ANIMAL BIOTECHNOLOGY AND CULTURAL ECOLOGY

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ABSTRACT

Animal biotechnology development is strongly related to historical contexts of animal production in a country and the receiving environment, particularly the existing cultural ecology. Cultural ecology influences both progress and process of adoption of such technology. A simulation on the technology's discriminating power indicates that only those with sufficient techno-economic and social capability have greater possibility to adopt such a technology.

Key words: Biotechnology, cultural ecology, adoption

ABSTRAK

BIOTEKNOLOGI PETERNAKAN DAN EKOLOGI KULTURAL

Perkembangan bioteknologi peternakan di suatu negara berkaitan erat dengan konteks sejarah produksi peternakan berikut lingkungannya, terutama lingkungan ekologi kultural. Ekologi kultural mempengaruhi progres dan proses adopsi teknologi tersebut. Suatu simulasi atas kekuatan diskriminatif bioteknologi peternakan menunjukkan bahwa hanya mereka yang memiliki kemampuan teknis-sosio-ekonomi saja yang memiliki peluang besar untuk mengadopsi teknologi tersebut.

Kata kunci: Bioteknologi, ekologi kultural, adopsi

INTRODUCTION

An avant-garde in genetic improvement, animal biotechnology as a breakthrough technology has strong potential to dramatically changes the map of animal reproduction and production in a region. It is a futuristic technology that can be implemented in the near future, yet it is quite an expensive and demanding technology so it also possesses discriminating potential to the users. Its genetic improvement potential may spectacularly change animal farming practice in terms of livestock and farming management and land use due to the increasing quantity and quality of foodstuff required for better quality animal population.

Animal biotechnology development is strongly related to the historical context of animal production in a country and the receiving environment, particularly social environment of the technology users, which often distinguished as cultural ecology. In such a context, the existing cultural ecology determines the social characteristics of the given technology that further influence both progress and process of adoption of such technology. The differences of need and level of technology, as well as differences in socio-economic condition of the users, play significant roles in the implementation process of the technology. People are the central focus of development and they are also the subjects of the process of technology transfer. In relation to animal biotechnology, cognizance should be taken on the method of implementation, which will meet the community's social resilience as well as the user's technical and economic capacity.

Technical impact of animal biotechnology has been positively recognized. Similar admiration also appears for positive economic impact of such a technology. These positive impacts are increasingly understood and accepted. Such circumstance is soundly related to the existing user's technical skill and knowledge as well as the relatively receiving economic status of the users. Yet, few recognize social and sociological condition as specific cultural ecology as a determinant to animal biotechnology application or, if it is, the recognition is more often neglected or ignored. This review tries to recount potential relations between people's understanding on animal biotechnology and the existing cultural ecology to the possible implementation of such biotechnology.

THE EXISTING CATTLE FARMING IN INDONESIA

As in the case of advanced animal technology implementation in Indonesia, particularly in Java with its specific cultural ecology as well as among Javanese farmers throughout the country, careful consideration should be taken to anticipate possible social and cultural reaction. Cattle for Javanese farmers, particularly wet-rice farmers, are multi purpose livestock playing various technical, social and economic roles. Its technical contribution is primarily as draught animals and other traction power for both agricultural and non-agricultural purposes. To some respect, the quality in terms of body size and traction power, local cattle is less appropriate for an efficient performance. Nevertheless, quality improvement through genetic approaches is more often hampered by its relatively poor condition due to traditional management under less supporting condition. The livestock is usually low of genetic potential for higher productivity but is shaped to adapt to and survive the rigorous conditions dictated by complicated interaction between physical, social and economic factors. To make things worse, diseases, parasites and ill-management lead to irregular productivity. If an animal in a household is of less-than-marginal utility, there is an additional factor whose evaluation would involve long-range bovine biographies (ATMADILAGA, 1991). The utility of an animal to its owner cannot be established simply by its performance during season or a production cycle, particularly when social requirements is also taken into account.

In such a system where cattle play technical and economic roles, cows in Java have the function primarily to produce offspring due to farmer’s need of traction power that leads to income generation. The question is, when? And how many offspring? Differ to that in the US or Europe, cows raised under the traditional Java wet-rice farming system breed under ambiguous environment. In the US and Europe, cows usually become pregnant under well-controlled, hence predictable, circumstances. In Java, cows become pregnant under bizarre situation. A cow may become pregnant when she is in the field during her heat, she can get pregnant when her owner wants her to become pregnant by mating her with a locally available bull, or by performing artificial insemination. The first case brings along consequence that the sire of her offspring is a non-descript bull, which further causes uncertain quality of the future generation. In the second case, the consequence of using better quality semen from better quality bull will increase the amount of feed for the new generation. Biotechnology, however, contributes to the increasing demand of feed quantity as well as quality to sustain the new population.

In term of feed requirement, cattle in Java depend on wastelands and agricultural waste products. The principle sources of crop by-products are rice straw, corn stover, cassava tops, sweet potato vines, peanut vines and sugarcane tops. These foodstuffs are relatively low in nutrient, which has to be improved if cattle production is to be enhanced. On the other side, farmer’s knowledge and ability to improve feed quality is hampered by various social and economic factors while expanding carrying capacity of the farm leads to a flying herd system (ATMADILAGA, 1991).

Another information that should be encountered is the fact that most animals are in the possession of small and poor farmers. Small farmer is weak in skill and technology, weak in capital and information. Therefore, it is quite absurd to think that animal biotechnology to improve cattle quality can simply be adopted by small farmers. Yet, there are conditions that should be prearranged to organize farmers to adopt and apply the products of animal biotechnology. If the genetic quality of cattle is to be improved, and its feed requirement is also increase both in quantity and quality, then biophysical, technical and social consideration should be taken into account. The truth that small farms with low land-ownership does not guarantee enough food production for the family leads to an argument that cattle may become competitor for human in terms of using land to produce either food crops or foodstuffs. Consequently, even better quality animals are threatened by under nourishment, which leads to low and uncertain productivity. Another truth is that the decision of selecting suitable land use is most often determined by the need of the farm family yet with no intention to cast-off cattle from the existing farming practice due to its paramount complementary roles in agriculture. From the economic point of view, keeping cattle as traditional livestock, even if common resources and energy are taken into account as production cost, will turn out uneconomical.

Despite paradoxical argument on the importance of cattle in the Javanese farming systems, interaction between cultural factors, environment and actual carrying capacity has made cattle as the Javanese farmer’s biotic assets. Its biological capacity in producing manure, traction power and particular social status, and meat as the ultimate contribution of the animal, has made cattle a valuable element in the systems.

PROBLEMS ENCOUNTERED

The approach to animal biotechnology should also be a sociological one, which will be useful in the implementation of the technology as a policy. Apart from the conflicting opinion on humane and ethical approach to the use of such a technology, the explanation is more sensible and do not fall back on norms or local beliefs. The sociological approach underlines more on the relationship between man and cattle, particularly in Java where cattle play a significant complementary role in agriculture. Moreover, for most Javanese, cattle are often considered as unique element of a farm family. To many farmers, livestock is more often viewed more as a social commodity, not wholly an economic one (SATARI *et al.*, 1991). On the other side, cattle are also competitors with human for land, which the Javanese perceive as their primary source for living (SURADISASTRA *et al.*, 2000). From the biological point of view, higher genetic quality of cattle often requires better food quality, and in regions where land is scarce, good quality foodstuffs can only grown on good quality of lands. This demand fortifies the position of livestock as the possible sole competitor for human to use good lands to produce food in the existing communal agricultural system.

Evolutionary development in agriculture will lead to better uses of cattle from traction power to source of meat. Biotechnology will play principal roles in such a transformation due to its powerful capability in improving animal quality for the sake of human need. During the process of transfer, a room of adjustment should allow the technology to fit into the existing cultural ecology. Changing farmer's attitude from keeping animal for power and social purpose to raising them for meat and, therefore, improving their income, requires solemn and continuous efforts. This endeavor further requires specific tasks such as education and special guidance to penetrate the society's social fabric to provide chance to enjoy more positive aspect of the socially sound technology. One among various social fabrics that play major role in the process of adoption is the existing social moral or ethic of the target community. Social acceptance and understanding due to educational and knowledge do not always follow the rapid development of biotechnology. Social norms, ethic and perception as parts of the existing cultural ecology are often trapped in preserved time as they have been serving the social needs in a natural basis and by so doing they have become a dogma to the society. As example, in vitro fertilization and embryo transfer in human might stimulate social argument on the definition of "mother" due to the fact that to most laymen, the definition of "mother" is simply "the one who bears and gives birth to the children". Few have thought that the existing moral standard might create conflicting situation in defining or redefining biological terminology. From the sociological point of view, the definition of a position is an establishment of social consensus in which both social ethic and social needs interact to construct reality. This argument is ambiguous comparing to LUBIS's statement (1994) that human moral standard does not apply to animal. Nevertheless, trend on human rights development in the last decade tends to play particular roles in people's perception toward social understanding of biotechnology. In fact, the developing social perception toward the application of new technology brings along the humane approach (SCHROTEN, 1992) as a more human consideration in implementing new technology to animal for the sake of human prosperity. In such relation, cultural ecology might play vital roles in the implementation of particular animal biotechnology.

THE INTERMINGLED SOCIAL IMPACT OF TECHNOLOGY

Cultural ecology of a user community possesses particular self defense mechanism, namely social norms and moral standard. Naturally, such a mechanism influences the community's social resilience when the members of the society are confronted to new situation. A techno-social interaction (SURADISASTRA, 1999) occurs when new technology is launched among the user's community with particular standard of ethic. The extremely slow adoption of hoe as an alternative to digging stick in the Baliem Valley of Irian Jaya (now Papua) may become a classic example on how the existing social norms interact with the physical appearance of new technology (DIMYATI *et al.*, 1991).

In Indonesia where most livestock farmers are under educated and under exposed to the outer world, the social cost of new technology transfer is incredibly high. Animal biotechnology is intended to increase efficiency and effectiveness to improve preferred genetic quality. Those who can afford such technology are often considered as key farmers who then are expected to be involved in the process of technology transfer. On the contrary, those who are unable to adopt new ideas and technology are pushed aside and, socially, will form a less productive, lower class farmer community. The discriminating force of biotechnology can be seen in this stage. Only farmers with relatively high education level and better social economic status can possibly afford animal biotechnology. Aside from its technical requirements, the technology also demands proper understanding of its users. High social resilience will probably play the ultimate key factor because the user needs time and mental flexibility prior to the adoption of such high technology. To make things more complicated, a question on how to present animal biotechnology in an acceptable package follows. How much of the technology should be provided for the users? How deep should the users possess required knowledge and skill, and what should be done to those who are in the target groups but cannot afford such technology? And what happened to the user's norms and its conflicting potentials? Even among rich farmers, there are also cases where technology has made them more dependent to the source of technology and information, and biotechnology will make richer farmers even more dependent than others.

An alternative to such pessimistic judgment is to implement animal biotechnology among higher level of users, commercially able to adopt, and provide chance to produce the products of the technology. The products, such as high quality animal or ready-to-implant embryo are to be used by farmers as the end users of the technology. The intention of implementing the technology in an isolated environment implies a policy of limiting the possible social disturbance when the technology applies particular methods and approaches which violate or irrelevant to the existing ethic. On the other words, the production of high quality products of animal biotechnology should be carried out in a laboratory setting, but the products should reach the ultimate consumers of the technology. This situation is comparable to cosmetic and medicine industries, which produce drugs in a close environment and lab setting, using animals to test various health effects, and publicly send the products to the consumers. Furthermore LUBIS (1994) experienced that the revolutionary biotechnology was often socially unaccepted simply because of humane feeling on violating local norms and ethic among the user's society. Her experience supports SRINIVAS's (1952) statement on India's sacred cattle where Indians are reluctant to slaughter their cattle due to an orthodox Hindu opinion that regards the killing of cattle with abhorrence. HESTON (1980) also stated that cow in India are protected because of the principle of nonviolence to living things (*ahimsa*). The Indian case is probably the most classic example on how cultural ecology restraints particular forwarding technical process in animal biotechnology.

DISCRIMINATING POTENTIAL: WHO IS TO BE SACRIFICED?

Since the primary theme of technology adoption is through the application of technology packages that contain a complete modern package of production technology, traditional farmers rarely adopt the whole package without considerable adjustments. Part of this problem is that most modern animal production research still occurs mostly on research stations where scientists experience different condition to those practiced by animal farmers (SURADISASTRA and LUBIS, 1994). Scientists have access to all necessary inputs, while traditional livestock farmers do not. Furthermore, there are also risks that farmers have to take. Many of them simply cannot afford to take those risks. Farmers know that they can obtain maximum benefit from new technology if they have the whole technology package. Paying for just a half of the technology will be a waste because the technology will give little returns or no returns at all. For farmers, particularly those with low land ownership such as Javanese farmers, it is all or nothing. If one element of the package is missing, such as inadequate amount of required feed, the performance of the animal may not much better than the one raised in traditional way. This may not be totally true, but in many cases this presumption is valid in many parts of the country.

The modernization of animal production through the introduction of new and advanced biotechnology has the power to transform rural communities in Indonesia. Some of the features of the social transformation are the widening gap between the rich and the poor, the increase rural-urban migration of those who lost their jobs in agriculture, the shift of economic opportunity from women to men, the concentration of agricultural land in the hands of the wealthy, and many other dismaying features.

SURADISASTRA (1994) has demonstrated the possible application of a Malthusian view of lifeboat ethic (HARDIN, 1980) to a simulated interdependency situation on maintaining ecosystem capacity. In relation to animal biotechnology, such a simulation can also be applied. As a case, embryo transfer as an advanced technique in biotechnology has great possibility to be applied among those who can afford specific requirements, including social, economic and biophysical factors. Social requirements are reflected in terms of education, skill and farming experience. Economic requirements are often elaborated in terms of wealth, purchasing power, or economic status. Biophysical condition is delineated in terms of physical facilities available. The simulation involves three classes of livestock farmers, each class is assumed as possessing at least one animal as recipient to embryo produced by biotechnology. Their education level being relevant to their economic status and their land ownership is assumed as over 1 hectare for rich farmer, less than 1 hectare for poor farmers, and nil for landless farmers. To implant a cattle embryo, a minimum techno-socio-economic condition is required. To simplify the simulation only 5 requirements are put into the game, namely education level, farming skill including livestock raising skill, condition of their cows as recipients, capital in terms of economic ability to obtain the technology, and the animal barns needed to house the recipient and its offspring. Table 1 shows how the simulation works.

The simulation indicates that for rich farmers who possess most production inputs, the possibility to adopt embryo transfer technique and using their cows as recipient is considerably high. This situation is due to the hypothetical fact that rich farmers are able to afford all required condition, which mostly are acquired through economic progress.

Table 1. Simulated adoption possibility of embryo transfer technique (E.T.) among different socio-economic status

Farmer's status	Requirements for embryo transfer (based on assumption)					Possibility to adopt E.T.
	Education level	Farming skill	Capital and pur-chasing power	Recipient (cow) condition	Animal barns	
Rich farmer	Relatively high	High	High	Good	Relatively large	High
Poor farmer	Low to intermediate	High to intermediate	Medium	Fair	Medium	Intermediate to low
Landless farmer	Low	Intermediate to low	Low	Poor	Small to none	Low to none

Note: Adpated from SURADISASTRA (1994)

Poor farmers with limited land and weaker purchasing power may have several components necessary for the adoption of embryo transfer, but they may lack in particular parts of the requirements. They may have things that can be acquired by economic resolution but to a limited amount, or they may be able to afford economically the offered technology or service through particular arrangement such as credit or loan. Thus, some of poor farmers may be able to join the embryo transfer program with special arrangements.

Landless farmers may have things that are necessary for the adoption of embryo transfer, but mostly those that are acquired socially or irrelevant to economic value. They can afford technology that socially valued or traded but difficult to get economically acquired condition. Therefore, the possibility of poor farmers to join program of embryo transfer is extremely low or nil.

The result of the above simulation strengthen SURADISASTRA and LUBIS's statement (1994) on the degree of adoption of livestock technology that depend primarily upon the target group's social economic status. Low status farmers tend to neglect the application of new technology simply because of the limitation of land ownership, lack of family labor, and low market orientation. Therefore, the adoption rate of any technology between rich and poor farmers will never be the same. The writers further affirmed that there always be groups of people who are left behind for they cannot obtain either the technology or the component of the technology, or both.

Applying SURADISASTRA's (1994) simulation of lifeboat ethics, it is obvious that animal biotechnology implementation, as pictured by a simulated condition in Table 1, will leave behind landless farmers and a fraction of poor farmers although they are the ones who need help and technology to improve their productivity. As elaborated in HARDIN (1980), what should we say to those who are left behind simply because they cannot afford the condition to adopt new technology that may enhance their quality of life? Through such a consideration, the populist approach as promoted by CHAMBERS *et al.* (1989); ROLING and ENGEL (1989); WARREN (1991); REIJNTJES *et al.* (1992), which placed farmers as the user of the technology through the use of their local knowledge may be redundant. Biotechnology is completely a new, advanced and revolutionary technology that requires relatively high demand on certain conditions. Its populist thought is probably lies on its possibility of applying local knowledge related to livestock raising in the existing ecosystem and farming situation.

CONCLUSION

There are many social benefits as well from the introduction of modern agricultural technology. But the social cost of such introduction of technology is always greater than expected. To summarize the discussion, several conclusions can be drawn from this short paper:

1. Advanced animal biotechnology possesses significant discriminating power that stratifies the users into categories of able farmers, less-able farmers, and unable farmers.
2. The existing cultural ecology should be manipulated to better acceptance situation through social and sociological approaches to expand farmer's understanding on the techno-social cost of applying such a technology.

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