breeders, communication between the breeder and the cow still occurs, albeit at a lesser frequency and intensity compared to the buffalo. As stated by a farmer in an interview (interview, August 2021): “When we feed the cow, we pet the head. Sometimes we talk. They can identify the owner; they even memorize the sound of the owner’s motorbike. It can be understood from their voices.” Communication also takes place when the owner cleans the cows and their stalls every few days – then the owners sometimes talk to the cows. On some occasions, emotional aspects are still involved, as evidenced by a young farmer who said (interview, August 2021): “If the cow does not want to eat, while there is enough grass, it means the animal is sick. Then we feel sad and look for ways to heal the cow.”

In addition, the interview responses reveal a certain nostalgia for the forms of interaction with buffalo that no longer exist. While the adoption of the new species is warranted in economic terms, there seems to be a certain emotional void that has been left with the disappearance of the former interspecific taskscape and the specific interactions that belonged to them. The eruption marks a division between pre- and post-disaster subsistence practices for some families, but the memories of past interactions with the buffalo that are contrasted with the present cattle-raising, preserve such buffalo interactions as something valuable. In some cases, continuity with the past is evident in the animal-feeding practices by the animal keepers. The last group of families who had maintained their buffalo until the 2010 eruption, have now switched to cows. Interestingly, they only feed their cattle grass or rice stalk remnants without any additional concentrates, as they would do with the buffalo during the buffalo period. An old farmer from one of these families said (interview, September 2021): “I have never given *kombor* (grass mixed with concentrates) to the animal. Nowadays people give *kombor* to their cows. When I raise animals, it is never like that, I just feed them grass. It is a habit and tradition.” Besides traditions, also educational background may play a role in preserving traditional agricultural practices. A young educated family uses local plant remains and manure as fertilizers for *salak* plants, following their understanding of organic farming. Ironically, the education that values traditional farming was made possible by previous generations’ shift to market-based agricultural production.

Thus, the differences between the interactions with the two domestic animal species lie in the intensity of contact (i.e. how often humans and non-humans meet) as well as the semiotic character of the contact (a communication based on mutual feedback vs a one-sided command-based contact or desemiotized contact). Modes of communication are thereby influenced by the reasons for keeping the animals, the duration of keeping them (from a few months for cows to years for buffalo), and the number of animals present.

Confined agency and the breakdown of semiotic fitting

Hence, from a more zoosemiotic and experiential perspective, the agroecological changes discussed in the previous section involve significant transformations of daily interactions with other species. However, these often remain unnoticed in post-disaster modernization discussions, where other species are merely seen as objects of socioeconomic transformation and livelihood vulnerability. A critical stance towards the commodification of life and living beings in the free-market- and profit-oriented economies that modernization often entails has guided several

human–animal scholars to turn to Marxian conceptualizations (e.g. Tapper 1988; Foster, Clark 2020; Noske 1997: 11–21).

In his pioneering work in more-than-human anthropology Richard Tapper investigated the relations of production between humans and animals along Marxian lines, while paying attention to the different modes of othering animals (Tapper 1988; *cf.* also Pálsson 2009). In the context of disaster studies, Steve Glassey (2020) has suggested the integration of the sociozoological scale into disaster management in order to consider the different values attributed to different species and the vulnerability they face. However, as our study shows, this sociozoological scale that features the social values and norms towards animals, as well as the ‘modes of othering animals’ that reflect different relations of production, should be further supplemented with more detailed observations of the interactions that reflect and sustain these values and relations of production. Moreover, as we saw from the interspecific dependencies of the described agroecosystems (the buffalo being needed for rice cultivation, but not for *salak*), the giving up of certain species means the co-extinction of the skills and practices related to those species. These interspecific interactions are relevant for understanding disaster vulnerability, but also for understanding post-disaster transformations of individual experiences and practices on the one hand and social transitions on the other hand.

It is characteristic of capitalist and modernization transitions that human–farm animal contact becomes mediated through technologies that are used to maximise the “output” of the animal body. At the same time, this contact becomes more direct and devoid of semiotic mediation, as it is considered unnecessary and too “humanizing” for the fast-paced animal production process. This leads to the collapse of the signs mediating human–animal communication. The animals also experience the time–space compression of the temporal and spatial plans (Magnus 2011) – they gain biological life stages quicker (reaching reproduction age earlier, gaining the dimensions of a full-grown animal sooner, etc.) and must fulfil their basic biological needs with less, and impoverished, space, although one can cynically remark that those species have “won” as they can be more easily desemiotized.

A similar observation regarding the *umwelten* and communication of modern farm animals has been made by Morten Tønnessen, who contends “Characteristic of these domesticated *Umwelten* is the lack of communication – a mute or unheard existence in a decidedly human environment” (Tønnessen 2010: 390). However, such transformations are not uniform, with shifts in the human-bound species composition as well as the extent of the transformation of interspecies communication depending on the historical trajectory of the specific society. Furthermore, the willingness of communities and individuals to uphold certain

kinds of semiotic interactions also plays a part in negotiating such transformations.

Hence, despite the common considering of their cows as economic assets by our informants, there were at least some signs of communication with their animals. We would argue that it is still possible to uphold such interspecific communication due to the small number of livestock – a household commonly has two to seven cows – which leaves open the possibility of treating each animal as an individual. Such small-scale farming has been common on the slopes of Mt. Merapi, where families raise livestock on a household basis, rather than through industrial methods. Maintaining occasional communication with cattle also shows the locals' devotion to taking care of their cattle. This further reflects a vital role of animals as a major source of subsistence and livelihood security, especially in the face of potential disasters. However, the anonymity of the animals is also maintained as they are typically sold after a few months of ownership.

The tendency towards impoverished direct interactions with the cattle recalls a movement towards what some Marxian scholars have called 'alienated speciesism' (e.g. Foster, Clark 2020; Noske 1997). Returning to the paper by Hornborg, mentioned at the beginning of the article, this raises a question of whether this is an example of "the profoundly meaningful realms of experience of which capitalist modernity tends to deprive us" (Hornborg 2018: 256). However, it is important to note that the differences between animal rearing practices are not solely due to the socioeconomic system, but also influenced by the breeding history and human activities and agroecological complexes. While the socioeconomic system inevitably affects these factors, the established interspecific ties and the semiotic fitting of the species can in principle challenge and resist the system and uphold the semiotic relations that maintain an emotionally and ecologically resilient multispecies community. Our case study, however, shows that this kind of a semiotic fitting or *umwelt* matching can be severely weakened by the market economy, where the species that are put to live side by side in an agricultural complex do not need any functional or communicational match, as they come to function as individual units of production. Also, the role of humans as mediators between different *umwelten* and hence contributors to the semiotic fitting is phased out and the 'ecological disembedding', as Hornborg (1999: 149) calls it, becomes a condition for humans and non-humans alike. Moreover, we suggest that our case is indicative of larger transformations in semi-natural communities where humans do not serve as skilled mediators between different species of a community (e.g. by making hay for the farm animals, by collecting manure for the fields, etc.), but rather as intermediaries between market prices and species that fit the market demand. In such cases, the metabolic relationships between different species are determined by external factors, such as market prices, leading to what might be

called an ‘imposed fitting.’ These systems are not autonomous or self-regulating and are subject to collapse as soon as the external factors change. The boundaries between ‘facilitated fitting’ and ‘imposed fitting’ need not be sharp in concrete agricultural systems, but in analytical terms they are qualitatively distinct forms of human mediation between species.

We may therefore conclude that in modernization the economic sign systems often take the lead, suppressing sensory ones that uphold community ties. Hornborg (2001) has discussed the interdependence of sensory, linguistic and economic sign systems, but also noted their tendency to progressively detach themselves from the logically prior one. Hornborg’s semiotic analysis focuses on humans, but it also applies to human–non-human relations. This leads to the question: if these sign systems become detached and operate independently, is such a situation sustainable and can it still be reversed?

However, as these communities that we observed have not yet entered an industrial mode of subsistence and the memories of past interspecies interactions persist in the form of nostalgia, the possibility of meaningful interspecific ties is maintained. Whether this will be realized depends on factors such as transfer of knowledge between generations, the ability to maintain small-scale farming, and willingness to translate nostalgia into action.

Conclusion

Natural disasters may play a role in shaping ongoing social transformation through an interplay of both natural and social aspects of the disaster. In these transitions, human–domestic animal relations are critical in communities that depend on agriculture for their livelihoods, and they reflect, but also enforce, the adoption of certain socioeconomic strategies. In our case study the shift from raising buffalo to keeping cattle in the aftermath of a disaster illustrates how natural causes of giving up certain domestic species are coupled with the social and economic trajectories of post-disaster reconstruction and development programmes as well as changes in the nearby communities. The shift from one domestic animal species to another is partly an outcome of the weakening and eventual disappearance of certain interspecific ties in the agro-ecosystem. This includes the replacement of human skills and practices related to the species, contributing to the abandoning of certain interspecific taskscape and routines. The processes of modernization are not some abstract social forces that are only to be described in terms of large-scale transformations beyond individual grasp. They do translate into tangible experiences, shaped also by contacts between different

species, and they target economic sign systems just as much as sensory ones (cf. Hornborg 2001; Nazaruddin 2022). The disappearance of interspecific signs that results from modern animal-keeping technologies at the same time affects the ability to assess the physical and mental conditions of non-human beings. This further emphasizes the anonymization and objectification of non-human animals and thereby enhances drawing them into market-economic production cycles.

However, the disappearance of interspecific signs (cf. also Tønnessen 2010) is not always complete or immediate. Hence, although our cases demonstrate the impoverishing of semiotic ties between humans and their domesticates as might be expected as a corollary of modernization, this is not a flat and finalised impoverishment. Farmers' communication with cattle may reflect a vital role of animals as a source of livelihood and livelihood security. Furthermore, the memories and nostalgia for prior interactions with buffalo uphold the values for certain types of human and non-human animal contacts and their semiotic dependencies.

A transition from subsistence to market-oriented economic practices, such as replacing buffalo raising and rice farming with *salak* farming and cow keeping, is often seen as a way to improve local prosperity. However, for our case it is too early to draw far-fetched conclusions about the impact of such a transition on the particular communities; still, it is important to note that this transformation has not come without consequences. Hence, the resilience paradigm of disaster recovery, which has laid much stress on the market economic levers of providing economic resilience to impacted communities, fails to acknowledge the potential vulnerability created by dependence on uncontrollable market fluctuations. Neither does it take into account the differences between facilitated semiotic fitting, that relies on human skills and knowledge about affordances of the environment to bring different species together, and imposed fitting, where the species composition is prone to collapse as soon as the external factors that hold them together, change or disappear (e.g. the market price drops).

The conclusions of this study could be strengthened or disputed by further studies on the effect of modernization and market economy on semiotic fitting, interspecific taskscapes and personal experiences, particularly in the case of abrupt environmental change. However, it would also be interesting to explore the circumstances under which traditional patterns of interspecific communication may act as a form of resistance or opposition to ongoing socioeconomic transformations.

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Perubahan hubungan ketergantungan antar spesies pascabencana: dari kerbau yang aktif berkomunikasi ke sapi yang dianggap bisu di lereng Gunung Merapi

Makalah ini menunjukkan bagaimana bencana alam dapat berperan sebagai pendorong terakhir untuk perubahan yang tengah terjadi di sebuah masyarakat. Sembari berfokus pada pergeseran hubungan antara manusia dengan hewan, artikel ini juga membahas bagaimana pergeseran tersebut melekat dalam transformasi yang lebih luas dari hubungan manusia dengan lingkungan serta perubahan ekonomi dan budaya yang mendasarinya. Artikel ini menggambarkan hubungan ketergantungan antar spesies yang membentuk sebuah ekosistem pertanian, serta menunjukkan hilangnya ekosistem tersebut ketika spesies-spesies pertanian tersebut, dalam konteks pascabencana, dialihkan ke produksi perekonomian pasar. Dengan demikian, artikel ini mengungkap bagaimana ketepatan semiotik dari spesies-spesies pertanian yang difasilitasi manusia digantikan oleh ketepatan baru yang dipaksakan manusia, di mana komposisi spesies sangat ditentukan oleh harga pasar. Pada saat yang sama, artikel ini juga menunjukkan bahwa perubahan dan berhentinya komunikasi manusia dan non-manusia adalah sebuah penanda sekaligus akibat wajar dari modernisasi dan ekonomi pasar. Sebagai sebuah studi kasus, artikel ini membahas erupsi Merapi tahun 2010 di Indonesia dan akibat-akibat serta proses-proses sesudahnya di beberapa dusun di lereng gunung tersebut. Kajian ini menganalisis bagaimana pergeseran dari pemeliharaan kerbau pembajak sawah ke pemeliharaan hewan ternak untuk ekonomi pasar merefleksikan, tidak hanya perubahan ekonomi, tetapi juga perubahan semiotik dan sikap yang bersumber dari pergeseran intensitas dan jenis hubungan antara manusia dengan hewan.

Katastroofijärgsed muutused liikidevahelistes suhetes: kõnekatest pühvlitest tähendusvaeste veisteni Merapi mäe nõlval

Artiklis uuritakse, kuidas looduskatastroofid võivad osutada viimaseks tõukeks juba toimuvatele ühiskondlikele muutustele. Inimese ja teiste loomade vahelisi suheteid vaadeldakse inimese ja keskkonna vahelistes laiemates suhetes toimunud muutuste ning nende aluseks olevate majanduslike ja kultuurimuutuste taustal. Artiklis tuuakse välja liikidevahelised sõltuvussuhted põllumajanduslikus ökosüsteemis ning analüüsitakse nende hääbumist, kui põllumajanduslikud liigid lülitatakse katastroofijärgselt turumajanduslikku tootmisesse. Inimese kaasabil toimunud põllumajanduslike liikide semiootiline sobitumine asendatakse sel juhul inimese poolt peale sunnitud sobitumisega, mille puhul liigiline koosseis sõltub eelkõige turuhindadest. Samas katkevad ja muutuvad ka inimese ja teiste liikide senised kommunikatsiooniviisid, mis on moderniseerumise ja turumajanduse kogemuslik kaasnähe ja tunnus. Artikli juhtumiuuring keskendub 2010. aasta Merapi mäe vulkaanipurskele Indoneesias ja selle järelmõjudele mäeküljel asuvates külades. Artiklis analüüsitakse, kuidas üleminek künnipühvlielt turumajanduslikule veisekarja kasvatusele peegeldab mitte ainult majanduslikku, vaid ka afektiivset ja semiootilist nihet, mis on tihedalt seotud inimese ja teiste loomade suhete muutusega.