REGIONAL LIVESTOCK QUOTA SYSTEM UNDER ENVIRONMENTAL CAPACITY IN KOREA

SONG, JOO-HO*

Key words: Livestock Manure, Environment, Maximum loads, Quota, Nutrient, Regulations, Economic Instrument, Density, Livestock Unit, Nitrogen balance

ABSTRACT

Livestock manure is a good source of nutrient necessary for crop growing. In Korea, however, nutrient supply for crop growth is larger than the nutrients demand in many regions, thus environmental concerns associated with livestock manure are rising. Many policy measures have been implemented but with little effect. Recognizing the urgent need to improve environmental burdens of livestock production, the government announced a new plan to introduce a Nutrient Maximum Loads System in 2007. The concept of this system is to limit the total supply of nutrients according to the nutritional needs of the region. Livestock manure as well as the consumption of chemical fertilizer is accounted for in the calculation of nutrient supply. This is less restrictive than regulating the numbers of livestock since there exists flexibility to choose between chemical fertilizer and livestock when there is a need to reduce nutrient supply. If this system proved to be ineffective, then Regional Livestock Quota System would be introduced in 2011. This study explained the necessity of introducing a target oriented policy tool to prevent environment from deterioration with respect to livestock manure. The experiences from these systems in coming years in Korea would provide useful information for other countries.

* Senior Fellow, Korea Rural Economic Institute.

Ⅰ. Introduction

The livestock industry is considered one of the industries able to thrive under free trade in the Korean agricultural sector. The livestock sector represented around 28% (8.9 billion Korean won) of the total value of agricultural production in 2003, with exceptional growth in the pork industry in the late 1990s as a result of beef market liberalization.

Livestock manure has long been used as a reliable source of fertilizer for crop production. Recently however, the environmental risks of livestock manure management in certain regions have increased as livestock production units have grown fewer, larger, and more specialized. In Korea, farmers can raise livestock with no upper limit as long as farms are equipped with adequate manure management facilities. Most farms have manure composting facilities but not enough land resources on which properly treated manure may be applied as fertilizer. In many countries with small land areas and large numbers of livestock (some European countries), livestock numbers are usually linked to the cultivating areas (owned or rented) of its associated farm to maintain adequate number of animals in accordance with land size. There is no such link in Korea. As environmental concerns related to livestock have been increasing recently, some studies (Kim et al. 2000, Choi et al. 1999) analyzed the adequate numbers of livestock considering agricultural land size in Korea but few suggested how to maintain adequate livestock size. Therefore, it is necessary to develop a framework that can be implemented as expeditiously and smoothly as possible when Korea decides to limit the number of livestock in consideration of agricultural land size.

In this study, section 2 summarizes the current Korean livestock manure management policies and explains the serious environmental problems associated with livestock manure. Section 3 analyzes the need to implement new livestock production limiting measures in Korea comparing with other alternatives. Section 4 introduces a new government plan associated with manure

management and analyzes relevant issues including the livestock quota system in Korea. Section 5 details the conclusion of the paper.

II. Livestock Manure Management Policies and Environmental Concerns in Korea.

The most important regulation related to livestock manure is the "Act on the Disposal of Sewage, Excreta and Livestock Wastewater". In Korea, livestock manure is treated in 3 different ways. The most common method is to mix livestock manure with straw or sawdust and store it in a composting area for several months. Another method is to render livestock manure into liquid fertilizer through fermentation. These two methods process recycled livestock manure for agricultural use. The third method is to purify the manure below certain levels (less than BOD 150mg/ℓ, for example) and discharge it into rivers. In Korea, 83% of farms have composting facilities, 5% has liquid fertilizer processing facilities and only 7.5% of livestock farms have manure purification facilities. The main purpose of the "*Act on the Disposal of Sewage, Excreta and Livestock Wastewater*" is to maintain water quality by imposing penalties on the discharge of improperly purified waste into rivers, lakes and marine areas. The law requires the livestock farm with compost facilities to have storage capacity for fermentation for more than 1 month, but does not require sufficient agricultural land to accommodate the processed manure. Farms which have liquid fertilizer facilities should have enough land to apply the liquid fertilizer and enough storage to accommodate 6 months of processed volume. But only 5% of livestock farms have liquid fertilizer facilities. Therefore, 95% farmers can increase livestock numbers easily with no consideration of acquiring additional agricultural lands. Consequently, many farmers do not have enough land to dispose of the processed manure. Sometimes, excessive manure is applied to the land and farms discharge unprocessed manure into rivers in order to save on operation costs.

On the other hand, there are regulations that authorize

local governments to restrict livestock farming in certain areas, such as drinking water foundation preservation areas and environmentally susceptible areas. Local governments, however, seldom uses this power unless there is a serious conflict between livestock farmers and other groups since the provisions are "selectively enforceable" and livestock farming is an important source of income for local economies. Such regulations have proven largely ineffective in managing livestock manure waste with respect to environmental protection.

If livestock manure is overproduced compared to land capacity, it then becomes the source of pollution. Table 1 shows the comparison of livestock numbers versus agricultural land size between OECD countries. Korea ranked the third in the Livestock Unit per hectare of agricultural land following the Netherlands and Belgium. The Netherlands and Belgium, which have relatively small land and large numbers of animals, have introduced many policy measures restricting the number of animals during 1990s and reduced the environmental burden of the livestock industry. But the situation in Korea in 2003 has remained unchanged compared with 1996. Higher livestock unit densities yield higher environmental risks.

TABLE 1. Comparison of Livestock Density between OECD Countries, 2003

	Size of Agricultural lands(1,000ha)	No. of Heads (1,000heads)		Livestock Unit (1,000)	LU/ ha in 2003	LU/ ha in 1996
		Cattle	Pig			
Netherlands	1,933	3,735	10,766	6,965	3.6	4.4
Belgium	1,390	2,684	6,366	4,594	3.3	3.7
Korea	**1,846**	**1,998**	**9,230**	**4,767**	**2.6**	**2.7**
Denmark	2,694	1,681	12,969	5,572	2.1	2.0
Japan	4,726	4,563	9,725	7,481	1.6	1.5
Germany	17,038	13,386	26,495	21,335	1.3	1.3
U.S.A,	215,676	96,100	59,513	113,954	0.5	0.6
Australia	461,486	27,215	2,940	28,097	0.1	0.1

Note: Livestock Unit is calculated as counting Cattle 1, pig 0.3 and the number of poultry is not considered here.

Livestock manure provides a valuable nutrient source for crop and substitute for chemical fertilizer. However, the environmental risks of livestock manure have increased in regions where livestock production units have grown larger. Areas with high intensity livestock production usually have nutrient surpluses exceeding the assimilative capacity of the crop land of the regions. In many cases, disposal of livestock manure is driven by lowering disposal costs rather than optimizing the nutrient needs of crops, leading to environmental deterioration. Because livestock manure is costly to transport over long distances and requires additional processes in order to be applied to the crop field, chemical fertilizers are often preferred by farmers. Table 2 shows the supply and demand situation by nutrient content in Korea. Nutrient needs are calculated by multiplying the size of farming land of each crop with the standard amount of nutrients needed for each crop and adding up the needs of individual crops. Nutrients supply consists of the amount of chemical fertilizer consumed and the amount of organic fertilizer converted from the livestock manure produced annually. The total supply of nitrogen exceeds the nutrients needs by 11% and total supply of phosphorus exceeds needs by 25%. The share of livestock manure is higher for phosphorus supply.

If we look into regional figures of these nutrients surpluses, then the environmental risks associated with nutrient surplus are very serious in some regions. Among 165 counties nationwide, 6 have nitrogen surplus ratios over 2 while 6 counties

TABLE 2. Comparison of Nutrients Needs with Supply in Korea (2003)

Unit: 1,000 M/T

	Nutrients Needs (A)	Nutrients Supply (B)			Surplus ratio(B/A), %		
		Total	Chemical fertilizer	Livestock manure	Total	Chemical fertilizer	Livestock manure
Nitrogen	441	490	331	159	111	75	36
Phosphorus	215	268	128	140	125	60	65

Source: Ministry of Agriculture and Forestry and Ministry of Environment (2004)

have phosphorus surplus rates over 3. Therefore, it is necessary to introduce effective policy measures to limit the livestock production for these animal congested regions.

In Korea, the needs to strengthen environmental regulation on livestock farming is growing as the size of crop land and pasture land on which manure can be spread is diminishing. The market opening as a result of the Uruguay Round has had a negative impact on Korean agriculture and the ongoing DDA (Doha Development Agenda) negotiations would also further reduce the capacity of agriculture. Kim et al. (2004) estimated the total size of agricultural land in 2013 as 1,593 thousand hectares, a 20% decrease compared with 1,936 thousand hectares in 2003.

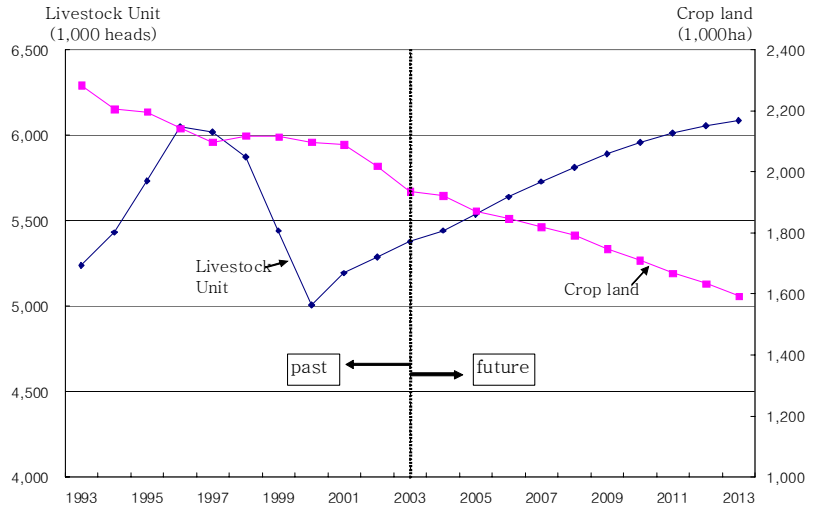
Prospects about size of the livestock unit are somewhat uncertain. Recently, animal disease has occurred with increasing frequency and environmental regulations have become more stringent-these developments may undermine the livestock industry. The ongoing DDA and FTA (Free Trade Agreement) would be important factors in determining the future of the livestock industry in Korea. The livestock sector however, enjoys relatively strong competitiveness under the free trade regime compared to the crop sector in Korea. Korean cattle numbered 2,844 thousand heads in 1996 but shrank to half in 2001 due to the spreading fear of the beef market opening in 2001. Cattle numbers are now increasing again because of high price for domestic beef. The domestic beef is regarded as a differentiated good from imported beef because the price difference has widened since the beef market liberalization. Shin et al. (2004) estimated the prospect of animal production in

TABLE 3. Regional Comparison of Surplus Ratio by Nutrients among 165 counties

Nitrogen Surplus Ratio				Phosphorus surplus Ratio				
Less than 1	1~1.5	1.5~2	Over 2	Less than 1	1~1.5	1.5~2	2~3	Over 3
23	99	37	6	29	66	38	26	6

Source: Ministry of Agriculture and Forestry and Ministry of Environment (2004)

FIGURE 1. The Past and Prospect of Agricultural Land and Livestock Unit Numbers



Note: livestock unit is calculated using a standard manure excretion amount ratio compared with cattle. Cattle excrete 14.6 kg manure per day, milk cow 35.6, pig 4.2

Source: Shin et al. (2004), Kim et al. (2004)

2013 as Korean cattle 1,803 thousands heads(1,667 thousands in 2004), pig 10,449 thousands (9,046 thousands in 2004), milk cow 524 thousand heads (503 thousand in 2004). Figure 2 shows the past and prospect of cropland size and the size of livestock units in Korea from 1993 to 2013.

The numbers of livestock units are likely to increase in the future while the size of agricultural land will decrease, thus the environmental risks associated with livestock manure would increase unless stronger policy measures to limit the number of livestock are introduced.

III. Policy Measures Reducing Harmful Effects of Livestock Production

Agri-environmental policy measures affecting the livestock industry are focused on reducing the harmful environmental impacts of livestock production. The main objectives of such policy measures have been to reduce water pollution and odor. The most popular policy measures are regulations, technical assistance and research programs. Recently, economic instruments including environmental taxes, subsidies, and tradable rights have been implemented in some countries. Subsidies based on farm fixed assets, farming practice or resource retirement typically have cross-compliance with environmentally friendly farming on the receipt of payments. In 2004, Korea introduced a direct payment pilot system on livestock farmers who raise animals in environmental-friendly ways. The caveat is that cattle and milk cow farmers must have a feed lot above minimum size per animal, and that pig and poultry farmers raise fewer animals than the standard density regulations in per unit size of raising facility. The payments are proportional to the extent of exceeding the minimum requirement. The maximum amount is set at 15 million Korean won for each farm. The government planned for 1,000 farmers to participate in the pilot project, but only 512 farms participated since livestock prices remained high in 2004.

Environmental taxes/charges are policy measures imposing a tax or charge on farm inputs or outputs that are potential sources of environmental damage. Sweden, Norway and Austria are imposing fertilizer taxes to reduce the usage of chemical fertilizer. In Korea, however, the government has subsidized the use of chemical fertilizer to increase production since 1962 and recently decided to terminate the fertilizer subsidy by 2005 and have increased the subsidy on organic fertilizer instead. Taxes on excessive manure have been used in the Netherlands and Belgium. In these countries, manure surplus was defined in terms of excess manure production in relation to land availability for each farm

and a levy was imposed on farms producing more than certain level (125kgP_2O_5/ha/year, Netherlands) depending on the level of production. In the Netherlands, manure production rights were established in 1986 so that each farm was assigned a manure quota expressed in kg P_2O_5 according to the historical production of each farm and the production rights became tradable in 1994. A buy-out scheme was also implemented in the Netherlands and Belgium in 2000-2001 to further reduce the total numbers of livestock by financing the exit of livestock farmers. It is anticipated that this buy-out scheme will reduce the Dutch manure surplus by about one third by 2003 (OECD 2003).

Regulations are compulsory measures imposing obligations on production to limit the environmental impact of animal production and are the most common policy measure in many countries. Some examples include regulations on discharge of manure to water, distance and site regulations, permits, restrictions on the maximum numbers of animal production, regulation on manure storage, controlling the quantity of manure spread, etc.

Restrictions on the maximum numbers of animal rearing can be characterized as three types, regulations restricting the livestock density, regulations limiting the quantity of manure produced, and restrictions on the expansion of livestock operations (OECD 2003). The regulations on livestock density are to limit the size of livestock operation per unit size of farm land and are very common in Europe. Regulations limiting the quantity of manure produced are implemented in the Netherlands and Belgium. There are restrictions placed on the expansion of livestock operation. In Belgium and Spain, it is prohibited to set up a new farm in areas which already have high pig populations.

Each of these policy tools to reduce the harmful effects of livestock production has pros and cons. Table 4 shows the evaluation of some important policy tools in terms of effectiveness, efficiency, enforceability and acceptability. Tax on farm inputs is a good tool for enforcement, but a poor policy to be accepted politically. Buy-out is an excellent policy tool in terms of these 4 criteria, but it can be implemented only with a system that can

restrict the set up of new farms in other places. Direct regulations analyzed in Table 4 are considered effective in obtaining the desired goal but hard to be accepted because these regulations restrict the activity of each farm. No policy tool is superior to others and each country should choose a policy mix suitable for its situation to reduce the environmental impact of livestock production.

Along with these economic instruments and regulations, there are also many technological options to reduce the environmental impacts from livestock production. Changing dietary composition and improving feed conversion efficiency can lead to a reduction in nutrient excretions per unit of production. Manure storage systems and housing systems also affect air emission levels of animal production. These options have long been implemented

TABLE 4. Evaluation of Policy Tools to Reduce Harmful Effects of Livestock Production

Criteria / Policy Tools	Effectiveness	Efficiency	Enforce -ability	Accept -ability
(1) Economic instruments				
- Environmental tax on farm inputs	--	++	+++	--
- Environmental tax on surplus manure	-	++	--	--
- Subsidy	-	-	+	++
- Buy out	++	+	++	+
- Tradable right	++	++	--	-
(2) Direct regulation				
- Limit on the Livestock density	++	+	--	--
- Limit on the quantity of manure	+++	++	-	--
- Restrictions on entry or expansion	+	?	+	--

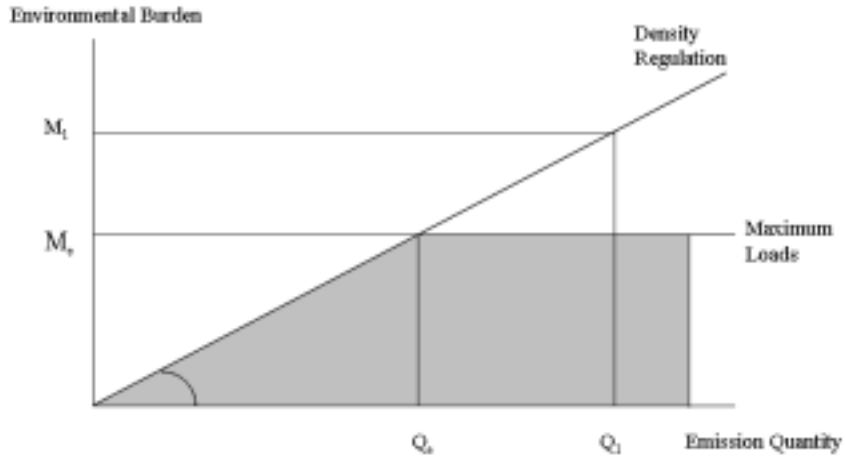
Note: The symbol + denotes high, - denotes low, ? denotes not clear. Oskam et al. (1998) evaluated the effects of policy instruments for plant protection products using 9 criteria (including 4 used in this table), but the policy tools analyzed here are different from those of Oskam et al.

but have not been effective in reducing the environmental impact of livestock manure. Considering the urgent need to reduce the excessive nutrients supply in some regions and the ineffectiveness of current regulations on preventing harmful effects of livestock manure Korea now needs a target-oriented policy measure to directly limit livestock numbers in addition to these ordinary policy tools.

In environmental economics, density regulations have long been used as an effective policy tool to solve pollution problems. The government sets a limit on the amount of pollutants per unit of emission while producers may discharge as long as they purify pollutants adhering to a predetermined density. However, the development of industry and urbanization resulted in a rapid increase in pollutant sources. Even though the pollutant level of each firm was within the acceptable limits, the total amounts discharged into a region could exceed the maximum environmental capacity. Therefore, in a region where pollutant emission amounts exceed regional environmental capacity, density regulation would no longer be effective and thus should be changed to a maximum loads system setting a regional maximum amount of pollutants that would not further harm that particular area. In this system, if total amount of pollutants of existing sources exceeds the maximum loads, then the relevant authority should cut down the total amount of pollutants under the maximum loads by either allotment to individual pollution sources or constructing public purification facilities.

Density regulation is easy to implement but may not be effective when the number of pollutant sources increases beyond certain levels. The maximum loads system is difficult to implement but effective where environmental risk is high. Figure 2 shows that environmental burden is increasing proportionally according to the emission quantity. Under the density regulation, if the emission quantity is Q_1, then the environmental burden is M_1, which exceeds the environmental capacity, M_e, of the region. Therefore, if the emission quantity is below Q_e, then density regulation would be an effective policy tool, but if it exceeds Q_e,

FIGURE 2. The Comparison of Density Regulations and Maximum Loads System



then maximum loads system would be effective in keeping the environment from deteriorating. Korea implemented this Pollution Maximum Loads System for the four major rivers basins starting in 2004 and will implement a similar system in metropolitan atmosphere areas in 2007. Accordingly, there have been many arguments that similar systems should be introduced to the Korean livestock sector to ease environmental concerns.

Ⅳ. A New Agri-Environmental Plan to Limit Livestock Numbers in Korea

The Korean government announced a new plan in November 2004 which emphasizes the utilization of livestock manure for crop growing and establishes stronger regulations on livestock numbers. Previous measures were oriented toward the proper disposal of livestock manure in preventing water pollution, but this new plan implies a significant view change on livestock manure from a potential source of pollution to recyclable resource. One of the important features of this new plan is to introduce a Regional Nutrient Maximum Loads System starting in 2007. Each region

will calculate the total nutrient (Phosphorus especially) demand necessary for crop growing and total nutrient supply, which can be calculated as the chemical fertilizer consumed plus nutrient equivalent production of livestock manure for the region. Thus, if the supply of nutrient exceeds demand, then that region would be classified as nutrient surplus region and the local government of the region exceeding certain levels of surplus ratio should establish a special plan to reduce the nutrient surplus. If the efforts of the local government do not succeed to reach the targeted surplus reduction level, then central government would enforce penalties, such as a suspension to livestock related budgetary payments. If this system proved to be effective in solving environmental problems then it would continue. But if proved to be ineffective, the government would review the necessities of introducing a regional livestock quota system in 2011. The main difference between a Regional Nutrient Maximum Loads System and a Regional Livestock Quota System is that the former includes the amount of chemical fertilizer consumed and the latter does not. Considering that livestock farmers may have less resistance with the Regional Nutrient Maximum Loads System than with the Livestock Quota System, this would be a good approach starting with mild regulations to solve environmental problems.

The Regional Nutrient Maximum Loads System would be more flexible in implementing in the sense that local government could adjust the amount of chemical fertilizer and the livestock numbers within the nutrient ceiling. However, it may be difficult to control the amount of chemical fertilizer used in the region since farmers choose either chemical or organic fertilizers based on several reasons including prices and convenience. Also under the Nutrient Maximum Loads System, both livestock farmers and crop growing farmers are to be managed and thus administrative costs would be high.

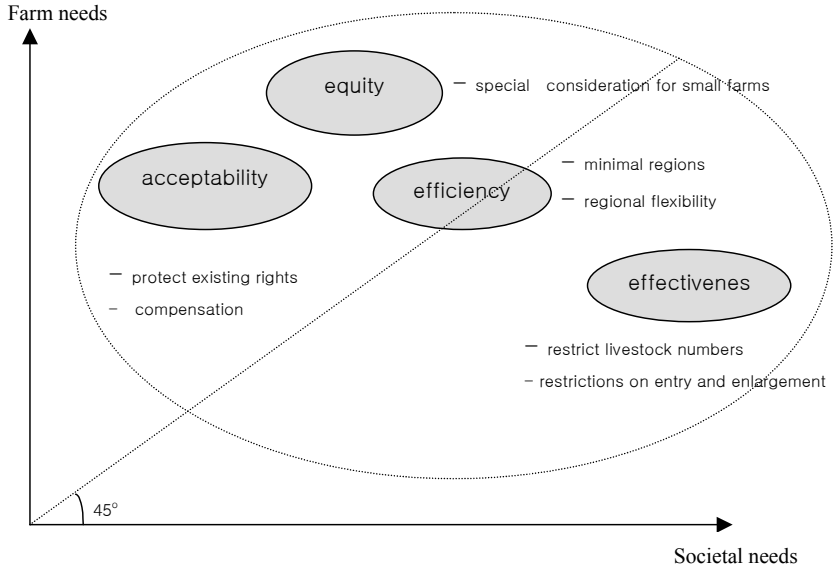
The details of the Nutrient Maximum Loads System would be determined by 2006, as in-depth study is ongoing. In estimating the total nutrient needs of the region, the nutrient needs for forest

and other non-commercial farming should be taken into account. In general, the farm with manure purification facility may produce less nutrients than the farm with compost facility of a same livestock size. If farms can transport manure into other regions, it would reduce the total supply of the nutrients in the region. These are the examples that should be considered in establishing action plan for the Regional Nutrient Maximum Loads System.

The system should accommodate farmers concerns about economics and societal concerns about the environment in order to achieve successful results. First of all, the need to introduce new regulations to limit the usage of chemical fertilizer and livestock numbers, as well as the belief that the current situation is in need of new strong regulations to mitigate the environmental impact on land and water due to agricultural activities, should be widely accepted widely by the public because the new regulations would be costly. At the same time, the new system should consider the potential income loss of farmers that would be resulted from the restriction on the animal size and develop a mechanism to compensate any income loss. Appropriate government bodies should agree to allocate budgetary resources for the livestock farmers who will be regulated more strictly in animal production than previously at the expense of improving environmental quality. The acceptability, effectiveness, efficiency and equity of the system should be considered in designing the framework of the system. Figure 3 shows measures to accommodate farm and societal needs in these criteria for the maximum loads system.

The first issue to consider is effectiveness of the system. In order to achieve the environmental goal, the restriction on livestock numbers is an essential element of the system. It may restrict the freedom of farmers to choose scale of the farm, but since current livestock numbers in some regions exceed environmental capacity, Korea needs to introduce stronger restrictions on livestock farm size. It is difficult to reduce existing farm size, but relatively easier to put restrictions on farm entry and expansion. It is therefore necessary to declare a “standstill” at the outset of implementation.

FIGURE 3. Measures to Accommodate Farm Needs and Societal Needs



For the efficiency criterion, it is necessary to choose regions on a minimal basis to save on administrative costs. All the counties in the nation can be categorized into 3 regions (black, grey, and white regions)[1] according to the nutrient surplus ratio (nutrient supply divided by nutrient demand of the region). Counties with higher surplus ratios would belong to darker regions. In black regions, where surplus ratios exceed a certain number, xx, new farms and expansion of existing farms are prohibited while local governments would concurrently enact schemes to reduce nutrient surplus effectively. In grey regions, where the surplus ratio is between yy and xx, new farms could be prohibited but

[1] In Flanders, Belgium, whole regions are classified in this way according to the amount of P_2O_5 kg/ha. In black regions with P_2O_5 production greater than 125kg/ha, growth is only possible when other livestock farms cease production. In white regions, where P_2O_5 production is less than 100kg/ha, production is allowed to increase up to 100kg P_2O_5/ha.(OECD 2003)

expansion of each farm would be allowed until regional surplus levels reach the previously established limit, xx. In white regions, new farm and expansion of existing farms are allowed until the surplus of the region reaches the yy level.

For the acceptability amongst the farming community, and if there is a need to reduce the livestock numbers, then appropriate compensation has to be provided for the income loss occurred. In reducing the livestock numbers, buying out on a voluntary basis would be more acceptable than proportional reduction from individual farms in order to minimize restricts on the economic activity of the individual farm. For equity issue, there is a need to give special consideration to small farmers or family farmers. Maximum loads system is likely to favor large scale operations by preserving current production amounts. Therefore special and differential treatment should be allowed to small farms in terms of expanding the size of the farm up to a certain level.

If the system does not work well, then the Regional Livestock Quota System would be reviewed in 2010 for introduction. Quotas are used frequently in many countries and milk is a typical commodity for quotas. The main purpose of introducing quota is to manage supply within a ceiling at a national level for price stabilization. But the regional livestock quota system is different from the ordinary quota system in the sense that the purpose of the livestock quota is to solve environmental concerns and not to maintain balance between supply and demand. Consequently, there is no need to apply quotas system to all the regions nationwide. Only regions with high nutrient surplus ratios should adopt this livestock quota system. The Netherlands introduced a livestock manure quota in 1987 and classified its regions into two categories, manure surplus regions and manure deficit regions while more stringent restrictions were imposed on manure surplus regions. Initial allocation of manure quotas were based on the historical production of each farm individually. In the beginning, quota trade was prohibited but became tradable in 1994.

There are many critics on quota system. Once implemented, these quotas would become valuable assets to the holders and would be difficult to terminate. Efficient farmers would buy or rent quotas from inefficient farmers to increase production. As a result, the quotas would precipitate additional production costs for new farms or expanding farms. For milk quotas, inspection and maintenance would be easier than for manure quotas since milk deliveries to dairy factories are easy to control. In addition to that, dairy farms would be rewarded with a price guarantee.

Even with these positive characteristics, a repeal of the milk quota was frequently suggested in the European Union. As for livestock or manure quotas, farmers are not rewarded in terms of money or protected in terms of import restriction. On the contrary, it is foreign livestock farmers that benefit. Another disadvantage of product quotas is that by nature, they limit rather than stimulate environmental investment by individual livestock farmers (Gardebrok 2001). The Dutch quota system to control animal waste is a quota on livestock numbers used as a proxy for environmental impacts from animal waste. Farmers are more likely to buy quotas instead of investment on environmental technologies. This investment on quotas as well as heavy administrative burdens for both government and farms, barely leads to improvements in environmental quality (LEI 2000).

The quota system could be an effective target-oriented policy tool when other policy measures are ineffective in reducing environmental burdens of livestock production. Wossink (2004) analyzed the effects of manure production rights in the Netherlands and referred to the CPB (Netherlands Bureau for Economic Policy Analysis) study. The study concludes that without the manure policy, total manure production from livestock in the Netherlands would have been 5 to 10% higher. Because of many concerns related to the livestock quota system, careful consideration should be given before implementation of such a system. In the initial stage, if introduced, quota trade should not be allowed and a group approach rather than individual approach should be given

higher priority where a region should reduce total livestock numbers. Buy-out schemes for farmers who want to shut down production would reduce livestock farmer disapproval to the proposed system and increase the effectiveness when implemented simultaneously.

Ⅴ. Conclusions

Livestock manure is a good source of nutrient necessary for crop growing. In Korea, however, nutrient (nitrogen and phosphorus specifically) supply for crop growth is larger than the nutrient demand in many regions, thus environmental concerns associated with livestock manure are rising. Many policy measures have been implemented but with little effect. The nitrogen balance in the surface soil is a good indicator of the risks to the environment, and Korea had the highest number of 238kg/ha among OECD countries in 2002. This figure would not go down in the near future unless strong regulations are introduced in restricting livestock numbers. Recognizing the urgent need to improve environmental burdens of livestock production, the government announced a new plan to introduce a Nutrient Maximum Loads System in 2007. The concept of this system is to limit the total supply of nutrients according to the nutritional needs of the region. Livestock manure as well as the consumption of chemical fertilizer is accounted for in the calculation of nutrient supply. This is less restrictive than regulating the numbers of livestock since there exists flexibility to choose between chemical fertilizer and livestock when there is a need to reduce nutrient supply. The use of chemical fertilizer, however, is difficult to control and monitor compared with livestock numbers. Moreover, optimal operational implementation of this new system remains to be developed in detail.

This new livestock manure management plan is bold in the sense that there would be an entirely new system in Korea to link numbers of livestock with the environmental capacity of their particular region. It would need an accurate database on livestock

numbers for each farm as a prerequisite for successful operations.[2] This database shall be established by the end of 2005 because all but small livestock farms should locally register its livestock house size as well as numbers by animal type. The Nutrient Maximum Loads System would severely limit farmers' freedom to choose farm size, while Livestock Farmers Groups express serious anxiety regarding the introduction of this system. It is therefore necessary to accommodate societal and farmers concerns for successful implementation of the new system. If existing farmers benefit is undermined, then proper compensation should be accompanied.

The current government plan is a stepwise approach that would start with the Nutrient Maximum Loads System in 2007 and if proven to be ineffective in improving environmental quality, it would then review the possibilities of introducing a livestock quota system in 2010. The quota system is an effective measure in restricting the number of livestock production directly, but there are also many criticisms on the inefficiency of the system. In recognizing the problems associated the quota system, the government is willing to implement less restrictive measures first. In the regional Nutrient Maximum Loads System, county-wide collective efforts to reduce the environmental burden are emphasized. Incentives and compensatory measures would be implemented rather than compulsory proportional reduction of nutrient supply for each individual farmer. The detail of the system will be finalized in 2005 and 2006 before implementing an action plan in 2007. The experiences and lessons from this system in coming years would provide useful information for other countries.

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[2] In the Netherlands, the initial quota was over-allocated 10 to 25% since allocation was based on a farm survey in which many farmers mentioned the maximum stable capacity instead of the average occupation (Wossink 2004).

REFERENCES

Kim, Byung-Eul, Kim, Bae-Seng, Kim, Tae-Gon, Kim, Jae-Hwan, 2004. "The Changing Circumstances and Overall prospect of Korean Agriculture." (in Korean). Chapter 1 of *2004 Agriculture Prospect*. Korea Rural Economic Institute.

Kim, Jae-Hwan, Park Chi-Ho, Han Jeong-Dae et al. 2000. "The utilization of Livestock manure." Chapter 2 of *Calculation of Adequate Number of Livestock Considering Regional Nutrients Needs*. (in Korean). Rural Development Administration, Institute of Livestock Technology.

Ministry of Agriculture and Forestry, Ministry of Environment, Korea. 2004. (in Korean). *Synthesis report on the livestock manure management and usage*.

Shin, Seung-Yul, Song Woo-Jin, Seong Dong-Hyun and Lee Hyung-Woo. 2004. "Livestock Prospect." (in Korean). Chapter 9 of *2004 Agriculture Prospect*. Korea Rural Economic Institute.

Choi, Jee-Yong and Shin Eun-Seung. 1999. *A study on the Proper Management of Livestock Manure in Accordance with Environmental Capacity*. (in Korean). Korea Institute of Environmental Policy Evaluation.

The Netherlands, Ministry of Agriculture, Nature Management and Fisheries. 2001. *Manure and the Environment, The Dutch Approach to Reduce the Mineral Surplus and Ammonia Volatilization.*

Gardebroek, Cornelis. 2001 "The Impact of Manure Production Rights on Capital Investment in the Dutch Pig Sector." selected paper presented at the AAEA annual meeting in Chicago, IL.

LEI (Agricultural Economics Research Institute, Netherlands). 2000. "Myths and Sagas about pig sector." Report 6.00.05

OECD. 2003. "Agriculture, Trade and the Environment: the Pig Sector."

Oscam, A.J. et al. 1998. *Additional EU Policy Instrument for Plant Protection Products*. Wageningen Pers.

VLM (Vlaamse Land Maatschappij). 2004. *The Manure Bank.*

Wossink, Ada. 2004. "The Dutch Nutrient Quota System: Past Experience and Lessons for the Future." Chapter 4 *of Tradeable Permits: Policy Evaluation, Design and Reform.* OECD.